ANALYZING THE INVESTMENT POTENTIAL TO INCREASE PRENATAL CARE
UTILIZATION AS A TACTIC TO DECREASE
PRETERM BIRTH COSTS IN TENNESSEE

by

Michael S. Wiggins

Dissertation
Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Business Administration

Liberty University, School of Business

May 2021
Abstract

Preterm birth contributes significantly to health care costs in the United States (Frey & Klebanoff, 2016). Certain components of prenatal care reduce preterm birth incidence (Newnham et al., 2014). Tennessee’s preterm birth rate ranks 35th among the 50 United States (National Center for Health Statistics, 2019). This study analyzed the investment potential to reduce preterm birth cost through increasing prenatal care utilization in Tennessee. Based on 2018 data, the study identified a significant relationship between prenatal care utilization and preterm birth incidence in Tennessee. The study also identified a significant opportunity to increase prenatal care utilization in Tennessee when compared to Oregon, which is a state with higher prenatal care utilization and lower preterm birth incidence. Although the study did not identify a statistically significant difference between preterm birth costs and term birth costs, it did identify an economically material difference. It is clear from the findings that a material investment opportunity exists to increase prenatal care utilization as a tactic to decrease preterm birth costs in Tennessee. Additional research may determine if at-risk groups produce opportunities for larger investment.

Key words: prenatal care, preterm birth, preterm birth costs, health care costs, Tennessee
ANALYZING THE INVESTMENT POTENTIAL TO INCREASE PRENATAL CARE

UTILIZATION AS A TACTIC TO DECREASE

PRETERM BIRTH COSTS IN TENNESSEE

by

Michael S. Wiggins

Dissertation

Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

Liberty University, School of Business

May 2021

Approvals

_____________________________   ___________________
Michael S. Wiggins, Doctoral Candidate    Date

_____________________________   ___________________
Terrence Duncan, D.B.A., Dissertation Chair    Date

_____________________________   ___________________
Renita Ellis, Ph.D., Committee Member    Date

_____________________________   ___________________
Edward M. Moore Ph.D., Director of Doctoral Programs    Date
Dedication

I dedicate this project to my wife and best friend, Robin.
Acknowledgments

My family’s support and sacrifice made this project possible. Thank you to my wife, Robin, for her continuing support and encouragement. Thank you to my children for understanding that Daddy had to spend many Saturdays completing school assignments. Thank you to my father for teaching me the value of continuous learning and frequently asking when I was going to get my doctorate. Thank you to my mother for always showing interest and being my fan.

Others also contributed significantly to this work. Dr. Kennard Brown, Executive Vice Chancellor and Chief Operating Officer, University of Tennessee Health Science Center, for allowing me access to the University’s extensive academic resources. Mary Nell Bryan, Chief Executive Officer, Children’s Hospital Alliance of Tennessee, for advice on obtaining the relevant hospital financial data. Dr. Terrence Duncan, my Dissertation Chair, for providing helpful insight, encouragement, and guidance throughout the process. He was engaged, responsive, and consistent. I could not have asked for a better guide through the process. Dr. Renita Ellis, dissertation committee member, for helpful insight, useful suggestions, and timely encouragement. Dr. Marie Jackson for encouragement and insightful recommendations. Dr. Tamikia Jones for consultation regarding statistical analysis. Amanda Newell, Vice President, Financial Policy, Tennessee Hospital Association, for facilitating access to the hospital cost data. Patrick A. Turri, Assistant Vice President for Data Analysis, Tennessee Hospital Association, for patiently responding to my numerous emails. Lastly, thank you to Dr. Joe Van Matre. Dr. Van Matre taught my first undergraduate statistics class and several subsequent quantitative methods courses. For the past 30 years, he has been my teacher, advisor, and encourager. He influenced my work significantly and inspired me to pursue continuous improvement.
# Table of Contents

Abstract........................................................................................................................................... ii  
Approvals ....................................................................................................................................... iii  
Dedication ...................................................................................................................................... iv  
Acknowledgments ............................................................................................................................ v  
List of Tables .................................................................................................................................. xi  
List of Figures ............................................................................................................................... xii  
Section 1: Foundation of the Study..................................................................................................1  
  Background of the Problem ......................................................................................................... 1  
  Problem Statement ...................................................................................................................... 2  
  Research Questions ..................................................................................................................... 3  
  Hypotheses ................................................................................................................................... 4  
  Purpose Statement ....................................................................................................................... 5  
  Nature of the Study ...................................................................................................................... 5  
    Qualitative Research Methods ................................................................................................ 6  
    Quantitative Research Methods .............................................................................................. 7  
    Mixed-Methods Research Methods ........................................................................................ 9  
    Nature of the Study Summary ................................................................................................. 10  
  Conceptual Framework .............................................................................................................. 10  
    Barriers to Prenatal Care Utilization ...................................................................................... 10  
    Consequences of Prenatal Care Underutilization ................................................................. 11  
    The Cost of Preterm Birth ........................................................................................................ 12  
    Using Prenatal Care to Reduce Preterm Birth ....................................................................... 13
Research Design ......................................................................................................... 67
Population and Sampling ............................................................................................. 68
Data Collection .............................................................................................................. 71
  Data Collection Instrument ...................................................................................... 71
  Data Collection Technique ..................................................................................... 73
  Data Organization Technique .................................................................................. 74
  Data Collection Summary ....................................................................................... 75
Data Analysis .................................................................................................................. 75
Reliability and Validity ................................................................................................... 78
  Reliability ................................................................................................................. 78
  Validity ....................................................................................................................... 79
Section 2 Conclusion ...................................................................................................... 80
Section 3: Presentation of the Findings ........................................................................ 83
  Descriptive Statistics ................................................................................................. 84
    Response Rate ........................................................................................................ 84
    Demographics ........................................................................................................ 85
  Hypothesis Tests ........................................................................................................ 88
    RQ1: How Does Preterm Birth Relate to Prenatal Care Utilization? ....................... 89
    RQ2: How Does Prenatal Care Utilization in Tennessee Compare to States With
        Lower Preterm Birth Rates? .................................................................................. 92
    RQ3: How Could Increasing Prenatal Care Utilization Have Affected Health Care
        Costs in Tennessee During the Study Period? ....................................................... 95
List of Tables

Table 1. Relevant Query Fields .....................................................................................................74
Table 2. Parameters for Select Query Values ................................................................................76
Table 3. Study Response Rate .......................................................................................................85
Table 4. Study Subject Stratification .............................................................................................86
Table 5. Tennessee Gestational Age and Prenatal Care Utilization Data ......................................87
Table 6. Tennessee Gestational Age and Prenatal Care Utilization Percentages ..........................88
Table 7. Oregon Gestational Age and Prenatal Care Utilization Data ..........................................88
Table 8. Oregon Gestational Age and Prenatal Care Utilization Percentages ...............................88
Table 9. SPSS Output for Prenatal Care Utilization by Gestational Age: Case Processing Summary ........................................................................................................................................90
Table 10. SPSS Output for Prenatal Care Utilization by Gestational Age: Utilization * Gestation Cross-Tabulation ........................................................................................................................................90
Table 11. SPSS Output for Prenatal Care Utilization by Gestational Age: Chi-Square Tests .....90
Table 12. SPSS Output for Prenatal Care Utilization by Gestational Age: Case Processing Summary ........................................................................................................................................93
Table 13. SPSS Output for Prenatal Care Utilization by Gestational Age: State * Utilization Cross-Tabulation ........................................................................................................................................94
Table 14. SPSS Output for Prenatal Care Utilization by Gestational Age: Chi-Square Tests .....94
Table 15. Tennessee Hospital Association Birth Cost ...................................................................98
Table 16. Preterm Birth Cost Statistical Analysis ..........................................................................99
Table 17. Preterm Birth Cost Materiality .......................................................................................99
Table 18. Investment Potential Materiality ....................................................................................100
List of Figures

Figure 1. Conceptual Framework.................................................................15
Section 1: Foundation of the Study

Preterm birth contributes significantly to health care costs in the United States (Frey & Klebanoff, 2016), and Tennessee’s preterm birth rate ranks 35th among the 50 United States (National Center for Health Statistics [NCHS], 2019). Newnham et al. (2014) demonstrated that certain components of prenatal care reduce preterm birth incidence. For example, increasing prenatal care utilization in Tennessee could reduce the state’s total health care expenditure. This section includes a description of the foundation of the study analyzing the relationship between preterm birth costs and prenatal care utilization. The aim of the study was to identify investment opportunities in Tennessee to reduce preterm births and therefore reduce total health care costs. Research on this topic is important because increasing prenatal care utilization can reduce the human and economic cost of preterm birth.

Background of the Problem

Health care costs in the United States are increasing (Conway, 2017; Dielman et al., 2017). The Centers for Medicare and Medicaid Services (CMS) forecasted that growth will average 5.5% annually through 2027, reaching annual expenditures of $6 trillion. CMS forecasted that, during the same period, Medicare spending will increase by 7.6%, Medicaid spending by 6%, private insurance costs by 5%, and individual out-of-pocket costs by over 5%. These forecasts highlight the fact that increasing health care costs are a concern for the federal government, state governments, employers, and individuals. The projected growth causes people to seek opportunities to reduce health care costs and forms the foundation for the study.

One area of significant health care spending is preterm birth (Jacob et al., 2017; Zainal et al., 2019). Preterm births, which are those occurring before the completion of 37 weeks gestation, often result in extended hospitalization and expensive critical care services for the
newborn (Mangham et al., 2009). Prenatal care utilization reduces preterm birth (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Osman et al., 2018). Additional scholarly literature describes interventions that increase prenatal care utilization and therefore reduce preterm births. These interventions include home-based prenatal care, group prenatal care, and alternative provider prenatal care models (Holland et al., 2018; Jack et al., 2017; Meadows et al., 2019). There was a gap in the literature, however, in defining the resources available to invest in increasing prenatal care utilization. This research project analyzed preterm birth and cost data from Tennessee to determine if resources are available to redeploy toward interventions for increasing prenatal care utilization and therefore reducing total health care costs.

**Problem Statement**

The general problem to be addressed is the failure of the United States health care system to invest sufficiently in primary care, resulting in poor health outcomes relative to the cost of care. Koller and Khullar (2017) explained that the United States continues to undervalue primary care and cited underinvestment in primary care as one of the fundamental reasons that the United States ranks last among high-income countries in health outcomes. Papanicolas et al. (2018) confirmed that the United States ranked last among high-income countries in health outcomes, including infant mortality. Kluge et al. (2018) encouraged increased primary care investment and cited the association between increased primary care services and reductions in health care costs. Delnord et al. (2017) connected the lack of primary care investment in the United States to preterm birth rates that are higher than other industrialized nations. Several studies have connected prenatal care utilization to reductions in preterm birth rates (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Newnham et al., 2014; Osman et al., 2018). Preterm birth rates in the United States vary by state. Tennessee’s preterm birth rate ranks 35th among the 50 United
States (NCHS, 2019). Bailey (2015) found that utilization of prenatal care in Tennessee and other Southern Appalachia states is suboptimal due to economic disadvantages, reduced prenatal care access, and other cultural issues. Investing to increase prenatal care utilization in Tennessee has the potential to reduce total health care costs by reducing preterm birth rates (Tennessee Department of Health, n.d.). The specific problem to be addressed is suboptimal prenatal care utilization in Tennessee, resulting in costly, and preventable, preterm births.

**Research Questions**

The following research questions guided the study and assisted in exploring the problem:

RQ1: How does preterm birth relate to prenatal care utilization in Tennessee?

RQ2: How does prenatal care utilization in Tennessee compare to states with lower preterm birth rates?

RQ3: How could increasing prenatal care utilization have affected health care costs in Tennessee during the study period?

The first question considered the effect of prenatal care utilization on the preterm birth rate. To answer the research question, the researcher analyzed the factors affecting preterm birth and the potential to mitigate those factors through increased prenatal care utilization. For example, Allen et al. (2018) cited prenatal care utilization as an effective strategy to reduce preterm birth rates among women with Type 2 diabetes. The question led the researcher to evaluate the difference between preterm birth rates in regions with greater prenatal care utilization and those with less.

To answer the second question, the researcher evaluated whether prenatal care utilization in Tennessee differs from states with lower preterm birth rates. Several factors create barriers to prenatal care utilization, including educational, economic, and cultural barriers (Ayers et al.,
Determining if there is a statistical difference between prenatal care utilization rates assisted the researcher in understanding if such issues created more significant barriers in the study region. As part of this evaluation, the researcher considered methods for increasing prenatal care utilization. Methods explored in the literature included home-based prenatal care visits, group prenatal care, reduced-visit care models, and alternative provider models (Carter et al., 2016; Holland et al., 2018; Jack et al., 2017; Sakharkar et al., 2016).

To answer the third research question, the researcher considered how increasing prenatal care utilization could have affected the study area’s health care economy. Preterm birth creates significant health care expenditures (Hall & Greenberg, 2016), but increasing prenatal care utilization can reduce these expenditures (Kluge et al., 2018). To explore this question the researcher considered the expenses associated with increasing prenatal care utilization, as well as the potential cost reductions from reducing preterm births.

**Hypotheses**

The following null hypotheses (H₀) and alternative hypotheses (Hₐ) were tested:

H₀₁: There is no statistically significant relationship between prenatal care utilization and preterm birth in Tennessee.

Hₐ₁: There is a statistically significant relationship between prenatal care utilization and preterm birth in Tennessee.

H₀₂: There is no statistically significant difference in prenatal care utilization in Tennessee compared to a state with lower preterm birth rates.

Hₐ₂: There is a statistically significant difference in prenatal care utilization in Tennessee compared to a state with lower preterm birth rates.
H₀³: There was no material investment opportunity to increase prenatal care utilization in Tennessee during the study period as a mitigating tactic to reduce preterm birth costs.

Hₐ³: There was a material investment opportunity to increase prenatal care utilization in Tennessee during the study period as a mitigating tactic to reduce preterm birth costs.

**Purpose Statement**

The purpose of this quantitative causal-comparative study was to add to the body of knowledge by analyzing the relationship between prenatal care utilization and preterm birth cost. The researcher explored the relationship through an in-depth study of prenatal care utilization and the associated preterm birth rate in the State of Tennessee. The study includes additional exploration into preterm birth causes and the potential for investment in prenatal care to prevent those causes. A deeper understanding of this topic will assist health care policy makers in determining the most effective resource allocation strategy. Such a strategy will reduce total health care costs while improving the population’s health status. It is also possible to reduce the human suffering caused by preterm birth (Jha, 2019). Health care leaders who are followers of Christ will be motivated to reduce preterm births in order to reduce human suffering. Such work is an example of secular work that has a ministry component. Keller and Leary-Alsdorf (2012) characterize the ultimate purpose of work as serving God by serving others. This research study has the potential to serve others by identifying interventions that could preserve life, lessen human suffering, and effectively steward economic resources.

**Nature of the Study**

The purpose of this quantitative causal-comparative research study was to analyze the relationship between prenatal care utilization and preterm birth cost. The study focused on the human and economic costs of preterm birth. To accomplish this purpose, the researcher
considered quantitative, qualitative, and mixed-methods research approaches in the context of the study’s purpose and chose the quantitative causal-comparative approach based on the considerations described in the following sections.

**Qualitative Research Methods**

The researcher considered the qualitative method first. Qualitative designs are systematic approaches to research, but they focus on relationships and complexity rather than on determining cause and effect, which is the focus of the quantitative method (Stake, 2010). Qualitative approaches are most appropriate when researchers seek to gain a detailed understanding of a particular subject and recognize the need to explore the complexity of individual experiences (Creswell & Poth, 2018).

Creswell and Poth (2018) listed the five qualitative research approaches: narrative, phenomenological, grounded theory, ethnographic, and case study. The narrative approach allows a researcher to explore a topic through the narratives of individuals in the study group (Squire et al., 2014). Creswell and Poth instructed readers to utilize the phenomenological approach when seeking the essence of an experience. As with the narrative approach, phenomenology seeks to gain information about individual experiences. Grounded theory also explores the views of the participants through gathering data about their experiences (Creswell & Poth, 2018). An ethnographic research design focuses on individuals but considers the social and cultural implications of the topic (Le Compte & Schensul, 1999). Each of these qualitative research designs would offer insight into the topic, but they would also fall short of determining the extent of the relationship between prenatal care utilization and preterm birth costs.

The fifth qualitative design, case study, would also have fallen short of determining the strength of the relationship. Creswell and Poth (2018) described the case study approach as
appropriate when a researcher wishes to develop a detailed understanding of a case or multiple cases. Stake (2010) described the case study approach as being a simplistic method for making comparisons and acknowledged that multiple case studies can provide a good depth of understanding. These descriptions are relevant to studying prenatal care utilization and its relationship to preterm birth because the study considered the issue within a specified geographic area. The case study approach allows researchers to evaluate a large amount of qualitative data with complex interactions but would not allow the researcher to test the statistical significance between prenatal care utilization, preterm birth, and the associated economic consequences. It would have allowed the researcher to gain insight into the relationship between prenatal care utilization and preterm birth with a focus on the related human and economic consequences.

Melamed and Robinson (2019) identified other limitations of conducting a qualitative case study, especially when studying rare events. Fortunately, this study benefited from existing, government-supported data sets that provided robust birth information. The researcher therefore used large, validated data sets to gain insight into preterm birth and prenatal care. Ultimately, the researcher rejected the qualitative approach because the study involved using a large, static data set to analyze differences in the study population and to understand the consequences of those differences. The researcher did not seek to gain a rich, detailed understanding of a case or group of cases.

**Quantitative Research Methods**

The researcher next considered the quantitative method. A quantitative approach is appropriate for a study seeking complete objectivity, statistical rigor, and broad application (Queirós et al., 2017). The quantitative approach seeks to identify statistical correlations and causal relationships (Creswell & Poth, 2018). It is useful for testing relationships between
variables and determining the statistical strength of those relationships. This study sought to
determine whether prenatal care utilization rates in Tennessee are statistically different from the
rates in areas with lower preterm birth rates. Based on these results the researcher further
analyzed the investment potential for increasing prenatal care utilization and decreasing the
economic and human consequences of preterm birth.

The literature review also revealed that other researchers have used the quantitative
approach for similar studies. VanderWeele et al. (2009) utilized multivariate logistic regression
models to analyze the relationship between prenatal care adequacy, infant mortality, low birth
weight, and preterm birth. Other authors utilized the quantitative method to demonstrate the
relationship between prenatal care utilization and preterm birth. (Allen et al., 2018; Leneuve-
Dorilas et al., 2019; Osman et al., 2018). Therefore, the purpose of the study, the problem
statement, the research questions, and the scholarly literature support utilizing the quantitative
approach.

There are three types of quantitative research designs available for researchers in the
Doctor of Business Administration program: descriptive, correlational, and causal-comparative/
 quasi-experimental. The descriptive design, as the name implies, describes a phenomenon by
asking who, what, when, and where questions (Sousa et al., 2007). This design is appropriate
when a phenomenon is poorly understood and initial data gathering is necessary. The researcher
rejected the descriptive design because the phenomenon under study is well documented and the
existing data sets facilitated relationship analysis.

The researcher also considered the correlational approach. This approach attempts to
understand or determine relationships between two or more aspects of the study (Hackett, 2019).
The design limits itself to considering correlational associations and does not assume causal
relationships. The researcher rejected this approach because the study acknowledged and analyzed the causal relationship between prenatal care utilization and preterm birth costs.

Lastly, the researcher evaluated the causal-comparative approach. Causal-comparative research is also known as ex post facto research and seeks relationships between variables after an event has occurred (Salkind, 2010). Thus, researchers attempt to determine the causes or consequences within data sets that already exist. Given that this study involved an attempt to understand the consequences of prenatal care utilization or underutilization, and the opportunity for investment to mitigate those consequences, the causal-comparative approach was most appropriate.

**Mixed-Methods Research Methods**

Though the quantitative approach was appropriate, the researcher also considered the mixed-methods approach. The mixed-methods approach utilizes both qualitative and quantitative research to gain a deeper understanding of a topic (McKim, 2017). Mixed-methods research requires additional time and expertise but can provide a detailed understanding of both causal relationships and subjective experiences. The researcher considered the mixed-methods approach for this study because it offered an opportunity to determine the strength of the relationship between prenatal care utilization and preterm birth. The approach would then allow the researcher to analyze the broader implications for investing in prenatal care utilization to reduce preterm birth incidence. After reviewing the scholarly literature, however, it became clear that the relationship between prenatal care utilization and preterm birth was well established (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Osman et al., 2018). This study offers value by describing the relationship between prenatal care utilization and preterm birth and analyzing how the relationship could create investment opportunities to mitigate human and economic suffering.
in the study area. The quantitative causal-comparative approach was, therefore, the most appropriate approach.

**Nature of the Study Summary**

Of the three research methods, quantitative, qualitative, and mixed methods, the quantitative approach was the most appropriate for this study given its focus on understanding the consequences of prenatal care utilization on health care economics. Although there are various quantitative designs, the causal-comparative design provided the best opportunity to understand the consequences of prenatal care utilization on preterm birth costs. This method and design facilitated a deeper understanding of the economic opportunity for investing in prenatal care utilization as a strategy for reducing the human and economic costs of preterm births.

**Conceptual Framework**

The scholarly literature includes concepts relevant to prenatal care utilization and preterm birth. Figure 1 graphically represents these concepts including barriers to prenatal care utilization and the consequences of prenatal care underutilization. Preterm birth is a frequent consequence of prenatal care underutilization. A significant amount of scholarly literature is devoted to preterm birth and its costs. The relationship between prenatal care utilization and preterm birth costs was fundamental to this research project. The quantitative study considered the following variables: prenatal care utilization rates and preterm birth rates, where prenatal care utilization was the independent variable and preterm birth was the dependent variable.

**Barriers to Prenatal Care Utilization**

The literature documents a variety of barriers to prenatal care utilization. For example, cultural norms present barriers such as a lack of trust in the health care industry (Ayers et al., 2018; Cook et al., 1999). Transportation availability is another potential barrier (Melnikow et al.,
1997). Cook et al. (1999) explained that a lack of after-hours availability hinders prenatal care utilization. Education level is another factor frequently cited as relevant to prenatal care utilization (Ayers et al., 2018; Baron et al., 2015; Boerleider et al., 2015). Many of these factors are potentially confounded with broader economic barriers (Boerleider et al., 2015). Despite significant literature detailing the importance of prenatal care, another barrier is the lack of awareness of prenatal care’s importance (Ayers et al., 2018). Barriers to prenatal care utilization relate to Research Question 2 on the reasons for suboptimal prenatal care utilization. Gaining an understanding of these barriers allowed the researcher to determine investment opportunities to increase prenatal care utilization.

**Consequences of Prenatal Care Underutilization**

The scholarly literature frequently cites the consequences of prenatal care underutilization. While some consequences accrue to the mother, this study focuses on the outcomes of prenatal care underutilization experienced by the child. For example, uncontrolled gestational diabetes negatively affects maternal health (Kovilam et al., 2001; Sperling et al., 2018; Xu et al., 2020), but the focus of this project was on the secondary effect on the child at birth. Two subthemes became apparent in the review. The first was a collection of maternal risk factors that, if left untreated, can create birth complications. The second subtheme was the fundamental concept in the research, which is the relationship between prenatal care underutilization and preterm birth.

**Uncontrolled Maternal Risk Factors.** The literature describes risk factors that contribute to poor birth outcomes. Appropriate prenatal care utilization can mitigate these risks. In addition to gestational diabetes, risk factors include maternal obesity, preeclampsia, previous preterm birth, previous cesarean section, intrauterine infection, and maternal dyslipidemia
There is some disagreement as to whether other factors, such as economic status, create additional risk (Izotón de Sadovsky et al., 2018; Sonchak, 2015). The literature demonstrates that certain maternal risk factors play a role in poor birth outcomes.

**Preterm Birth.** The relationship of prenatal care utilization to preterm birth was the fundamental basis of this research study. The following concepts from the scholarly literature establish the relationship between prenatal care utilization and preterm birth. The risk factors described in the previous section lead to poor birth outcomes. Infant mortality is the most significant of these outcomes. The literature draws a direct relationship between prenatal care underutilization and infant mortality (Chen et al., 2005). Preterm birth is the leading cause of infant mortality (Cnattingius et al., 2013; Zainal et al., 2019). Prenatal care reduces the incidence of preterm birth (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Osman et al., 2018), and it is this relationship that was most critical to this study. To summarize, preterm birth is the leading cause of infant mortality, yet prenatal care reduces the incidence of preterm birth. It follows that increasing prenatal care utilization will decrease preterm birth and therefore decrease infant mortality.

**The Cost of Preterm Birth**

There are both human and economic costs associated with preterm birth. Since this is a Doctor of Business Administration research project rather than a public health research project, the primary focus of the project was the economic consequence of preterm birth. The literature contains a significant number of citations highlighting the human cost of preterm birth, however.

**The Human Cost of Preterm Birth.** The human cost of preterm birth includes factors that will have lasting consequences. Preterm birth negatively affects physiological characteristics
such as laryngeal development and phonation (Reynolds et al., 2019). Preterm birth also negatively affects brain development (Iskusnykh et al., 2018). Kelly (2016) demonstrated that preterm birth negatively affects educational experience. Related research indicates that each additional gestational week improves kindergarten literacy levels (Mallinson et al., 2019). These human costs may also have an economic component, such as the effect on future earning potential. This project focused on the health care costs related to preterm birth, so these other related costs were outside the scope of the project. Researchers may wish to explore such related costs in future studies.

The Economic Cost of Preterm Birth. The scholarly literature also addresses the economic cost of preterm birth. This cost was fundamental to the research project because it establishes the resources available to redeploy toward prevention. Zainal et al. (2019) explored the infant hospitalization cost and the cost of lost wages for parents. The cost of the initial hospitalization was the most significant of these costs (Mangham et al., 2009). Jacob et al. (2017) considered the cost of preterm birth over the first 3 years of a child’s life. Stevenson et al. (1998) emphasized that survival rates are increasing, which leads to greater cost. Although Stevenson et al. focused on costs associated with caring for the child, Merinopoulou et al. (2019) explained there are also maternal costs. Researchers have also explored maternal costs, but these costs are minor compared to the cost of care for the child.

Using Prenatal Care to Reduce Preterm Birth

The literature has established that prenatal care underutilization results in preterm birth and creates human and economic costs. Another concept explored in the literature is the opportunity to increase investment in prenatal care. This investment could create a positive return through reduced preterm birth costs. The literature supports this concept by highlighting
the positive results of prenatal interventions such as nutritional counseling, screening for infections, and preventing exposure to cigarette smoke (Newnham et al., 2014; Nianogo et al., 2019). Prenatal Progesterone supplementation also reduces preterm birth (Osman et al., 2018). These examples serve as possibilities for additional investment in prenatal care to reduce preterm birth rates.

**Relationship to Research Questions**

The concepts explored in the scholarly literature created the foundation for the study and related to the research questions. Listed below are the questions and descriptions of how they relate to the concepts identified in the literature.

**RQ1: How does preterm birth relate to prenatal care utilization?**

The concepts described previously relate directly to this question. The literature clearly states that prenatal care utilization can reduce preterm birth incidence.

**RQ2: How does prenatal care utilization in Tennessee compare to states with lower preterm birth rates?**

If prenatal care utilization in Tennessee is significantly lower than in areas with lower preterm birth rates, then an opportunity exists to increase prenatal care utilization in Tennessee.

**RQ3: How could increasing prenatal care utilization have affected health care costs in Tennessee during the study period?**

Increasing prenatal care utilization can decrease preterm birth, therefore reducing preterm birth costs. This research question attempts to understand if a material investment opportunity exists to increase prenatal care utilization as a tactic to decrease preterm birth costs.
Significance of the Study

This study is significant because of the growing concern about health care expenditures in the United States. According to CMS national health expenditure data, U.S. health care spending was $3.6 trillion in 2018. This equates to over $11,000 per person in the United States (CMS, 2020) and represents 17.7% of the nation’s gross domestic product. Health care spending has continued to increase, growing by 4.6% from 2017 to 2018.

The growth of health care expenditures has implications for individuals, businesses, and health care organizations (Dieleman et al., 2017). Individuals experience financial hardships when catastrophic health events require expensive diagnostic and therapeutic interventions (Bao et al., 2018). Furthermore, businesses must address the increasing cost of providing employer-sponsored health insurance (Vistnes et al., 2015). Health care organizations feel pressure from
individuals, businesses, and insurance providers to reduce costs while providing excellent clinical outcomes and patient experiences.

This study relates to these concerns through a focus on the potential to reduce health care expenditures. Through an analysis of the relationship between prenatal care utilization and preterm birth, the study offers insight into the possibility of reducing health care costs through increased prenatal care utilization. Such an intervention could significantly reduce the total cost of health care expenditures.

**Reduction of Gaps**

The scholarly literature includes articles on prenatal care, preterm birth, and certain costs associated with preterm birth. This study advances those topics through analysis of the relationship between prenatal care and preterm birth, with an emphasis on preterm birth costs. Although there is a substantial amount of literature focused on preterm birth costs, this study adds to the body of knowledge by linking the cost of preterm birth to investment opportunities for reducing preterm births. Investing in prenatal care may reduce total health care expenditures.

**Implications for Biblical Integration**

Reducing health care spending demonstrates good resource stewardship. Jesus instructed his followers to invest resources wisely. The biblical parable of the wise manager in Luke, Chapter 12, instructs followers of Christ to invest resources to generate a positive return. This story teaches followers of Christ that they must not only account for the use of God’s resources, but also work to maximize their benefit (Haymond, 2017). The study analyzed the possibility of making such an investment in prenatal care to reduce total health care expenditures.

While reducing health care spending in the United States has the potential to benefit society, there is potentially a more meaningful impact on humanity. As Jha (2019) described,
reducing preterm birth rates has the potential to save lives. Health care leaders who are followers of Christ will be motivated to reduce preterm births to reduce human suffering. Such work is an example of secular work that has a ministry component. Keller and Leary-Alsdorf (2012) characterized the ultimate purpose of work as being to serve God by serving others. Van Duzer (2010) asserted that businesses focused on enhancing the welfare of the community are engaged in work that matters to God. This research study has the potential to serve others through the identification of interventions that could preserve life and lessen human suffering. The project therefore demonstrates alignment between economic benefit, societal benefit, and divine calling.

Relationship to the Health Care Management Cognate

The study focuses on both a health-care-related issue and a business-related issue. Prenatal care utilization is a significant health care policy concern. Health care organizations are transitioning to value-based payment rather than fee-for-service payment (Wasfy et al., 2019). In these new models, health care organizations receive compensation for better clinical outcomes. Thus, they economically benefit by keeping patients healthy rather than by performing clinical interventions. As a result, health care organizations are focusing more on population health. They are seeking to identify potentially high-cost patients and create interventions to reduce total costs (Belnap & Wrathall, 2017). Preterm birth is an example of a health condition that generates significant cost to the health care system (Frey & Klebanoff, 2016). The study results add value to the body of knowledge, and to the health care industry, by identifying the potential return on investment for implementing a more robust prenatal care program.

Summary of the Significance of the Study

The study is significant because of the heightened interest in health care costs in the United States. It advances existing literature by filling a gap in current scholarship related to
investment opportunities to reduce health care expenditures. The study benefits society by exploring the possibility to reduce health care expenditures. It honors God by analyzing an investment opportunity to reduce human suffering associated with preterm birth. Lastly, the study relates to the health care management cognate of the Doctor of Business Administration program by linking a health policy issue with the fundamental business principle of seeking a return on investment.

**Terms, Assumptions, Limitations, and Delimitations**

The following section includes definitions of terms that may not be familiar to the reader. The section also provides information about assumptions in the study. It concludes by discussing the study’s limitations and delimitations.

**Definition of Terms**

The terms below are relevant to this study and appear frequently in health care publications. They include both clinical and administrative terms. The definitions relate to the context of the study.

- **dyslipidemia**: Dyslipidemia refers to elevated low-density lipoprotein cholesterol or depressed levels of high-density lipoprotein cholesterol (Fodor, 2011). Low-density lipoprotein cholesterol is also known as bad cholesterol, while high-density lipoprotein cholesterol is also known as good cholesterol. Dyslipidemia is a condition in which cholesterol levels are unfavorable.

- **incidence**: When used in health care literature, incidence refers to the number of new cases of a disease during a defined time period (Centers for Disease Control and Prevention [CDC], 2012). For example, the preterm birth incidence in 2018 is the number of preterm births that occurred in 2018.
• **mortality**: Mortality in the context of health care literature refers to death. The mortality rate is the frequency of death in a defined population during a specified interval (CDC, 2012).

• **preeclampsia**: Preeclampsia is the clinical term for high blood pressure during pregnancy (Mol, 2016).

• **prenatal care**: Prenatal care is the care provided to pregnant women and focuses on maximizing maternal and fetal health (U.S. Department of Health & Human Services, 2019).

• **preterm birth**: Preterm birth is any live birth occurring before completing 37 weeks of pregnancy (World Health Organization, 2018).

**Assumptions**

This section describes facts assumed true but not verified in the study. Each assumption includes a risk mitigation strategy. The primary assumption is that prenatal care utilization rates will respond to appropriate interventions. As discussed previously, prenatal care utilization reduces preterm birth incidence (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Osman et al., 2018). An assumption in this study was that investments to increase prenatal care utilization can decrease the total cost of health care by reducing preterm birth incidence. If prenatal care utilization rates do not respond to interventions, then there would be no return on investment. Exploring interventions that have demonstrated a positive effect on prenatal care utilization, such as nurse home visitation and group prenatal care, would mitigate the risk associated with this assumption (Holland et al., 2018; Meadows et al., 2019).

A related assumption is that the State of Tennessee can achieve prenatal care utilization rates experienced in other states. The ability to achieve the prenatal care utilization rates of better
performing states provides a target for investment potential. As with the previous assumption, exploring interventions that have demonstrated a positive effect on prenatal care utilization will mitigate the risk associated with this assumption.

Lastly, data about prenatal care utilization originate from a single source: the CDC National Vital Statistics System. This study included an assumption that responses to questions about prenatal care utilization are consistent across all the states cited in the study. Sonchak (2015) made a similar assumption in comparing obstetric care across multiple states. This assumption allowed the researcher to compare data from Tennessee with data from better performing states. These data assisted in understanding the possible return on investment for improving prenatal care utilization. Mitigating the risk of this assumption required acknowledging a range of possibilities for resources available to invest. This range ultimately related to policy questions relating to how much can be invested to reduce preterm birth rates.

**Limitations**

The study had certain limitations or weaknesses. The study was limited to women in Tennessee who gave birth during a given period. This limitation allowed the researcher to focus the study; however, it limited the researcher’s ability to generalize the findings across populations in all states during all periods. Analyzing only the specified region during the specified period mitigated this limitation. The data for prenatal care utilization were self-reported. There are inherent limitations in self-reported data (Alshurafa et al., 2019). Mothers may provide erroneous information for various reasons, whether intended or unintended. To minimize the effect of this limitation, the researcher utilized the same data set to compare results from a different state during the same period. As the same data set was used, and the relevant finding was a comparison, the limitation was constant across the data set. The data contained
records where prenatal care utilization was unreported. To minimize this limitation, the researcher excluded such records. The study only included data records that reported prenatal care, which reduced the available data, but the remaining set included sufficient data.

There were also limitations associated with calculating Tennessee’s preterm birth cost in 2018. The data set included only those infants whose initial hospitalization was linked to the mother’s delivery insurance claims. Limitations in hospital financial systems prevent all preterm infant hospitalizations from being included in the database. Additionally, the Tennessee Hospital Association data were aggregate data that did not allow the researcher to stratify based on any demographic characteristic. This did not present a barrier to the purpose of the study, but it may limit the usefulness of the data in further research. Limiting the study scope to initial hospitalization costs and referencing cost information provided in other studies such as Frey and Klebanoff (2016), Hall and Greenburg (2016), and Jacob et al. (2017) minimized this limitation.

Lastly, there may have been confounding factors that affected prenatal care utilization but were not identified and were therefore not included in the scholarly literature. Proposed interventions to increase prenatal care utilization may not be effective if such factors are present. The researcher utilized comparisons from the same data set, gathered by the same instrument, during the same period to minimize this limitation.

**Delimitations**

Constraints and scope create study boundaries. The group studied was mothers in Tennessee during a particular 12-month period. Data from other states facilitated comparison, but the primary focus was Tennessee. There was no attempt to generalize the findings in this quantitative causal-comparative study. There were also several delimitations related to the economic consequences of preterm birth. The researcher considered the costs of initial hospital
care for preterm infants. Associated preterm birth costs create an additional economic burden, but they were outside the scope of this study. These costs include, but are not limited to, follow-up care, specialty outpatient care for chronic conditions, and subsequent hospitalizations. Although Hall and Greenberg (2016) considered lifetime earning consequences, such economic effects were outside the scope of this study. Similarly, Merinopoulou et al. (2019) evaluated maternal costs related to preterm care, but such costs were not included in this study. These areas provide opportunities for future exploration.

**Literature Review**

The review began by considering the health care economic situation described in recent research. This foundational information allowed the researcher to understand trends and current pressures facing government, businesses, and individuals. These pressures created the need for additional academic research on opportunities to reduce health care spending. The review then expanded to consider a specific driver of health care expenditures: preterm birth. Literature about preterm birth includes causes, consequences, costs, and clinical developments. The review also identified a clear, inverse relationship between prenatal care utilization and preterm birth. Further exploration of the literature revealed research on costs and barriers to prenatal care. Lastly, the literature review summarizes literature about interventions proven to increase prenatal care utilization and decrease costly preterm births. These interventions represent investment opportunities for decreasing total health care costs by reducing preterm births. These topics followed the study’s conceptual model and supported the problem statement by identifying opportunities to reduce total health care spending by investing in prenatal care.
Health Care Economics

The researcher analyzed the relationship between prenatal care utilization and preterm birth in the context of economic effect. Appreciating the study’s potential to inform health care economic policy requires an understanding the health care economy. This section of the literature review summarizes academic literature about the history of health care delivery and the associated economics.

History of United States health care economics.

The U.S. health care economy has evolved since the nation’s founding. According to Shi and Singh (2017), traditionally held cultural beliefs about self-reliance and assistance for the needy shaped American views of health care. These cultural beliefs led the American health care system toward a model of individual responsibility, rather than community utility. Shi and Singh further described the early days of American history when there was little formal medical education, and medical care was a trade rather than a profession. At that time, the health care economy functioned as a free market with no private or public health insurance. Expenditures for health care services came from private funds. Those with the economic means to pay for health care received health care services in the home. Hospitals in the United States served as charities to provide economically disadvantaged people with access to care. The Pennsylvania Hospital was the first formal hospital in the colonies (Morton & Woodbury, 1895). The number of such charitable organizations continued to expand, and in the following years, more hospitals formed to care for the economically disadvantaged.

The health insurance market began to form in the late 19th century. Fox and Kongstvedt (2013) described the advent of insurance plans offered by individual medical practices. These plans covered care offered by medical practices combined in the plan. Fox and Kongstvedt
continued by describing the advent of employer-sponsored health insurance when the railroads began offering health care to their workers. Other employers followed by offering similar arrangements, often developing a proprietary health care infrastructure that included physicians, clinics, and hospitals. The trend continued in the early 20th century when farmers formed a health insurance collaborative. These trade-based models continued to develop, including an arrangement by Baylor Hospital in Texas to provide prepaid hospitalization insurance to a group of teachers. This arrangement by Baylor created the initial foundation of Blue Cross Blue Shield, and created a new era of private insurance (Fox & Kongstvedt, 2013).

Private insurance plans continued to develop in the first half of the 20th century. Access to health care services remained limited, however, until the creation of the Medicare and Medicaid programs in 1965 (Shi & Singh, 2017). Medicare is the federal health insurance program for people who are 65 or older, certain younger people with disabilities, and people with end-stage renal disease (Medicare.gov, 2020). Medicaid is a program jointly funded by states and the federal government that provides health coverage to low-income adults, children, pregnant women, and people with disabilities. The federal government administers Medicare, and state governments administer Medicaid. These programs served to increase access to health care services.

Health care cost trends.

Health care costs are increasing in the United States (Catlin & Cowan, 2015; Frost et al., 2018; Strane et al., 2016; Warshawsky, 2017). Health care costs are not only increasing, but they are increasing at a faster rate than per capita personal income (Catlin & Cowan, 2015). Catlin and Cowan (2015) considered health care spending growth from 1960 to 2013. In 1960, health spending in the United States was $147 per person. By 2013, that figure had risen to $9,255 per
person, representing an average annual increase of 8.1%. The authors contrasted the increase in health care spending with changes in per capita adjusted personal income. During the same period, income grew at only 5.7% per year on average. They also evaluated the impact on personal health care spending and found that overall health spending increased at a faster rate than personal income. In 1960, household expenditures on health represented 4% of adjusted personal income. By 2013, that share had risen to 6%. Their research highlights the trend of increasing health care costs on a national and a personal level.

Individual health care costs are increasing even though employers often pay a significant portion of health insurance premiums on behalf of employees. Frost et al. (2018) analyzed health claims data from the Health Care Cost Institute and found that total health care spending for enrollees in employer-sponsored insurance plans increased by 44% from 2007 through 2016. They reported a depressed growth rate in 2009, but even in that year, growth continued. Rising health care costs negatively affect both individuals and employers.

Increasing health care costs also contribute to expanding earnings inequality between high-wage and low-wage earners. Health insurance premium increases, on a dollar basis, have a larger percentage impact on low-wage worker compensation. Warshawsky (2017) explored the disproportionate burden of health care spending increases on low-wage workers and concluded that one method to reduce earnings inequality is to control the rate of growth for health care costs. The study showed that increasing health care costs contribute to societal economic consequences and to the erosion of individuals’ discretionary income.

The strain of health care cost increases on low-wage workers is a topic in other scholarly literature as well. Increasing costs cause some families to go without health insurance for their children. Strane et al. (2016) analyzed the effect of increased health care costs on health
insurance coverage for children. Using data for 2008–2013 from the Medical Expenditure Panel Survey, Strane et al. determined that a growing number of low-income families with access to employer-sponsored health insurance were opting to put their children on public insurance, which negatively affects governmental health care costs due to the expanding enrollment.

The U.S. federal government’s budget includes substantial health care expenditures. Health care cost increases therefore have a significant effect on total public spending. Cubanski et al. (2019) provided detailed information about health care spending as a part of the federal budget. The authors reported that health care spending represented 15% of the federal budget in 2018, and they forecasted that health care spending would grow to 18% of the federal budget by 2029. Although Cubanski et al. did not take a position as to whether this level of spending is appropriate, they pointed out the opportunity cost associated with dedicating this portion of the federal budget to health care spending. Other initiatives could benefit from the dollars spent on health care, which was an important concept related to the purpose of this study. Analyzing the relationship between prenatal care utilization and preterm birth cost involved examining the opportunity costs associated with preterm birth. Redirecting a portion of preterm birth costs toward prenatal care utilization tactics would free funds for reinvesting in other community benefit programs.

The previously referenced articles identify the effects of increasing health care costs on individuals and governments. Such cost increases also affect employers. Employers often pay for a portion of the health care premiums for their employees and are therefore interested in minimizing their economic exposure to premium increases. This presents difficult choices for employers as they attempt to manage employment costs. Guo and Tao (2015) examined employers’ responses to rising health care costs by reviewing the Census Bureau Medical
Expenditure Panel Survey–Insurance Component data from 1997 to 2005. The data revealed that employers did not take drastic action to reduce their costs. Few dropped health insurance coverage, reduced workers’ eligibility, or substantially scaled back coverage. They did take subtle action, however. Guo and Tao reported interventions including adopting cost-efficient health plans, increasing employee contributions, and increasing out-of-pocket costs for employees. Even so, employers absorbed a large portion of the increased health spending and therefore sought other ways to maintain operating margins. Guo and Tao emphasized the economic burden on employers posed by increasing health care costs.

Many employers offer health care insurance coverage to employees and their dependents, but some firms are seeking to decrease health insurance premium costs by changing employees’ dependent coverage. Miller et al. (2017) analyzed data from the Medical Expenditure Panel Survey–Insurance Component and determined that employers were seeking cost savings through changes to employees’ dependent coverage. These interventions were more prevalent in small firms with fewer than 10 employees. Many firms continue to offer dependent coverage, but some charge a significant premium for inclusion. Others place limitations by covering only those dependents who do not have access to other employer-sponsored insurance plans. These measures represent additional efforts by employers to decrease their total cost of health care.

Health care costs have increased over many years. Even in periods when cost growth slowed, there was still absolute growth. Frost et al. (2018) explored diminished health care cost growth following the Great Recession of 2007–2009. The researchers evaluated data for 2001–2013 from the Medical Expenditure Panel Survey–Insurance Component and found the largest decrease in growth occurred in 2009–2011. This decrease resulted from declining employee
enrollment secondary to a significant decrease in employment. Thus, even in times of economic retrenchment, health care costs have continued to increase.

**Drivers of health care cost escalation.**

The literature described in the previous section established the occurrence of sustained health care cost growth over many years. Other scholarly literature has explored the reasons for the growth. One significant driver of health care cost increases is service utilization (Frost et al., 2018). Health care expenditures increase when more individuals utilize health care services such as laboratory services, imaging services, or physician office services. This is a logical finding, but the research does not draw conclusions about cost avoidance. Frost et al. (2018) did not consider whether some health care service utilization prevents more costly interventions that would otherwise become necessary in the future.

Service utilization certainly affects health care costs. Other reasons for increasing health care costs include service intensity, population growth, aging, and price increases (Conway, 2017; Dieleman et al., 2017). Conway (2017) and Dieleman et al. (2017) did not find service utilization or disease prevalence to be significant drivers of increasing costs. Service intensity was a significant driver, however. Intensive care unit services, advanced imaging technology, and other high-level medical services contributed substantially to increasing health care costs. Identifying service intensity as a driver relates to this study because of the expenses associated with neonatal intensive care unit services for preterm infants.

Physicians are becoming more aware of service intensity costs and seeking to integrate economic considerations into their clinical decisions. Chemotherapy is an expensive, high-intensity service that can significantly increase health care expenditures at the end of life. These expenditures create economic burdens for insurers, employers, and individuals who must cover
out-of-pocket costs. Bao et al. (2018) analyzed data from Canada’s Institute for Clinical Evaluative Sciences in Toronto, Ontario. They defined high-cost patients as those at or above the 90th percentile of costs, and they utilized validated algorithms to define preventable acute care services. Although they focused the study on high-cost patients, the results indicated greater savings opportunities for lower cost patients. Preventable spending accounted for 10% of high-cost patient spending and 25% of lower-cost patient spending. Bao et al. argued for clinicians to seek a balance between the benefits of high-intensity services, quality of life, and individual economic burden.

The proliferation of expensive medical technology and pharmaceuticals drives service utilization (Fuchs, 2018). Babies born preterm benefit from such advances, but the cost is significant. Fuchs (2018) contended that cost containment is possible with certain mitigation strategies. This concept is fundamental to the exploration of prenatal care utilization and preterm birth costs. Increasing prenatal care utilization may prove to be an effective mitigation strategy against the significant cost of preterm birth.

Service intensity is such a significant driver of health care costs because a small portion of patients account for the majority of health care costs (de Oliveira et al., 2019). One strategy for reducing total health care costs is to identify individuals at high risk for requiring intense medical care and engaging mitigation strategies to eliminate their future need for such services. If managed appropriately, such programs could reduce total health care costs by investing in low-intensity prevention services rather than waiting for individuals to require high-intensity interventions. Belnap and Wrathall (2017) proposed a method of reducing costs by identifying potentially high-cost patients and seeking early intervention. The authors described a care management program for patients with certain health conditions that generate significant health
care costs. They asserted that identifying these patients early in the disease process allows providers to engage in interventions to reduce total health care costs. They conducted a retrospective cohort study to evaluate an algorithm for identifying potentially high-cost patients. The algorithm correctly identified 79% of patients who eventually ranked among the top 15% of costs during the following 3 years. This research emphasized the importance of identifying high-risk patients and seeking to intervene as a mitigation strategy to reduce total health care costs.

Primary care utilization is one of the mitigation strategies to reduce the need for future high-intensity services. Primary care physicians can identify disease processes early in development and seek to intervene before high-intensity services are required. L’Esperance et al. (2017) considered the economic relationship between primary care utilization and specialty care utilization, and they considered associations between primary care funding, specialty care utilization, patient satisfaction, and clinical outcomes. They performed a retrospective cross-sectional study of primary care practices in England between 2014 and 2015, they employed regression models to explore relationships, and they developed financial modeling to predict specialty care cost savings. L’Esperance et al. found a relationship between primary care funding supplements and reduced specialty care costs. They did not find associations between primary care investment and patient satisfaction or health outcomes. The findings are important because they indicate the possibility of increasing funding to primary care and preventative services as a strategy to reduce expensive specialty care services. This concept is consistent with this study’s focus on prenatal care investment to reduce preterm births.

It was important to this study to acknowledge that health care costs differ by region. Such variation suggests the possibility of applying best practices from higher performing geographical locations to those areas performing at an inferior level. Williams and Holmes (2018) evaluated
whether rural health care costs are higher than in urban locations. The authors analyzed Medicare expenditures using CMS fee-for-service claims for Medicare Parts A and B recipients for 2014. They defined “rural” based on the metropolitan status of the county in 2015. The analysis revealed mixed results. Some costs were lower in rural areas, including physician costs and hospice services. Other costs were higher in rural areas, including outpatient services and durable medical equipment. Overall, Medicare beneficiaries spend 3.5% less than urban beneficiaries. Williams and Holmes compared the national results to North Carolina results and found that rural beneficiaries had higher overall expenditures. The authors did not provide reasons for increased expenditures by rural beneficiaries, but it is possible to speculate that access to preventative services could be constrained in rural areas. Regardless of the reason for the variation, the existence of the variation reveals an opportunity to find best practices for improving services and reducing costs.

Reviewing the health care economics literature was important to the foundation of this study. The review established the importance of reducing health care costs that negatively affect individuals, businesses, and the federal government. Technological advances and increased care intensity drive the cost increases. Identifying certain high-cost conditions, and seeking to intervene, can reduce total health care costs. One of the high-cost conditions that requires significant service intensity and the utilization of high-cost technology is preterm birth.

**Preterm Birth**

The literature on preterm birth provides information highlighting its relevance to health care costs. Preterm birth refers to any live birth that occurs before completing 37 weeks of pregnancy (World Health Organization, 2018). Many articles describe preterm birth rates during various periods and in various locations. One recent article reported the U.S. preterm birth rate as
10.02% in 2018 (Martin et al., 2019). This rate indicates a substantial opportunity to improve human experience and reduce health care costs.

Preterm birth rates in the United States have declined in recent years but are higher than in other developed countries. Frey and Klebanoff (2016) acknowledged preterm birth rates are higher in the United States and as a result referred to preterm birth prevention as a public health priority. It is a priority because of its relationship to infant morbidity and mortality.

**Preterm birth causes.**

Preterm birth is a difficult issue to resolve because of its complexity. It results from multiple causes that challenge researchers to develop solutions. As a result, much of the relevant literature explores the causes and consequences of preterm birth.

**Tobacco use.** Tobacco use is a well-documented cause of preterm birth. For example, Dahlin et al. (2016) studied the associations between tobacco use and preterm birth and considered both smoking and snuff use. They also considered whether ceasing tobacco use affected preterm birth rates. To study these issues, Dahlin et al. developed a cohort study of all live singleton births registered in the Swedish Medical Birth Register from 1999 to 2012. They found that tobacco use increased the risk of preterm birth and that women who stopped using tobacco had no increased risk of preterm delivery. Based on these findings, the authors provided a strong warning to discontinue tobacco use during pregnancy.

**Maternal obesity.** Maternal obesity also contributes to preterm birth. Cnattingius et al. (2013) performed an often-cited study on the relationship between maternal obesity and preterm birth. They began by defining the foundation issue, which is that preterm birth is the leading cause of infant mortality, morbidity, and long-term disability. The authors then moved to their primary area of study: the relationship between maternal obesity and preterm birth. Similar to
Frey and Kelbanoff (2016), Cnattingius et al. obtained data from 1992 through 2010 from the Swedish Medical Birth Register–Main Outcomes and Measures to analyze preterm deliveries. They adjusted data for risk factors such as tobacco use, maternal age, and other factors, and they analyzed 1,599,551 deliveries, of which over 75,000 were preterm. Cnattingius et al. found that maternal overweight and obesity during pregnancy were associated with an increased risk of preterm birth. They also described the correlation between increased body mass index and preterm birth. The authors concluded by stating that these findings applied to women in Sweden and that any generalization would require additional research with other populations.

Other authors studied other populations and considered the relationship between maternal obesity and preterm birth. Ju et al. (2018) studied the effect of maternal obesity on preterm birth in Hawaii. The authors stated as fact the relationship between maternal obesity and preterm birth. They acknowledged, however, a dearth of research on Native Hawaiian and other Pacific Islanders (NHOPI). The authors found this to be a surprising gap given that NHOPI have high rates of poor birth outcomes and high rates of obesity. Ju et al. performed a retrospective cohort study of women using data from Hawaii’s Pregnancy Risk Assessment Monitory System from 2000 to 2011. They attempted to control for other risk factors including diabetes, tobacco use, and hypertension. Ju et al. found that maternal obesity increased the risk of preterm birth in the population studied. They noted that the increased risk was lower in NHOPI women than in White women, but they could not explain the difference. The authors concluded by noting the need for additional research to understand the relevant cultural factors contributing to NHOPI maternal obesity. Cnattingius et al. (2013) and Ju et al. highlighted the connection between maternal obesity and preterm birth.
**Maternal diabetes.** Maternal diabetes can relate to maternal obesity, but it is a primary contributor to preterm birth. Kovilam et al. (2001) conducted a foundational study on the relationship between maternal diabetes and preterm birth. They explored the degree of blood sugar control and its effect on preterm birth, and they analyzed data from 310 women enrolled in a Diabetes in Pregnancy Program. Kovilam et al. adjusted for certain factors related to diabetes, such as the duration of the disease. Even with these controls, the degree of blood sugar control still contributed significantly to the increased risk of preterm birth.

Other authors have found similar results and advanced the research on maternal diabetes and its relationship to preterm birth. Xu et al. (2020) considered blood sugar levels in the third trimester of pregnancy and found that women with poor blood sugar control were at significantly higher risk for preterm delivery. Not only did the authors confirm the relationship between maternal diabetes and preterm birth, but they also recommended prenatal care as a mitigating strategy to reduce preterm birth rates for diabetic women. This recommendation connects their research to the purpose of this research study, which was to consider the relationship between prenatal care utilization and preterm birth cost.

**Dyslipidemia.** Uncontrolled cholesterol levels also increase the risk of preterm birth. Smith et al. (2018) evaluated maternal lipid profiles to test their relationship to preterm birth. They studied California hospital discharge records from 2007 to 2012. The data included 2,865,987 live births. The authors adjusted for various risk factors and utilized logistic regression to determine the relationship between dyslipidemia and preterm birth. Smith et al. found that maternal dyslipidemia was significantly associated with an increased risk of preterm birth. The study indicated that controlling maternal cholesterol levels is a promising intervention for
reducing preterm birth rates. Thus, including this intervention in the course of prenatal care could reduce preterm birth incidence.

**Preeclampsia.** High blood pressure in pregnant women puts both the mother and the unborn infant at risk. Martin et al. (2017) explored a large data set of over 4.1 million singleton births analyzed by March of Dimes and the International Federation of Gynecology and Obstetrics Working Group on Preterm Birth. They analyzed the relationship of 21 potential risk factors and found preeclampsia was one of the leading causes of preterm birth. Martin et al. highlighted the need to use these data to develop interventions and set health policies to reduce preterm births. The findings contribute to this study’s purpose by identifying other possible intervention investment opportunities to reduce preterm birth rates.

**Previous preterm birth.** Mothers who have delivered a previous infant preterm are at greater risk for subsequent preterm deliveries. Martin et al. (2017) also identified previous preterm birth as a significant risk factor leading to subsequent preterm birth. Women who have had a previous preterm delivery, regardless of the reason, are at greater risk for another preterm delivery. Cho et al. (2019) explored this issue further and studied the effect of previous preterm labor on subsequent preterm delivery. Cho et al. studied women in South Korea by analyzing data from the National Health Insurance Claims Database and the National Health-Screening Programme. They reviewed women who had their first singleton delivery in 2010 and a subsequent delivery between 2011 and 2015. They found a significant increase in subsequent preterm deliveries following a preterm delivery. They also found that women with preterm labor in a prior pregnancy, even one that ultimately delivered at term, were significantly more likely to have a preterm delivery with subsequent pregnancies. Their findings highlight the importance of
preventing preterm deliveries, not only because of the impact on the premature infant, but also for subsequent deliveries.

**Maternal infection.** Maternal infection is another preterm birth cause frequently cited in the literature. Helmo et al. (2018) evaluated intrauterine infection and its relationship to preterm birth. Like many authors, they cited the significance of preterm birth as a research rationale and reported that preterm birth accounts for a significant number of deaths among children. Helmo et al. explored the inflammatory response of mother and baby and its effect on preterm birth. They found that intrauterine infection elevates the risk for preterm birth and subsequent complications. The authors concluded by urging additional scholarly exploration to identify early intervention opportunities to treat intrauterine infections.

Acknowledging that there are multiple causes of infection, other researchers considered specific organisms and their relationship to preterm birth. For example, Vieira et al. (2019) focused on Group B Streptococcus (Strep) infections. They obtained specimens from 270 pregnant women and performed two laboratory tests. The authors identified a higher risk of preterm delivery among women who had a strep infection. Vieira et al. argued for increased testing to identify women with strep infections, noting that early testing would allow for earlier treatment and reduced risk of preterm birth. Such testing could occur during prenatal care and may be worthy of investment to reduce preterm birth costs.

**Previous cesarean delivery.** As previously described, prior preterm delivery is a risk factor for subsequent preterm delivery. Other characteristics of previous pregnancies also relate to preterm birth. Wood et al. (2017) studied the effect of a previous cesarean delivery on preterm delivery by analyzing data from a large Canadian database. The authors conducted a retrospective cohort study of 189,021 matched first and second births, and they found a
significant increase in preterm deliveries for those women who had a previous cesarean delivery. If the cesarean delivery occurred in the second stage of labor, there was an even larger risk of preterm delivery in subsequent births. Wood et al. encouraged physicians to consider these findings while managing delivery in the second stage. The findings also informed women of additional risks associated with cesarean delivery. Women who have previously delivered via cesarean section are at high risk for subsequent preterm delivery and may represent a stratified group for investment to reduce preterm birth costs.

**Economic factors.** Economic factors are both risk factors for preterm birth and barriers to prenatal care. Izoton de Sadovsky et al. (2018) evaluated socioeconomic inequality as a risk factor for preterm birth. The authors reviewed four birth cohorts in Southern Brazil comprised of children born in 1982, 1993, 2004, and 2011. They analyzed birth outcomes relative to maternal income level. The study revealed a higher prevalence of preterm birth for lower income women. However, after adjusting the data for other risk factors including maternal skin color, age, education, and marital status, the differences disappeared for every cohort except 2004. The study demonstrated that economic factors by themselves did not contribute to more preterm births. The economic factors may relate to other risk factors, however. These findings indicate the importance of controlling other risk factors to mitigate preterm birth risk.

**Lack of prenatal care.** Several of the studies reviewed in previous sections identified opportunities to mitigate risk factors through prenatal care interventions. The studies identified prenatal care underutilization as a risk factor. Leneuve-Dorilas et al. (2019) conducted a retrospective study of all births in French Guiana between January 2013 and December 2014. They chose to study French Guiana because it has the highest birth rate in South America and the highest preterm birth rate of all French territories. Their analysis revealed that the absence of
pregnancy significantly increased the risk of preterm birth. This research was important to this study because Leneuve-Dorilas et al. identified another link to prenatal care as a mitigating strategy to reduce preterm birth rates. The study supported the validity of investing in prenatal care utilization to reduce the cost of preterm birth.

**Preterm birth consequences.**

Infants born before 37 weeks often require intensive care and other expensive interventions to survive. Preterm birth is a contributor to human and health care costs in the United States. It creates an evolving challenge to parents and physicians as they make health care decisions for premature infants.

Preterm birth survival rates are increasing. Stevenson et al. (1998) researched preterm infant survival by evaluating outcomes of the National Institute of Child Health and Human Development Neonatal Research Network from January 1993 to December 1994. The authors found significant survival variation based on birth weight. Approximately half of the infants weighing 501–750 grams survived while 96% of infants between 1,251 and 1,500 grams survived. They also noted that infants with greater birth weights had shorter, and presumably less expensive, hospital stays. The most encouraging finding of their research was that survival rates increased when compared to a similar review. Increasing survival rates result in greater health care costs for infants surviving preterm birth.

Increasing survival rates can also create ethical dilemmas for parents and physicians making health care decisions for preterm infants. For example, Upadhyay et al. (2015) considered whether resuscitation or comfort care is the best course of action for certain preterm infants. The authors conducted a retrospective review of infants in their perinatal database consisting of infants with birth weight <500 grams. They considered data from 1989 to 2009.
During that period, 29% of the infants survived. The survival rate for males was 13.8% compared to 39.2% for females. Of those who survived, 33% demonstrated age-appropriate neurological development at 24 months. This research demonstrated the human cost of preterm birth and the long-term consequences for children who survive.

**Physiological and neurological consequences.** Even if infants born preterm survive, they may experience lifelong physiological consequences. Iskusnykh et al. (2018) provided insight into the cognitive deficits experienced by preterm infants. They noted that preterm birth is a leading cause of cognitive deficits. They sought the causes of these deficits by creating a pig model for study, and they concluded that preterm birth disrupts cerebellar development by depressing genetic development. The study highlighted the long-term negative consequences of preterm birth.

Preterm birth also affects sound production capabilities in children. Reynolds et al. (2019) evaluated the influence of preterm birth on laryngeal development. They acknowledged that the inability to make sounds is a known consequence of preterm birth. This consequence relates to endotracheal intubation after birth. The authors identified that other causes, including the lack of physiological development, could exacerbate the issue. For example, they found that certain structures required for making sound do not form until at least 28 weeks gestation. While they explored other potential causes, the relevance to this study was the finding that prematurity disrupts an infant’s ability to make sound and therefore creates a risk for delayed speech.

Cognitive delays are also a potential preterm birth consequence. Kelly (2016) explored this topic by considering educational achievement. The author compared older children between the ages of 8 and 11 years old who were born preterm to children of the same age born at term. The study utilized logistic modeling to predict the risk of educational difficulties. The analysis
revealed that preterm birth negatively affects educational achievement. Although the study did not seek the neurological or physiological causes, the author used the results to recommend early educational intervention to support preterm children. Such interventions contribute to the cost of preterm birth outside of the medical services such children require.

Other authors have explored the cognitive consequences of preterm birth by considering educational achievement. Mallinson et al. (2019) conducted a longitudinal study of births in Wisconsin between 2007 and 2010. They sampled 153,145 singleton births and compared scores on the Phonological Awareness Literacy Screening–Kindergarten. Linear regression analysis revealed that shorter gestational age at birth was associated with lower scores. Mallinson et al. also included other variables in the model, including Medicaid coverage and maternal education level. These variables approximated economic advantage. In addition to the general finding that preterm birth negatively affected academic performance, multivariate regression analysis revealed associations with economic advantage. Economic advantage diminished educational consequences but did not eliminate them. Mallinson et al. also found that each additional gestational week related to improved academic performance. The study highlighted the educational consequences of preterm birth. It also revealed future economic consequences for preterm children based on depressed academic achievement. The findings indicate societal economic consequences besides the direct health care cost of preterm birth.

Economic consequences. Although the literature already reviewed indicated future economic consequences for preterm infants, a significant amount of scholarly work relates to the immediate economic implications of preterm birth. Preterm birth results in significant health care costs. Zainal et al. (2019) reviewed preterm birth costs at two hospitals in Malaysia. They focused on the initial hospitalization following birth. The study identified cost drivers, rather
than total cost. The authors considered staffing, supplies, and other overhead expenses. Although those findings may be interesting to other Malaysian hospitals, the results related to care intensity were relevant to this study. The study evaluated 112 preterm infants and demonstrated an inverse relationship between cost and level of prematurity. Specifically, Zainal et al. found that the median cost increased with care intensity and level of prematurity. The authors urged providers to seek measures to prevent or delay preterm birth as strategies to reduce cost. This finding was fundamental to the purpose of this study.

Preterm birth and its costs affect children and economies throughout the world. Jacob et al. (2017) analyzed claims data from a German health insurance company that included costs during the first 3 years after birth. The data provided costs for initial hospitalization as well as medications, outpatient treatment, and nonmedical remedies. The majority of costs occurred in the first 2 years and related primarily to initial hospitalization. They found that preterm infants generated significantly more health care costs than those born at full term. The authors emphasized that preterm birth creates negative health outcomes and produces significant health care costs. They recommended implementing programs to prevent preterm birth as a strategy to reduce health care expenditures. Such strategies require investment but may decrease total health care expenditures. The purpose of this study was to explore this relationship and determine the investment potential for such interventions.

Other authors have evaluated preterm birth in other countries. Mangham et al. (2009) produced an early study of preterm birth costs, focusing on preterm birth in England and Wales. The authors acknowledged that preterm birth relates to infant mortality and morbidity and imposes a burden on public resources. They evaluated costs beyond initial hospitalization and attempted to quantify economic consequences through adult life. Mangham et al. constructed a
decision-analytic model to estimate costs over the first 18 years after birth. They stratified the data by gestational age and used probabilistic sensitivity analysis to examine uncertainty in the parameters and generate confidence intervals. The model estimated costs of a hypothetical cohort of 669,601 children based on live birth and preterm birth data in 2006. The total cost of preterm birth was $4.567 billion in 2006 U.S. dollars. The results varied by gestational age. The incremental cost of a preterm child surviving to 18 years compared to a term survivor was $35,471. Extremely preterm children had substantially higher costs than those born later. A very preterm child (< 33 weeks gestational age) generated an incremental cost of $95,760 and an extremely preterm child (< 27 weeks gestational age) generated $146,847 of incremental cost. The study revealed that the majority of the costs in the first 18 years occurred during the initial hospitalization. This study is important because it provides a price estimate for preterm birth. It also supports the delimitation of subsequent costs of preterm birth since the majority of costs occurred in the initial hospitalization.

The literature reviewed in the previous section identified risk factors creating complicated pregnancies. Preterm birth can occur without such complications, however. Merinopoulou et al. (2019) analyzed delivery costs following uncomplicated deliveries in Italy between September 1, 2009, and December 31, 2014. They reviewed four databases to examine costs during pregnancy, at delivery, and 3 years after delivery for both mothers and infants. The authors used gestational age to stratify the data. Merinopoulou et al. determined that the combined maternal and infant costs were higher for preterm delivery. They pointed out that mothers incurred higher costs, but the differences were more substantial when infant costs were included. The study includes information about maternal costs but is most relevant because it acknowledges the significance of preterm infant costs.
Some authors have attempted calculations to value preterm birth costs. For example, Hall and Greenberg (2016) evaluated the broader cost implications of preterm birth by considering not only hospital expenditures but also educational attainment and lost earnings. They also took the important step of estimating potential savings associated with reducing preterm birth rates. They utilized previously reported hospital cost estimates and transformed the data using national cost-to-charge ratios. Hall and Greenberg also developed formulas to estimate lost educational attainment and adult earnings, but those measures were outside the scope of this study. The relevant findings related to 1,444 preterm infants. They estimated the initial hospital cost for those infants was $93 million in 2012 dollars. They stratified the data by gestational age and found that extending each preterm gestational age by 1 week could reduce hospital costs by over $25 million. The authors noted that their methods are generalizable to other populations. They further encouraged researchers to use the estimates to rally support for preterm birth interventions. These arguments related to the current research topic, considering the relationship between prenatal care and preterm birth in Tennessee, with a particular interest in exploring the economic implications of investing in prenatal care utilization.

**Prenatal Care**

According to the U.S. Department of Health and Human Services (2019), prenatal care is care provided to pregnant women that focuses on maximizing the mother’s and unborn child’s health. It assists the mother in maximizing health in support of delivering a healthy infant at term. Prenatal care covers general health issues that may have existed before pregnancy and attempts to intervene in any issues that develop during pregnancy. The scholarly literature describes a clear link between prenatal care and preterm birth. The literature also provides examples of prenatal care barriers and interventions to increase prenatal care’s effectiveness.
**Relationship to preterm birth.**

Prenatal care offers an opportunity for health care providers to recommend interventions that decrease preterm birth risk. These interventions could include smoking cessation programs, progesterone supplementation, or nutritional plans to control maternal diabetes. Osman et al. (2018) evaluated such interventions and identified a persistent number of preterm births in a London borough. They reviewed the scholarly literature and identified 13 interventions to reduce preterm births. Specific interventions that demonstrated reductions in preterm birth included smoking cessation and progesterone supplementation. Osman et al. also identified prenatal care in general as a successful intervention. The relationship between prenatal care and preterm birth is key to determining investment opportunities to reduce preterm birth incidence.

Prenatal care utilization can mitigate the effects of maternal risk factors such as advanced maternal age, low educational attainment, and tobacco use. Chen et al. (2005) studied the association between inadequate prenatal care and infant mortality in high-risk women. The authors performed a retrospective cohort study using the CDC’s NCHS birth/infant death database for 1995–1998. They limited their analysis to singleton births without malformations that occurred after 23 completed weeks of gestation. Chen et al. further restricted the study to infants weighing more than 499 grams. They utilized multivariate regression analysis to consider prenatal care adequacy for risk factors, and they found that infant mortality was higher when mothers received inadequate prenatal care or received care later in the pregnancy. Based on their findings, the authors described inadequate prenatal care as a risk factor for infant mortality. Thus, prenatal care utilization reduces preterm birth and its associated costs.

Prenatal care clearly benefits women with pregnancy risk factors such as diabetes. Allen et al. (2018) demonstrated these benefits through a retrospective cohort study of pregnant women
with Type 2 diabetes in California between 1997 and 2006. They stratified the women based on when they presented for care: first trimester, third trimester, or no presentation. The study revealed through chi-square statistical testing that earlier presentation to prenatal care reduced the risk of preterm birth. This study supported the possibility of reducing preterm births through increased prenatal care utilization by women with Type 2 diabetes.

Given that maternal diabetes is a pregnancy risk factor, prenatal care utilization is an important intervention to reduce preterm birth rates. Sperling et al. (2018) demonstrated the value of prenatal care as an intervention by studying women with preexisting diabetes and those who developed gestational diabetes. The authors performed a retrospective cohort study of patients involved in an academic medical center’s Diabetes in Pregnancy Program between 2006 and 2014. They performed a multivariate logistic regression analysis to determine if lower adherence to prenatal care relates to preterm birth, and they found that such an association did exist, with lower adherence resulting in a higher likelihood of neonatal intensive care unit admission. These findings are consistent with others in supporting prenatal care utilization as a mitigating strategy to prevent preterm birth and reduce the associated costs.

**Barriers to utilization.**

As summarized in the previous section, there is clear evidence that prenatal care improves birth outcomes and reduces preterm birth. Even though multiple studies link prenatal care utilization with better birth outcomes, prenatal care utilization remains suboptimal. Researchers who understand this reality have studied barriers to prenatal care utilization. For example, Ayers et al. (2018) considered prenatal care utilization barriers within a specific cultural group: U.S. Marshallese. The authors explored structural and sociocultural barriers. Pacific Islanders have higher rates of preterm births and other negative perinatal outcomes,
which indicates they would benefit from greater prenatal care utilization. The authors conducted three focus groups with Marshallese mothers living in Arkansas to understand their beliefs, perceptions, and experiences of prenatal care. Ayers et al. conducted a thematic qualitative analysis to identify important themes and found several barriers, including insurance benefit complexity, transportation issues, and language barriers. They characterized these as structural barriers. The authors also uncovered sociocultural barriers, including lack of awareness of the importance of prenatal care, embarrassment if unmarried, and confusion about using the health care system. The study identified interventions that could mitigate barriers to prenatal care utilization and reduce preterm births.

Lack of access can be a significant barrier to prenatal care utilization, especially for low-income women. Cook et al. (1999) surveyed women hospitalized in the postpartum unit of a large urban medical center. The women in the study most frequently cited access barriers as preventing optimal prenatal care utilization. Participants described a lack of evening or weekend clinic hours as the most significant reason for low prenatal care utilization. Participants also reported barriers related to embarrassment about being pregnant. These results were consistent with those reported by Ayers et al. (2018). These studies revealed investment opportunities to increase prenatal care utilization and therefore decrease costly preterm births.

Prenatal care utilization is especially important for women in lower socioeconomic classes because such women tend to exhibit more preterm birth risk factors. Baron et al. (2015) explored education level as a surrogate for socioeconomic status and evaluated data from a multicenter prospective cohort study conducted from September 2009 to March 2011 in the Netherlands. They performed a cross-sectional study based on questionnaires about maternal health and prenatal care. In total, 6,711 pregnant women completed the questionnaires. Through
multivariate regression analysis, Baron et al. found that women with less education were less likely to have adequate prenatal care and were more likely to exhibit other risk factors such as smoking, obesity, and poor nutrition. Standard prenatal care addresses each of these issues. This study highlighted the importance of prenatal care, its relationship to preterm birth, and preventable barriers to prenatal care utilization.

Economic barriers contribute to suboptimal prenatal care utilization. Investing to reduce those barriers could therefore reduce preterm birth incidence. The funding mechanism for such investments appears to be irrelevant, however. Clapp et al. (2019) considered the effect of Medicaid expansion under the Patient Protection and Affordable Care Act of 2010. The authors utilized a difference-in-difference design to assess outcomes before and after expansion. The control group was states that did not expand Medicaid under the Affordable Care Act. The authors evaluated associations with preterm birth and birth weight utilizing national birth certificate data from 2009 to 2017. The study included 8,701,889 women from 15 expansion states and 9,509,994 women from 11 non-expansion states. The results revealed no material change in the proportion of women who had insurance, but merely a shift from private insurance to public insurance. The results also indicated no difference in prenatal care utilization between the groups. Likewise, the preterm birth rate was not statistically different. Given other findings in the scholarly literature related to prenatal care and preterm birth, it is not surprising that groups with similar levels of preterm birth incidence had similar levels of prenatal care utilization.

Clapp et al. addressed whether the insurance model affects preterm birth. Financial barriers to prenatal care may exist, but Medicaid expansion does not appear to mitigate those barriers. This finding informs policy makers that the funding mechanism is less important than the intervention in reducing preterm births.
Sociocultural characteristics that negatively affect prenatal care utilization include maternal age (less than 19 or greater than 36 years of age), poor obstetric histories, lower educational level, and no supplementary insurance. Boerleider et al. (2015) focused on these factors in non-Western women. Like Baron et al. (2015), Boerleider et al. utilized data from the Netherlands to consider non-Western women in an industrialized country. They considered the total number of prenatal visits and explored utilization factors through blockwise logistic regression analysis. The study included 3,300 women. Although Boerleider et al. found slight generational differences, the more useful findings related to consistent prenatal care utilization barriers. Prenatal care utilization was depressed for mothers less than 19 years of age or more than 36 years of age. Regardless of age, prenatal care utilization was lower for women with poor obstetric histories, lower educational level, below-average income, and no supplementary insurance. The study emphasized prenatal care as a strategy to reduce preterm births and identified strategies to overcome barriers to prenatal care utilization.

Language barriers also limit prenatal care utilization. Fransen et al. (2012) evaluated midwives in Rotterdam for competence in delivering information about prenatal screening for Down syndrome to women from diverse ethnic backgrounds. They utilized a structured questionnaire to ascertain perceived ethnicity-related differences and conducted a group interview to explore the results of the survey. The midwives perceived significant barriers to delivering education to women from non-Western ethnic backgrounds. Even so, most failed to utilize available translation resources. The study’s findings describe language barriers from the provider’s perspective, but the barrier affects pregnant women’s ability to obtain appropriate prenatal care. Any intervention designed to increase prenatal care utilization must address potential language barriers.
Various factors limit access to prenatal care, including transportation limitations. Melnikow et al. (1997) demonstrated the importance of transportation access to prenatal care utilization. They recruited 104 low-income women intending to enroll for prenatal care at a Northern California family planning service. The authors randomly assigned participants to one of three groups. One group received a taxi voucher, one received a baby blanket coupon, and one received an appointment slip. The researchers compared attendance at the first prenatal care visit by each group. The study revealed that those who received the taxi voucher were significantly more likely to attend the first appointment. The authors also noted that only one of the 34 taxi voucher recipients used the voucher. This result indicated that transportation availability is both a real and a perceived issue. The transportation infrastructure in the United States has changed since 1997, and rideshare services provide additional transportation options. These options may create investment opportunities to eliminate transportation barriers and increase prenatal care utilization.

Access to transportation is an economic barrier to prenatal care utilization. Other authors have explored how economic issues can limit prenatal care utilization. Sonchak (2015) analyzed Medicaid reimbursement rates and utilized 2001–2010 Vital Statistics Natality data. The author considered whether Medicaid reimbursement rates for obstetric care affected prenatal care utilization. Analysis revealed a statistically significant positive relationship between Medicaid reimbursement rates and the number of prenatal visits. The author also emphasized that increased Medicaid reimbursement rates reduced the incidence of going without prenatal care. This a significant finding related to the purpose of this study, as it supports the idea that increased investment can increase prenatal care utilization. The study also revealed that one additional prenatal care visit yielded significant birth weight increases for a certain segment of the
population: White disadvantaged mothers. Such a finding emphasizes the power of prenatal care to reduce preterm birth rates. The study supports the concept that investment in prenatal care could produce a substantial return on investment through decreased preterm birth expenses.

The scholarly literature includes articles about prenatal care barriers in various cultures and regions. While these barriers appear to be universal, it was helpful to find consistency in a study by Bailey (2015), who evaluated barriers to prenatal care utilization in Tennessee. Bailey focused on a pregnancy smoking intervention by following pregnant smokers from prenatal care entry to birth. The researcher recruited participants from five medical practices in South-Central Appalachia. The results indicated significantly better birth outcomes, including fewer neonatal intensive care unit admissions, for participants in the program who quit smoking. Dahlin et al. (2016) acknowledged the relationship between tobacco use and preterm birth. Bailey connected prenatal care to smoking cessation and better birth outcomes in Tennessee. Barriers included cultural norms, access to prenatal care in rural communities, and economic barriers. These barriers are consistent with those found in other research and benefited this study by providing insight into investment opportunities to improve prenatal care utilization in Tennessee.

**Interventions to Increase Prenatal Care Utilization**

It is necessary to understand prenatal care utilization barriers to design appropriate interventions. The scholarly literature includes research on such interventions designed to increase prenatal care utilization and reduce preterm birth incidence. These interventions include home visits, telemedicine, and new models of prenatal care. The interventions demonstrate differing, and sometimes conflicting, performance data. This literature is important to the study because it demonstrates possibilities for investment to reduce preterm birth rates.
Home-based prenatal visits.

Several studies demonstrate the potential effectiveness of home-based prenatal care programs, but not all programs achieve the desired outcomes. The Nurse–Family Partnership appears to be one of the more effective prenatal care programs. It is a national, evidence-based home visiting program for first-time, low-income mothers. Participants in the program receive home visits by trained nurses. The nurses provide prenatal and other care advice during the home visits. Holland et al. (2018) evaluated the program’s effectiveness by evaluating the second pregnancies of women who had previously participated in the program. The authors randomized a group of mothers to continue in the program for their second children. They found that participants in the program had a reduced rate of preterm birth and low birth weight. The results indicate that home-based prenatal care is an effective intervention for reducing preterm births and may mitigate some of the barriers to prenatal care utilization.

Other studies also evaluated the Nurse–Family Partnership model. Thorland and Currie (2017) evaluated all participants in the program between July 1, 2007, and June 30, 2010. They compared their data to a cohort of first-time mothers from U.S. natality data. The authors placed the 27,195 Nurse–Family Partnership clients in three groups based on control factors, including maternal age, smoking status, education, marital status, and race-ethnicity. Utilizing McNemar’s Tests, the authors found that the incidence of preterm births among Nurse–Family Partnership clients was significantly lower than the control group. They emphasized the effectiveness of the Nurse–Family Partnership program as a prenatal care model to reduce preterm births. The model demonstrates its utility as an investment opportunity to mitigate preterm birth and its associated costs.
Not all home visitation prenatal care models are effective, however. Liu et al. (2019) conducted a literature review to determine home visit prenatal care effects on preterm birth, low birth weight, and rapid repeat birth. The authors reviewed articles from EMBASE, Web of Science, and the Cochrane Library from January 1960 to October 2018. The study was limited to randomized controlled trials focused on home visits. The authors did not find a significant relationship between home visits and a reduction in preterm birth. Although this finding may seem to contradict the findings from Thorland and Currie (2017) and Holland et al. (2018), Liu et al. included home visitation models other than Nurse–Family Partnership and found home visits had a favorable effect on low birth weight and rapid repeat birth. This study provides helpful insight because it offers a perspective that not all home visitation programs are effective. Programs that demonstrate effectiveness provide the best opportunity to maximize return on investment.

**Group prenatal visits.**

Group prenatal care is another intervention frequently cited in the literature. The scholarly literature reveals conflicting findings on the benefit of such programs. In group prenatal care, medical providers provide educational sessions to groups of women with similar gestational age in addition to private, individual physical examinations. Carter et al. (2016) compared perinatal outcomes of group prenatal care participants with those utilizing traditional prenatal care. They reviewed randomized controlled trials and observational studies reported in MEDLINE through PubMed, EMBASE, Scopus, Cumulative Index of Nursing and Allied Health Literature, the Cochrane Database of Systematic Reviews, the Database of Abstracts of Reviews of Effects, the Cochrane Central Register of Controlled Trials, and ClinicalTrials.gov. The authors considered outcomes including preterm birth, low birth weight, neonatal intensive
care unit admission, and breastfeeding initiation. They found that the rate of preterm birth was no different for women who participated in group prenatal visits. Similarly, they found that the groups had similar rates of neonatal intensive care unit admission and breastfeeding initiation. Although the observational studies indicated some improvement in low birth weight, the relationship did not exist in randomized controlled trials. This research indicates that group prenatal care is no more effective than individual prenatal care.

A more recent analysis of the group prenatal care model demonstrated positive results. Meadows et al. (2019) implemented a group prenatal care model in an urban obstetrical practice. The authors conducted a retrospective study comparing women in a group prenatal care program with a matched cohort of women receiving individual prenatal care. The women were patients of the same practice so the authors could utilize data from the group’s electronic medical record system. They compared rates of cesarean delivery and neonatal intensive care unit admissions for the participants. The study did not specify preterm birth rates, but neonatal intensive care unit admissions offer insight into the number of infants born with medical issues. The women in the group prenatal care program had significantly lower rates of cesarean delivery and neonatal intensive care unit admissions. The authors also compared information from hospital financial records and found that reduced neonatal intensive care unit admissions among the group prenatal care participants saved the Medicaid program approximately $37,027 per avoided admission. They did not attempt to generalize the findings outside of urban, residency training obstetrical practices. The results are useful in identifying a link between prenatal care utilization and reduced negative birth outcomes. The study also links a successful prenatal care intervention to reduced total health care expenditures. This cost reduction could form the basis for investment to increase prenatal care utilization as a strategy to reduce preterm birth rates.
A prominent group prenatal care approach is the Centering Pregnancy model. It incorporates standard prenatal assessments into a group approach that encourages patients to personally engage in care and learn from peers. Fiset et al. (2016) evaluated the model and compared it to individual prenatal care. The authors performed a retrospective cohort analysis with data from Christiana Care Health Services from 2009 to 2014. There were 5,003 deliveries from women receiving individual prenatal care and 444 deliveries from women in the Centering Pregnancy program. The authors controlled for parity, race, and prior preterm birth. Mean gestational age at delivery was significantly higher for women participating in the Centering Pregnancy program. Program participants also had significantly fewer preterm deliveries before 34 weeks. When extending to the 37-week definition of preterm birth, results were better for Centering Pregnancy participants, but not statistically significant. The study also found that the rate of neonatal intensive care unit admission, which is a significant source of high-intensity, high-cost health care services, was lower for Centering Pregnancy participants. The study provides relevant information about prenatal care interventions that require little additional investment but create economic arbitrage by reducing preterm births.

It is unclear, however, if the Centering Pregnancy model creates additional benefits over individual prenatal care. Groskaufmanis et al. (2018) sought to determine if the group visit approach demonstrated better birth outcomes. The authors reviewed retrospective data on group visit participants in the Myers Park Obstetrics and Gynecology Clinic of Charlotte, North Carolina. They utilized logistic regression models to assess group prenatal care effects on low birth weight, preterm birth, cesarean birth, and postpartum visit attendance. Seventy-eight women participated in group prenatal visits and 277 participated in individual visits. The results indicated no statistically significant difference in the two cohorts. Group prenatal care
participants did not demonstrate better outcomes than individual prenatal care participants did. Rather than proving that one model is better than the other model, the study indicated they achieved comparable results. The fact that the group prenatal model can achieve similar results to individual prenatal care means that it could be an effective alternative if there are barriers to individual prenatal care participation. In certain situations, group prenatal care may be an appropriate intervention to remove prenatal care utilization barriers and therefore reduce preterm birth incidence.

Other authors identified similar results. Mazzoni and Carter (2017) performed a meta-analysis of the literature to determine its effectiveness. They acknowledged that group prenatal care is an innovative model, but like Carter et al. (2016), found similar rates of preterm birth between mothers utilizing group prenatal care and those utilizing individual prenatal care. Their review indicated that patient satisfaction improved, but clinical outcomes were similar between the groups. They suggested conducting additional research to determine if certain subgroups might disproportionately benefit from group prenatal care. This study also acknowledged that group prenatal care is effective, but no more effective than individual prenatal care.

The Centering Pregnancy model serves as an alternative for increasing prenatal care utilization. It is necessary to understand its economic implications to determine if it is an effective investment for reducing preterm birth costs. Crockett et al. (2017) evaluated the Centering Pregnancy model in the context of its economic implications. They gathered data through a pilot incentive project sponsored by the BlueChoice Health Plan South Carolina Medicaid managed care organization. In the project, BlueChoice paid an obstetrical practice $175 for each patient who participated in at least five group prenatal care sessions. The authors employed a one-to-many case-control matching without replacement model in which they
retrospectively matched each Centering Pregnancy participant with five individual prenatal care participants. The authors matched groups based on the propensity score, age, race, and clinical risk factors. Analysis revealed fewer neonatal intensive care unit admissions for the 85 women in the Centering Pregnancy cohort. This resulted in net cost savings to the managed care organization of $67,293. Although this study does not specify the effect of Centering Pregnancy on reducing preterm births, it provides an example where investing in prenatal care returned total economic benefit to the health care system.

Other prenatal care models.

The scholarly literature also includes other prenatal care models. Some of the models are remote monitoring, inclusion in routine primary care, and modifications to traditional individual prenatal care. The models provide opportunities for investment to decrease preterm birth but demonstrate differing levels of effectiveness.

Standard prenatal care consists of 12–14 visits during pregnancy. The OB Nest model is a reduced-visit model that includes eight in-person provider visits, six virtual visits with an assigned nurse, and home-based monitoring devices for maternal blood pressure and fetal monitoring. The program also provides access to an online community of other participants. Butler et al. (2019) compared standard prenatal care frequency with the OB Nest model. The authors designed a randomized controlled trial for pregnant women between the ages of 18 and 36 years old receiving care in a Midwestern outpatient academic obstetric practice. The study evaluated patient satisfaction, pregnancy-related stress, and adherence to the American College of Obstetricians and Gynecologists recommendations on routine prenatal and ancillary services. Adherence to the recommendations was similar in both groups, but the OB Nest participants demonstrated higher levels of satisfaction and lower pregnancy-related stress. The study did not
evaluate birth outcomes but focused instead on process measures. The study describes an alternative form of prenatal care that may eliminate some of the barriers to prenatal care outlined in the previous section. Additional research is necessary to determine if this intervention affects preterm birth rates.

Other research also evaluated the OB Nest model but failed to make a connection to preterm birth incidence. Meylor de Mooij et al. (2018) considered the model’s effectiveness at increasing confidence in the pregnancy process and engaging women to be active participants in care. They tracked home monitoring tool usage and care team feedback to determine effectiveness, and they found that women were indeed more confident and engaged. The authors utilize these results to promote the potential for improved patient satisfaction and reduced costs. Like Butler et al. (2019) however, the authors did not study preterm birth rates or other perinatal outcomes. The study is useful in describing an alternative form of prenatal care but falls short of demonstrating improved and consistent outcomes.

Although research on the OB Nest model of reduced prenatal care visits did not demonstrate a specific relationship to preterm birth, other research indicates that reduced prenatal care visits are comparable to standard frequency programs. Sakharkar et al. (2016) considered whether a model with fewer visits than traditional models would lead to cost savings while maintaining quality. The authors analyzed Bahamian health care data to review direct medical expenses for laboratory tests, diagnostic procedures, and visit costs. They utilized the World Health Organization’s risk stratification tool to calculate risk adjustments. Employing a one-way sensitivity analysis, the authors reviewed women receiving care at Princess Margaret Hospital in the Bahamas. The women participating in the reduced-visit prenatal care program experienced lower costs than those participating in a traditional model. The study also revealed
no statistical difference between birth outcomes. As previously established, prenatal care utilization reduces preterm birth incidence. This study indicates that not only does prenatal care reduce expenses associated with preterm birth but also there may also be less expensive models of prenatal care. The combination of these tactics could reduce total healthcare expenditures.

Most of the scholarly literature considers prenatal care within the context of obstetrical care. However, it is possible to provide prenatal care in other venues and by other providers, including primary care providers. Oliveira et al. (2016) considered the factors that encourage women to utilize prenatal care within the primary care setting rather than in an obstetrics-focused practice. Their study analyzed factors that attract women to prenatal care and those that may tend to discourage prenatal care utilization. The study relates to prenatal care utilization barriers but belongs in this section regarding other models of prenatal care because of its use within a general primary care setting. The authors performed an integrative review of research data from Lilacs, Medline, and SciELO to understand the factors attracting women to use prenatal care within a primary care setting. The most notable factors supporting the use of primary care for prenatal services were scheduling ease and geographic proximity. Like the other studies in this section, the authors did not research birth outcomes, but they did find factors that could attract more women to utilize prenatal care. Given that prenatal care improves birth outcomes, increasing prenatal care utilization through primary care may provide an investment opportunity for reducing preterm births.

**Alternative provider models.**

Nonphysician providers can effectively deliver prenatal care. Jack et al. (2017) explored the effect of community health workers on advancing preventative care. The authors reviewed literature about community health worker interventions in PubMed, Cochrane Database of
Systematic Reviews, Cochrane Central Register of Controlled Trials, PsycINFO, Embase, and Web of Science from inception through June 2015. They found 34 relevant studies, 16 of which were randomized controlled trials, and 12 reported health care utilization outcomes. They found varying results. Five of the studies reported significant reductions in emergency department visits, hospitalizations, and urgent care visits. The authors found evidence suggesting that community health workers can assist in reducing the costs of preventable care for chronic disease patients. Their work in reducing preventable health care utilization indicates that community health workers can provide lower cost alternative or assistive services to increase prenatal care utilization.

Nurses can effectively substitute for physicians in prenatal care. Laurant et al. (2018) considered substituting nurses for physicians in situations and tasks where a physician’s skills and expertise are unnecessary. They reviewed studies from Cochrane Central Register of Controlled Trials, MEDLINE, Ovid, Cumulative Index to Nursing and Allied Health Literature, and EbscoHost, Grey Literature Report, OpenGrey, and the International Clinical Trials Registry Platform. The authors identified 18 randomized trials evaluating nurses working as substitutes for physicians. The results indicated little to no difference between nurse-led care and physician-led care. Rather than being inconclusive, the study indicates that nurses can replace physicians in certain primary and preventative care services. These results could inform strategies to expand access and utilization of prenatal care services.

Midwives represent another provider group who can provide cost-effective prenatal care. McRae et al. (2018) explored midwife usage and its effect on birth outcomes. They performed a population-based retrospective cohort study comparing midwife-led prenatal care to physician-led prenatal care. They studied effects on preterm birth, low birth weight, and small for
gestational age birth outcomes. The study included data from British Columbia, Canada, and included 57,872 pregnant women of low socioeconomic status. The authors selected women who were low to moderate risk and were carrying a single fetus. Deliveries occurred between 2005 and 2012. Of the participants in the study, 4,705 received midwifery prenatal care. The results indicated that those participants receiving midwifery care had lower odds of preterm birth, low birth weight, and small for gestational age birth outcomes. The results were consistent when compared to primary care physician-led prenatal care and obstetrician-led prenatal care. The study focused on low socioeconomic status women. It is unclear whether the results would extend to other socioeconomic classes. The results support midwives as effective alternative care providers for prenatal care. Utilizing midwives can expand access and increase the utilization of prenatal care services, therefore reducing the incidence and cost of preterm birth.

Section 1 Conclusion

Preterm birth effects are substantial. They create negative economic and humanitarian consequences. Investing in prenatal care has the potential to reduce preterm birth incidence. Understanding the relationship between prenatal care and preterm birth, with a focus on the cost of preterm birth, provides an understanding of the investment potential to reduce such outcomes. This study identified the investment potential to improve prenatal care utilization as a strategy for reducing preterm birth costs.
Section 2: Introduction

Section 1 provided the foundation of the study. It described the background of the problem and the problem statement. It also provided the purpose statement, which outlined how the study could contribute to the scholarly work on the topic. Section 1 discussed the nature of the study and provided a detailed description of why the quantitative causal-comparative approach was most appropriate for this study. The section also summarized the conceptual framework and included a discussion of the terms, assumptions, limitations, and delimitations of the study. Section 1 concluded with an exhaustive review of the scholarly literature to provide summaries of research related to prenatal care, preterm birth, and preterm birth cost.

Thus, the foundation of the study revealed that the effect of preterm birth is substantial. Preterm birth creates negative economic and humanitarian consequences. The section highlighted that investing in prenatal care has the potential to reduce preterm birth incidence and reduce total health care costs.

Section 2 describes the research project components. The section begins by reviewing the purpose statement. It continues with a description of the role of the researcher and how the researcher interacted with study participants. It also discusses methods used to access study participants for the project. The section explains the research method and design while justifying the use of the quantitative causal-comparative approach. Section 2 concludes with a discussion of the data collection, organization, and analysis techniques. At the conclusion of this section, the reader should understand the project structure and the techniques employed to conduct the study.

Purpose Statement

The purpose of this quantitative causal-comparative study was to add to the body of knowledge by analyzing the relationship between prenatal care utilization and preterm birth cost.
The researcher explored this larger problem through an in-depth study of prenatal care utilization and the associated preterm birth rate in the State of Tennessee. The study includes additional exploration into causes of preterm birth and the potential for investment in prenatal care to prevent those causes. A deeper understanding of this topic may assist health care policy makers in determining the most effective resource allocation strategy. Such a strategy will reduce total health care costs while improving the health status of the population. It is also possible to reduce the human suffering caused by preterm birth (Jha, 2019). Health care leaders who are followers of Christ will be motivated to reduce preterm births to reduce human suffering. Such work is an example of secular work that has a ministry component. Keller and Leary-Alsdorf (2012) characterized the ultimate purpose of work as serving God by serving others. This research study has the potential to serve others by identifying interventions that could preserve life, lessen human suffering, and effectively steward economic resources.

Role of the Researcher

The researcher’s role included several activities that shaped the study’s subject and execution. Researchers explore the complexity of topics within the context of those experiencing them and therefore must be mindful of their influence (Cleland, 2017). The researcher’s professional experience as a health care administrator influenced the subject selection. The researcher had 28 years of health care management experience, most of which occurred in pediatric academic medical centers with advanced neonatal intensive care units. This experience has provided the researcher insight into the human and economic costs of preterm birth.

The researcher began the research project by identifying the study problem. The specific problem to be addressed is suboptimal prenatal care utilization in Tennessee that results in costly, and preventable, preterm births. Then the researcher developed research questions to explore the
specific problem. Next, the researcher chose the research design and method most appropriate to achieve the study’s purpose. The researcher considered quantitative, qualitative, and mixed-methods approaches. Stake (2010) recommended the qualitative case study approach when studying multiple cases and making comparisons. However, the researcher rejected the qualitative approach because he did not seek to understand the experiences of participants but rather to analyze the consequences of preterm birth utilization on health care costs. A mixed-methods approach allows utilization of both quantitative and qualitative data, but the inclusion of qualitative data in this study was unnecessary to fulfill its purpose. Quantitative approaches focus on consequences or cause and effect relationships (Stake, 2010). The researcher deemed this method as the most appropriate for studying the relationship between prenatal care utilization and preterm birth costs.

Utilizing the quantitative causal-comparative approach mitigated certain bias risks inherent to qualitative research. For example, qualitative researchers must be conscious of their influence on study subjects, which can be especially problematic when participants view the researcher as an expert. Such a situation creates an environment where participants view the researcher as superior and themselves as inferior (Raheim et al., 2016). The situation creates a barrier between the researcher’s insider position and the participant’s outsider position. Qualitative researchers must also understand that cultural factors can contribute to participant barriers. Some cultures may be less willing than other cultures to participate in research based on trust in certain professions, beliefs about authority, and religious practices (Campbell-Voytal et al., 2019). These nuances affect any study design that requires participant recruitment.

This quantitative causal-comparative study eliminated those risks through the study design and through utilizing an existing data set. The next section describes the CDC National
Vital Statistics Center data set. This data set will provide the primary information regarding prenatal care utilization and preterm birth for all births in the study area. The database is extensive and so the researcher defined and documented the query necessary to obtain study information. A single data set, however, may not provide the necessary depth of understanding for the study. To gain a detailed understanding of the topic, the researcher considered multiple sources of evidence (Yin, 2014). For this study, the researcher performed numerous queries into the CDC data set to analyze the relationship between prenatal care utilization and preterm birth incidence.

The researcher also obtained financial information relative to preterm birth. This step was necessary to determine the investment potential for increasing prenatal care utilization. The researcher attempted to obtain this information from the State of Tennessee’s Medicaid agency, TennCare. A formal request is required to access the state’s healthcare claims data. The Appendix includes a copy of this request. The state grants access only in limited circumstances. The researcher was unsuccessful in obtaining access to the State of Tennessee’s data; therefore the researcher requested and received similar information from the Tennessee Hospital Association. The Tennessee Hospital Association maintains a charge database for all hospitals in the State of Tennessee accessible to its membership.

Lastly, the researcher considered investment potential to increase prenatal care utilization. To accomplish this, the researcher identified states that performed better in prenatal care utilization. Triangulating a better performing state’s data with Tennessee’s performance provided insight into the investment potential to increase prenatal care utilization and reduce preterm birth rates.
Participants

The quantitative causal-comparative study utilized several data sources to gain access to information about multiple subjects. The subjects are women in Tennessee who gave birth to living infants in 2018. Variables included gestational age at birth and prenatal care utilization. Additional data describing the cost of preterm birth will provide an economic perspective. The CDC National Vital Statistics Center maintains a robust data set on births in the United States with all the data fields necessary for this study. Additional data sources included the NCHS, TennCare, Tennessee Hospital Association, World Health Organization, Healthy People 2020, and public health data available at www.TN.GOV. The existence of these data sets allowed the researcher to gain access to the data without interviewing or observing individuals.

The CDC Natality database also protected subjects from potential ethical issues in the study. Creswell and Poth (2016) described three principles related to ethical research: respect for persons, concern for welfare, and justice. The CDC database mitigated all these concerns by eliminating identifiable data, creating no opportunity for harm, and providing data for all relevant subjects without regard to demographic or socioeconomic considerations.

The study involved evaluating additional data to provide a more complete understanding of how certain factors affect preterm birth rates among the study subjects (Wilson, 2016). For example, Baron et al. (2015) reported that demographic factors significantly affect preterm birth. The study compared birth outcomes of those who utilized prenatal care and those who did not. It also compared Tennessee’s birth outcomes to those in other states. These comparisons provided insight into the influence of factors such as geographic region, socioeconomic status, and educational level. This additional data helped the researcher more fully analyze the relationship between prenatal care utilization and preterm birth.
Lastly, the study utilized cost data from a variety of sources. Cost data were available in the literature (Fuchs, 2018; Jacob et al., 2017; Mangham et al., 2009; Zainal et al., 2019). Additional cost data were available from the Tennessee Hospital Association. The data consisted of blinded financial information for all hospitals in the State of Tennessee.

The study also have benefited from the State of Tennessee’s aggregate cost data. Tennessee’s Medicaid agency, TennCare, collects these data and makes them available for research. Accessing the data required a formal request by the researcher and approval by TennCare authorities. TennCare has complete discretion over who accesses the data. On March 8, 2020, the researcher submitted a formal data request to TennCare (see Appendix A). However, the researcher did not receive permission to utilize this data, and therefore the researcher requested similar data from the Tennessee Hospital Association. Appendix B includes a copy of this request, along with the data provided.

**Research Method and Design**

This research project employed the quantitative causal-comparative method and design to analyze the relationship between prenatal care utilization and preterm birth costs. This method and design were the most appropriate method and design because the researcher sought to understand the complexity of the relationship between prenatal care utilization and preterm birth costs, rather than the cause-and-effect relationship (Stake, 2010). The cause-and-effect relationship between prenatal care utilization and preterm birth is extensively documented in the scholarly literature (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Osman et al., 2018). This study analyzed the economic implications of preterm birth and the opportunity to invest in prenatal care as a strategy to reduce total health care costs.
**Research Method**

The researcher evaluated the three available methods, which were quantitative, qualitative, and mixed. The quantitative approach provides complete objectivity, statistical rigor, and broad application (Queirós et al., 2017). It seeks to determine a cause-and-effect relationship or understand the consequences of a relationship. Qualitative designs are rigorous in their own regard but focus on relationships and complexity rather than determining cause and effect (Stake, 2010). Mixed-methods research utilizes both qualitative and quantitative approaches. A mixed-methods study allows researchers to gain a deeper understanding of both causal relationships and subjective experiences by combining quantitative and qualitative data (McKim, 2017).

Researchers choose a research method based on the problem statement and study purpose. This study used the quantitative causal-comparative approach because it utilized a large existing data set to analyze the relationship between prenatal care utilization and preterm birth. The study further considered investment potential to increase prenatal care utilization as a strategy to reduce preterm birth costs. The cause-and-effect relationship between prenatal care utilization and preterm birth is established (Allen et al., 2018; Osman et al., 2018; Sperling et al., 2018). This study analyzed the opportunity to increase prenatal care utilization in Tennessee as a mitigating tactic to reduce preterm birth rates. The quantitative method allowed the researcher to gain an objective understanding of the relationship between prenatal care utilization and preterm birth cost.

**Research Design**

The researcher considered each type of quantitative design to determine which one would be most appropriate for the study. According to Salkind (2001), qualitative approaches include descriptive, correlational, and causal comparative. A study’s purpose determines the most
appropriate design. This study’s purpose was to understand the relationship between prenatal care utilization and preterm birth costs. An analysis of existing data about women who gave birth in the State of Tennessee during 2018 allowed the researcher to accomplish this purpose. This study reviewed all births in the State of Tennessee in 2018. The data allowed an exploration of various aspects of deliveries by Tennessee women during the defined period. The study was conducted thorough data analysis owing to a robust preexisting data set.

**Population and Sampling**

The study population included women who gave birth to live infants in Tennessee in 2018. The researcher compared the Tennessee study population to a similar population in Oregon. These states are suitable for comparisons based on their preterm birth rates and evaluation by March of Dimes (March of Dimes, 2019). Tennessee received a “D” grade in the March of Dimes Preterm Birth Report Card based on 2018 data. Oregon received an “A-” in the same report card. The March of Dimes grading methodology creates letter bands based on preterm birth rate standard deviation calculations across all states. Appendix C includes a complete description of the March of Dimes calculation. Oregon received the highest rating based on 2018 data, and is the only state rated as “A-.” In addition, Oregon is an appropriate comparison state because there were 41,742 births recorded in 2018 (CDC WONDER, 2020). This number of births provided a substantial comparative database to Tennessee’s 74,230 births in 2018.

Tennessee’s preterm birth rate was 11.1% in 2018, compared to Oregon’s preterm birth rate of 7.8% (March of Dimes, 2019). Given that the link between prenatal care utilization and preterm birth is well established, this study sought to determine if there is a significant difference in prenatal care utilization rates between Tennessee, a “D” rated state, and Oregon, an “A” rated
state (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Osman et al., 2018). If there is a significant difference, further analysis will evaluate the investment potential for increasing prenatal care utilization as a tactic to reduce preterm birth costs.

Moser and Korstjens (2018) encouraged researchers to gather data in such a way as to develop a full understanding of the study’s purpose. Given that the population included thousands of women and their infants, the researcher considered various sampling strategies to accomplish this aim. The first is criterion sampling. Criterion sampling identifies cases that meet certain descriptive characteristics (Creswell & Poth, 2016). In this study, the applicable criteria were prenatal care utilization and birth before the completion of 37 gestational weeks. As noted previously, the cases were from 2018, which was the most recent year of birth data available from the CDC.

The second technique considered was convenience sampling. Convenience sampling is a necessary consideration when evaluating thousands of data entries. Creswell and Poth (2016) acknowledged that convenience sampling, which involves utilizing the most readily available and accessible sample, saves resources, but may not provide all of the desired information. The authors indicated that such a sample also risks bias in excluding certain subjects based on social, cultural, or economic factors. Researchers must select the most appropriate sampling technique to mitigate this risk.

Exploring the objective relationship between prenatal care utilization and preterm birth cost requires an extensive data set. Seeking to resolve this issue, the researcher identified a database that provided criterion and convenience sampling from the entire population of subjects. The CDC Natality data set provides data on pregnant women and live births through birth certificate records. The Data Collection section includes an extensive description of the data
set. The purpose of the study was to analyze the relationship between prenatal care utilization and preterm birth costs. For this reason, the sample of women studied included only those who reported their prenatal care utilization. Some women reported no utilization while others reported various degrees of utilization. The study excluded those who did not report utilization. It was beyond the scope of this research to consider whether utilization among those who did not report was different from those who did report.

The study benefited from additional data used to gain a more robust understanding. Such data can provide a greater depth of understanding (Gibson, 2017). Preterm birth cost data enhanced the study’s analysis of the relationship between prenatal care and preterm birth. The researcher attempted to gain access to neonatal intensive care unit cost data from the State of Tennessee through a research data request. The researcher submitted a formal request (see Appendix A). The researcher also sent email requests but did not receive permission from TennCare. The Tennessee cost data would have provided useful insight, but other cost data for further analysis were available. The researcher received information from the Tennessee Hospital Association that provides a broader perspective on investment potential. Although TennCare data would have only provided information on Medicaid beneficiaries, Tennessee Hospital Association data provided financial information from all Tennessee hospitals without regard to the insurer. These data provided an additional depth of understanding of the topic. If necessary, there were also cost data available in the literature (Beam et al., 2020; Fuchs, 2018; Jacob et al., 2017; Mangham et al., 2009; Zainal et al., 2019). The preterm birth cost references provided the data necessary to gain additional insight into preterm birth costs.

The study benefited from an existing, robust data set gathered and presented by a reputable third party: the CDC. The data set included a sufficiently large sample to provide a
good depth of understanding of the topic. Both a criterion and a convenience sample provided
the researcher with sufficient detail to analyze the relationship between prenatal care utilization
and preterm birth cost. The researcher next considers the data collection process.

Data Collection

The study utilized data from the CDC. Utilizing this third-party database allowed the
researcher to be a complete observer. Creswell and Poth (2016) described researchers in this
situation as neither seen nor noticed, which mitigates bias risk in a study’s data collection phase.
The study also utilized economic data from the Tennessee Hospital Association. These data
provided additional perspective to increase the study’s validity (Nguyen, 2009). They also
provided additional perspective and depth of understanding for the subject. The following
subsections describe the data collection instruments, the data collection technique, and the data
organization technique.

Data Collection Instrument

The data were contained in the CDC Wide-ranging Online Data for Epidemiologic
Research (WONDER) database. The online database provides an ad hoc query system to analyze
public health data. According to the CDC website, the WONDER database “furthers CDC's
mission of health promotion and disease prevention by speeding and simplifying access to public
health information for state and local health departments, the Public Health Service, and the
academic public health community” (CDC, 2019, para. 2). It provides information to public
health practitioners and researchers. The data are publicly available and may be used, published,
copied, and distributed without express permission, though users are encouraged to cite the data
whenever utilized.
The specific data set used for this study is the CDC WONDER Natality data set. The data set includes information about live births occurring in the United States to U.S. residents. The database includes various demographic characteristics such as state of residence, mother’s age, and several health status indicators. The data source is from birth certificates, the U.S. Department of Health and Human Services, CDC, and the NCHS Division of Vital Statistics. The most recent data, beginning in 2016, utilize the 2003 U.S. Standard Certificate of Live Birth. Appendix D contains a copy of this form.

The study required additional data to provide the necessary depth of analysis. Financial data allowed the researcher to gain information about the economic effect of preterm birth. The researcher requested reimbursement data from TennCare but did not receive approval to access the data. A copy of the researcher’s request is available in Appendix A. Instead of TennCare’s data, the researcher requested data from the Tennessee Hospital Association. These data provide an additional depth of understanding because they provide information for all patients at Tennessee hospitals regardless of the insurance carrier. The TennCare data would have only provided information on Medicaid beneficiaries. The Tennessee Hospital Association data provided the estimated hospital cost for all newborns born preterm in Tennessee in 2018. The Tennessee Hospital Association estimated hospital costs based on the cost to charge ratio from the *State Joint Annual Report for Hospitals* (Tennessee Department of Health, 2018). The report included total claims, total estimated cost, mean estimated cost, median estimated cost, and standard deviation estimated cost, for 2018. Appendix B includes a copy of the correspondence requesting permission for this data.
Data Collection Technique

This study required information about both maternal and birth characteristics. A query of the CDC WONDER database provided the necessary information. The study utilizes discrete nominal data from the data set. Nominal data are data contained in unordered, mutually exclusive categories (Holcomb & Cox, 2017). For example, mothers either utilize prenatal care or do not utilize prenatal care. The database includes ordinal data about how many prenatal visits the mother attended, but the number of visits is irrelevant to this study. The researcher stratified the women into only two categories, those who utilized prenatal care and those who did not. Similarly, this study classified infants as either born term or born preterm. The database provides ordinal data based on the number of gestational weeks, but the researcher stratified the births as either term (37+ weeks gestation) or preterm (<37 weeks gestation).

Prenatal care utilization is the relevant maternal characteristic. The CDC WONDER database includes the month in the pregnancy when maternal prenatal care began. It also provides results for “no prenatal care,” “not on certificate,” and “unknown or not stated.” The query specified the year 2018 because it was the most recent data available.

Gestational age at birth was the relevant birth characteristic. Clinicians use two methods to calculate gestational age: last menstrual period or obstetric/clinical estimate. Beginning in 2014, the NCHS changed the standard for gestational period from last menstrual period to obstetric/clinical estimate, so this study utilized the obstetric/clinical estimate method. The researcher used gestational age range to stratify the data. Those born before 37 weeks gestational age were preterm. Those born at or following 37 weeks gestational age were term. The query included only those births occurring before 37 weeks gestation.
This study focused on Tennessee births, so only infants born in Tennessee were included in the primary data set. Table 1 contains a summary of the fields included in the query. A list of all the available fields and values is included in Appendix E. The Data Analysis section includes a full list of all variables and values included in the study.

**Table 1**

*Relevant Query Fields*

<table>
<thead>
<tr>
<th>Section</th>
<th>Section description</th>
<th>Item/variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Table layout</td>
<td>Results grouping</td>
</tr>
<tr>
<td>2</td>
<td>Maternal residence</td>
<td>State</td>
</tr>
<tr>
<td>5</td>
<td>Select pregnancy history and prenatal care characteristics</td>
<td>Number of prenatal visits</td>
</tr>
<tr>
<td>10</td>
<td>Select delivery characteristics</td>
<td>Year</td>
</tr>
<tr>
<td>12</td>
<td>Select infant characteristics</td>
<td>Obstetric/clinical estimate gestational age</td>
</tr>
<tr>
<td>12</td>
<td>Select infant characteristics</td>
<td>Infant living at time of report</td>
</tr>
</tbody>
</table>

The researcher obtained the necessary financial data for the study by requesting data from the Tennessee Hospital Association. The Tennessee Hospital Association data provide estimated hospital cost for newborns born preterm in Tennessee in 2018. The information provided by the Tennessee Hospital Association did not include any protected health information. It included hospital cost descriptive statistics for total claims, total estimated cost, mean cost, median cost, and standard deviation cost. These data provided the researcher with information about the investment potential to increase prenatal care utilization as a tactic to reduce preterm birth cost.

**Data Organization Technique**

The researcher exported the query results into Microsoft Excel spreadsheets. Excel provided sufficient analytical capabilities for the descriptive statistics. The researcher also utilized SPSS to perform and validate the statistical analysis. Excel allowed the researcher to present the data for enhanced reader understanding. The spreadsheets and SPSS output included
sufficient notes and comments for understanding and replication should a future researcher wish to reproduce the findings.

The researcher did not need to take any exceptional measures to secure the data. The data in the CDC WONDER database is publicly available and de-identified, so no extraordinary data security measures were necessary. Similarly, the economic information from the Tennessee hospital financial management database did not contain any protected health information or proprietary pricing information. As no identifiable, patient-specific information is present in any of the data, no risk of data breach exists.

**Data Collection Summary**

The study benefited from an existing, government-sponsored database that includes the variables relevant to the study. The researcher developed a data collection process including the appropriate queries, techniques, and data organization. These activities provided the foundation for data analysis to improve understanding of the investment potential to increase prenatal care utilization and reduce preterm birth cost.

**Data Analysis**

Quantitative research projects require rigorous data analysis (Hackett, 2019). Analysis allows researchers to explore topics and gain insight that is unavailable in superficial observation. The appropriate analysis technique depends on the study’s purpose. The following describes the data analysis technique for this quantitative causal-comparative study.

Given the extensive amount of data available in the CDC WONDER database, over 450,000 birth records for 2018, the researcher defined a data analysis methodology to narrow the data. The parameters included maternal residence, prenatal care characteristics, select delivery characteristics, and select infant characteristics. For example, the researcher limited the maternal
residence database field by state. The researcher selected Tennessee as the parameter, which reduced the number of cases from over 450,000 to approximately 74,000. The researcher set similar parameters for each item to refine the data. Each of these parameters was important to the study. The state parameter focused the study on a particular geographic state: Tennessee. The number of prenatal visits field established whether a mother utilized prenatal care. The year parameter limited the study data to 2018 births. The obstetric/clinical estimate gestational age determined which infants were born preterm, before 37 weeks gestation. Infant living at time of report provides insight into the human cost of preterm birth given that some preterm infants are born living and require significant clinical interventions but do not survive to hospital discharge. Table 2 presents the study parameters for select items.

**Table 2**

*Parameters for Select Query Values*

<table>
<thead>
<tr>
<th>Section</th>
<th>Section description</th>
<th>Item/variable</th>
<th>Selected value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Table layout</td>
<td>Results grouping</td>
<td>By census region of residence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>State</td>
<td>Tennessee</td>
</tr>
<tr>
<td>2</td>
<td>Maternal residence</td>
<td>Number of prenatal visits</td>
<td>1 to 2 visits, 3 to 4 visits, 5 to 6 visits, 7 to 8 visits, 9 to 10 visits, 11 to 12 visits, 13 to 14 visits, 15 to 16 visits, 17 to 18 visits, 19 or more visits</td>
</tr>
<tr>
<td>5</td>
<td>Select pregnancy history and prenatal care characteristics</td>
<td>Year</td>
<td>2018</td>
</tr>
<tr>
<td>10</td>
<td>Select delivery characteristics</td>
<td>Obstetric/clinical estimate gestational age</td>
<td>Under 20 weeks, 20–27 weeks, 28–31 weeks, 32–33 weeks, 34–36 weeks</td>
</tr>
<tr>
<td>12</td>
<td>Select infant characteristics</td>
<td>Infant living at time of report</td>
<td>All values</td>
</tr>
</tbody>
</table>

The full query included 114 parameters, many of which were irrelevant to the study but required consideration before data coding began. Based on the research questions, the study will focus on Tennessee mothers who gave birth in 2018. The study further explored parameters
relating to prenatal care utilization and preterm birth. The full 114-item structure is included in Appendix E.

For data analysis, the researcher utilized Microsoft Excel and SPSS. The researcher downloaded the CDC WONDER query results into a spreadsheet and computed descriptive statistics for prenatal care utilization and preterm birth experiences. The researcher used the computational capabilities of SPSS to analyze the birth outcomes of women who utilized prenatal care services and compared them to women who did not utilize prenatal care services.

The researcher further analyzed the data by comparing prenatal care utilization rates in Tennessee with those in Oregon. According to March of Dimes (2019), Oregon has a lower preterm birth rate than Tennessee. The researcher then repeated the data query for Oregon births and conducted a chi-square test to determine if a significant difference exists between the two values. A chi-square test allows researchers to determine if sets of categorical data differ from each other (Van Matre & Gilbreath, 1987). The study utilized a two-by-two contingency table. For the analysis, the prenatal care utilization rate in Tennessee served as the observed result, and the utilization rate in Oregon served as the expected result. The null hypothesis indicated that no difference exists between the observed and expected values, between utilization in Tennessee and utilization in Oregon. The study provides the investment potential to increase prenatal care utilization in Tennessee given the material difference in prenatal care utilization rates.

The CDC WONDER database was the primary data source for this study. The study also included financial data for additional analysis. Financial data provide a deeper understanding of the economic consequences of preterm birth. The data were from a separate database and were not directly associated with the study subjects’ experiences. The data reflected the potential economic implications of investing in prenatal care utilization as a strategy to reduce preterm
births. As the financial data were not contained in the CDC WONDER database, they were not included in that coding structure. Coding for the financial data included the following parameters for preterm infants born in Tennessee in 2018: count, total estimated hospital cost, mean estimated cost, median estimated cost, and standard deviation estimated cost. The coding requirements for the financial data were minimal given that there were fewer data fields and parameters.

The data sets provided the researcher with the opportunity to conduct a detailed and rigorous quantitative analysis of prenatal care utilization and preterm birth. The additional financial data from the Tennessee Hospital Association allowed the researcher to identify investment potential to increase prenatal care utilization and reduce preterm birth costs. The analysis evaluated if such an opportunity exists.

Reliability and Validity

Reliability and validity are important for a study’s credibility (Creswell & Poth, 2016). This section defines reliability and validity and discusses how the study achieved reliability and validity. The discussion addresses both face and content validity. Each topic relates to the data collection and analysis processes and provides a foundation for strengthening the credibility of the study.

Reliability

Reliability relates to a study’s consistency (Creswell & Poth, 2016). It describes whether the results are repeatable under the same conditions. Rust and Cooil (2018) discussed reliability in the context of stability and often referred to data quality as a synonym for reliability. This study achieved reliability by utilizing archival data gathered through a standardized form and data-gathering process.
The data for this study are contained in CDC WONDER. The online database provides an ad hoc query system to analyze public health data. This study utilized a data set for birth records contained within CDC WONDER and gathered by the NCHS. The data-gathering tool was the 2003 U.S. Standard Certificate of Live Birth. The data-gathering process, described below, was rigorous and supported highly reliable data.

The NCHS oversees the National Vital Statistics System, which serves as the official national database for statistics on births, deaths, fetal deaths, marriages, and divorces (www.CDC.gov). The 2003 U.S. Standard Certificate of Live Birth serves as the most recent data-gathering tool. The NCHS collaborates with states to ensure that standardized procedures produce the data. The CDC website provides abundant information to support states’ efforts to standardize data, including a 12-page document called the Specifications for Collecting and Editing the United States Standard Certificates of Birth and Death – 2003 Revision (Centers for Disease Control and Prevention, 2017). This guidance, as well as numerous other tools, provides significant support to states in their efforts to produce reliable data. Utilizing a standard form and providing detailed guidance for collecting the data ensure data uniformity and reliability.

Validity

Validity is the extent to which data accurately represent what they presume to represent (Rubio et al., 2003). It relates to the accuracy of data. There are various forms of validity, including face validity and content validity. Face validity is a less technical form of validity and refers to the sensibility or relevance of the data (Holden, 2010). The concept refers to whether the data appear to represent what they are intended to represent. This study achieves face validity by utilizing a national database of maternal and infant characteristics gathered from birth certificates. It is an appropriate data set for studying maternal and infant birth characteristics.
Content validity is the extent to which data fully represent a study variable (Rubio, 2003). The instrument must represent the entire variable’s relevant content. This study achieved content validity by utilizing a robust, inclusive data set. The CDC WONDER Natality data set includes 114 parameters, many with multiple possible values. Designing a query with such a large number of parameters can present a challenge for reliability, but the wide range of values adds content validity. Thus, the researcher could explore the topic fully with such a robust data set.

This study achieved validity because of archival data gathered from an instrument that was developed and periodically revised through a rigorous process. The NCHS revises the data-gathering tool every 10–15 years. The process begins by surveying executives responsible for state vital registration and statistics. A panel consists of those executives and representatives of data provider and user organizations. Including users in the review process is a critical step for ensuring validity (Connell et al., 2018). The panelists reviewed previous documents and records to make recommendations about changes to the data tool and data-gathering processes. The panelists make changes to improve data quality for statistical and legal purposes (National Center for Health Statistics, Division of Vital Statistics, 2000). The process ensures exceptional data quality and supports the validity of this study.

Section 2 Conclusion

Section 2 described the research project components. The section began with a review of the purpose statement of this quantitative causal-comparative study, which is to add to the body of knowledge by analyzing the relationship between prenatal care utilization and preterm birth cost. The study emphasizes the economic cost of preterm birth but acknowledges the related human costs. Followers of Christ will be interested in the study as stewards of resources and as God’s instruments to reduce human suffering.
Section 2 also described the researcher’s role, which included identifying the study problem, selecting the quantitative causal-comparative study method and design, and finding data sources. For this quantitative study, the participants were women in Tennessee who gave birth to living infants in 2018. Section 2 described a robust archival data set, CDC WONDER, that gave the researcher access to participants without directly contacting them. This format mitigated bias risk in the data collection phase and placed the researcher in Creswell and Poth’s (2016) recommended position of being neither seen nor noticed by the participants.

The section also described the rationale for selecting the quantitative causal-comparative study method and design. This method and design were most appropriate because the researcher sought to analyze the relationship between prenatal care utilization and preterm birth costs, and the potential to invest in prenatal care utilization as a tactic to reduce preterm birth costs. The section also described the data collection process and provided Tables 1 and 2 to further clarify the parameters for the relevant query fields and values. Public access to the CDC WONDER database simplified case selection.

Section 2 concluded by describing data analysis and the steps taken to ensure data quality in terms of reliability and validity. Using the CDC WONDER database facilitated data saturation, but ensuring triangulation required additional data sources. To gain the greater depth of understanding achieved through additional analysis, the researcher utilized the Tennessee Hospital Association’s financial data (Gibson, 2017). Utilizing the CDC WONDER database strengthened data quality by utilizing a standardized data collection form, which was the 2003 U.S. Standard Certificate of Live Birth. This form benefited from face validity in addition to content validity. The data source also benefits from extensive data-collection training programs. These programs improve reliability by reducing variation in the data-gathering process.
The effect of preterm birth is substantial, as it creates negative economic and humanitarian consequences. Investing in prenatal care has the potential to reduce preterm birth incidence. Understanding the relationship between prenatal care and preterm birth, with a focus on the cost of preterm birth, provides insight into the investment potential to reduce such outcomes. The next section will describe the study’s findings and implications.
**Section 3: Presentation of the Findings**

Section 3 presents the study’s findings and a description of their professional applications within a Biblical worldview context. The section also recommends further study opportunities and includes personal reflections. The findings contribute to the scholarly literature on prenatal care and preterm birth. They will affect policy decisions and creates the potential to reduce the human and economic cost of preterm birth.

**Overview of the Study**

Health care costs in the United States are increasing (Conway, 2017; Dielman et al., 2017), and preterm birth contributes significantly to health care costs in the United States (Frey & Klebanoff, 2016). According to March of Dimes, Tennessee’s preterm birth rate is among the worst in the United States. The scholarly literature also demonstrates that certain prenatal care interventions reduce preterm birth incidence (Newnham et al., 2014). This study analyzed the investment potential to increase prenatal care utilization in Tennessee as a tactic to reduce preterm birth rates and their associated costs.

To analyze the investment potential, the researcher analyzed preterm birth rates and prenatal care utilization rates in two states: Tennessee and Oregon. Tennessee received a “D” rating in the 2019 March of Dimes Report Card while Oregon received an “A” rating. The researcher utilized CDC 2018 Natality data and conducted a chi-square test on preterm birth rates to determine if there was a statistically significant difference between Oregon and Tennessee performance. The analysis defined Oregon’s preterm birth rate as the expected value and Tennessee’s preterm birth rate as the observed value. The researcher then evaluated prenatal care utilization with a chi-square test. The researcher again defined Oregon’s rate as the expected value and Tennessee’s rate as the observed value. Lastly, the researcher utilized Tennessee
Hospital Association cost data to analyze preterm birth costs in Tennessee to determine if a material investment opportunity existed to increase prenatal care utilization.

The study found a statistically significant difference between preterm birth rates in Oregon compared to Tennessee. The study also found a statistically significant difference between prenatal care utilization in Oregon compared to Tennessee. The fact that there is special cause variation between prenatal care utilization rates in Oregon and Tennessee indicates that there is potential to improve prenatal care utilization in Tennessee. The scholarly literature confirmed that increasing prenatal care utilization reduces preterm birth (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Osman et al., 2018). Given this foundation of scholarly literature, the researcher analyzed Tennessee Hospital Association preterm birth cost data and determined that a material investment potential exists to increase prenatal care utilization as a tactic to reduce preterm birth cost in Tennessee.

**Descriptive Statistics**

This section provides descriptive statistics for the study population. It includes the response rate and participant demographics. The section also provides information about the total number of participants and their relationship to the study. Lastly, the section includes a description of the data used in the hypothesis tests.

**Response Rate**

The study benefited from utilizing an existing database containing all registered births. CDC WONDER provides an ad hoc query system to analyze public health data. For this study, the researcher accessed natality data gathered on all births to U.S. residents. The researcher focused attention on births in two states: Tennessee and Oregon. The response rate was 100% because the database includes data for all live births during the study period. The effective
response rate for this study was less than 100%, however. As the researcher sought to analyze prenatal care utilization and preterm birth, he included only those records reporting both prenatal care utilization and infant gestational age. Of the 80,751 live births in Tennessee in 2018, there were 6,638 records where prenatal care utilization or infant gestational age was unknown or not reported. Similarly, in Oregon, of the 42,188 live births in 2018, 462 records returned unknown or not reported prenatal care utilization or infant gestational age. These records were not included in the study, therefore reducing the effective response rate below 100%. Table 3 summarizes the study response rate.

**Table 3**

*Study Response Rate*

<table>
<thead>
<tr>
<th></th>
<th>Total live births</th>
<th>Gestational age and prenatal care unknown or not reported</th>
<th>Study records</th>
<th>Effective response rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tennessee</td>
<td>80,751</td>
<td>6,638</td>
<td>74,113</td>
<td>92%</td>
</tr>
<tr>
<td>Oregon</td>
<td>42,188</td>
<td>462</td>
<td>41,726</td>
<td>99%</td>
</tr>
</tbody>
</table>

**Demographics**

The primary study subjects were women residing in Tennessee who gave birth to living infants in 2018. The comparison group was women residing in Oregon who gave birth to living infants in 2018. As described in the previous section, the study subjects include only those with prenatal care utilization reports. The records stratified into four groups based on prenatal care utilization and infant birth characteristics. Table 4 summarizes the four group characteristics.
Table 4

Study Subject Stratification

<table>
<thead>
<tr>
<th>Mother utilized prenatal care and infant born <strong>term</strong></th>
<th>Mother utilized prenatal care and infant born <strong>preterm</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother did not utilize prenatal care and infant born <strong>term</strong></td>
<td>Mother did not utilize prenatal care and infant born <strong>preterm</strong></td>
</tr>
</tbody>
</table>

The strata applied to both the Tennessee data cohort and the Oregon data cohort. The database allowed for further stratification by a variety of demographic characteristics. Appendix E provides a list of demographic characteristics. Future studies may consider whether the results differ for different demographic strata. This study stratified no further than those characteristics described in Table 4.

Appendix E contains the various data queries used for the study. Table 5, Table 6, Table 7, and Table 8 contain summaries of all data by category. As reported previously, the data contained 74,113 relevant birth records for Tennessee and 41,726 birth records for Oregon. Because Oregon had 32,387 fewer births than Tennessee in 2018, the researcher calculated percentages for prenatal care utilization and gestational age to highlight differences in the data. The hypothesis tests and analysis determined if there were statistically significant differences in the data.

The data revealed that, in 2018, preterm births were 10.6% of all applicable births in Tennessee compared to 7.7% of all applicable births in Oregon. These percentages were similar to those reported by March of Dimes during the same period (March of Dimes, 2019). As March of Dimes data included all births regardless of prenatal care utilization, the percentages differed slightly. The March of Dimes comparison strengthened the researcher’s confidence in the data’s integrity.
As with the gestational age data, differences emerged when evaluating prenatal care utilization. In total, 98.4% of Tennessee women utilized prenatal care, while 1.6% did not. This compares to 99.1% of Oregon women who utilized prenatal care, while 0.9% did not. The data also revealed that of those Tennessee women who utilized prenatal care, 89.7% delivered a term baby while 10.3% delivered preterm. Of those who did not utilize prenatal care, 70.3% delivered a term baby while 29.7% delivered preterm.

The Oregon results followed a similar pattern to those from Tennessee. In total, 92.4% of those who utilized prenatal care delivered a term baby, while 7.6% delivered preterm. Of the mothers in Oregon who did not utilize prenatal care, 78.2% delivered a term baby compared to 21.8% who delivered preterm.

Differences exist in rates between Tennessee and Oregon, but it is unclear whether those differences are statistically significant based merely on comparing percentages. The following section shows the results of various statistical test employed to determine statistical significance. The section lists each hypothesis test and links it to the related research question.

**Table 5**

*Tennessee Gestational Age and Prenatal Care Utilization Data*

<table>
<thead>
<tr>
<th></th>
<th>Utilized prenatal care</th>
<th>Did not utilize prenatal care</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
<td>65,444</td>
<td>834</td>
<td>66,278</td>
</tr>
<tr>
<td>Preterm</td>
<td>7,483</td>
<td>352</td>
<td>7,835</td>
</tr>
<tr>
<td>Total</td>
<td>72,927</td>
<td>1,186</td>
<td>74,113</td>
</tr>
</tbody>
</table>
Table 6

Tennessee Gestational Age and Prenatal Care Utilization Percentages

<table>
<thead>
<tr>
<th></th>
<th>Utilized prenatal care</th>
<th>Did not utilize prenatal care</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
<td>89.7%</td>
<td>70.3%</td>
<td>89.4%</td>
</tr>
<tr>
<td>Preterm</td>
<td>10.3%</td>
<td>29.7%</td>
<td>10.6%</td>
</tr>
<tr>
<td>Total</td>
<td>98.4%</td>
<td>1.6%</td>
<td>1.6%</td>
</tr>
</tbody>
</table>

Table 7

Oregon Gestational Age and Prenatal Care Utilization Data

<table>
<thead>
<tr>
<th></th>
<th>Utilized prenatal care</th>
<th>Did not utilize prenatal care</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
<td>38,193</td>
<td>309</td>
<td>38,502</td>
</tr>
<tr>
<td>Preterm</td>
<td>3,138</td>
<td>86</td>
<td>3,224</td>
</tr>
<tr>
<td>Total</td>
<td>41,331</td>
<td>395</td>
<td>41,726</td>
</tr>
</tbody>
</table>

Table 8

Oregon Gestational Age and Prenatal Care Utilization Percentages

<table>
<thead>
<tr>
<th></th>
<th>Utilized prenatal care</th>
<th>Did not utilize prenatal care</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
<td>92.4%</td>
<td>78.2%</td>
<td>92.3%</td>
</tr>
<tr>
<td>Preterm</td>
<td>7.6%</td>
<td>21.8%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Total</td>
<td>99.1%</td>
<td>0.9%</td>
<td>99.1%</td>
</tr>
</tbody>
</table>

Hypothesis Tests

This section provides a detailed discussion of the hypothesis tests performed. It relates each test to the relevant research question and connects the findings to the theoretical framework and the scholarly literature. The section includes conclusions from the quantitative test results.
RQ1: How Does Preterm Birth Relate to Prenatal Care Utilization?

The literature demonstrated that prenatal care utilization can reduce preterm birth incidence (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Osman et al., 2018). These studies included various demographic categories and geographic regions. There was, however, an absence of scholarly literature related to this phenomenon in Tennessee. Rather than assume the findings of previous studies were applicable, the researcher analyzed the relationship between prenatal care utilization and preterm birth in Tennessee. The specific hypotheses tested were as follows:

H₀₁: There is no statistically significant relationship between prenatal care utilization and preterm birth in Tennessee.

H₁₁: There is a statistically significant relationship between prenatal care utilization and preterm birth in Tennessee.

Utilizing the CDC WONDER database and analyzing data from 2018, the researcher identified 74,113 births to mothers in Tennessee whose records included information about prenatal care utilization and the baby’s gestational age at birth. The data revealed that 29.7% of the babies whose mothers did not utilize prenatal care were born preterm. For those mothers who did utilize prenatal care, 10.6% of the babies were born preterm.

A chi-square test allowed the researcher to determine if there is a statistically significant relationship between prenatal care utilization and preterm birth in Tennessee. This test is appropriate for analyzing nominal, categorical data to determine if differences in the data are statistically significant (Van Matre & Gilbreath, 1987). The researcher utilized SPSS to conduct the analysis. In the following SPSS output (see Tables 9–11), “utilization” refers to prenatal care utilization and results in one of two values: “Y,” meaning that prenatal care was utilized, and
“N,” indicating that prenatal care was not utilized. Gestation is the other variable in the two-by-two table. It also has two possible results: “P” for babies born preterm and “T” for babies born at full term. Variables were weighted according to frequency.

Table 9

*SPSS Output for Prenatal Care Utilization by Gestational Age: Case Processing Summary*

<table>
<thead>
<tr>
<th></th>
<th>Valid cases</th>
<th>Missing cases</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Utilization * gestation</td>
<td>74,113</td>
<td>100.0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 10

*SPSS Output for Prenatal Care Utilization by Gestational Age: Utilization * Gestation Cross-Tabulation*

<table>
<thead>
<tr>
<th></th>
<th>Utilization</th>
<th>Gestation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Preterm</td>
<td>Term</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>352</td>
<td>834</td>
<td>1,186</td>
</tr>
<tr>
<td>% within utilization</td>
<td>29.7</td>
<td>70.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>7,483</td>
<td>65,444</td>
<td>72,927</td>
</tr>
<tr>
<td>% within utilization</td>
<td>10.3</td>
<td>89.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>7,835</td>
<td>66,278</td>
<td>74,113</td>
</tr>
<tr>
<td>% within utilization</td>
<td>10.6</td>
<td>89.4</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 11

*SPSS Output for Prenatal Care Utilization by Gestational Age: Chi-Square Tests*

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymptotic significance (two-sided)</th>
<th>Exact significance (two-sided)</th>
<th>Exact significance (one-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson chi-square</td>
<td>465.476a</td>
<td>1</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity correctionb</td>
<td>463.424</td>
<td>1</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood ratio</td>
<td>333.293</td>
<td>1</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisher’s exact test</td>
<td></td>
<td></td>
<td></td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N of valid cases</td>
<td>74,113</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a0 cells (.0%) have expected count less than 5. The minimum expected count is 125.38.

*bComputed only for a 2 x 2 table.
SPSS calculated the chi-square statistic as 465.476. The resulting \( p \) value was < 0.000. With a standard alpha level of 0.05, the researcher rejected the null hypothesis that there is no statistically significant relationship between prenatal care utilization and preterm birth in Tennessee. These results were consistent with the generalized findings about the relationship between preterm birth and prenatal care referenced previously in this section.

The researcher considered the possibility of both Type I and Type II errors. A Type I error occurs when the researcher rejects a true null hypothesis. In contrast, a Type II error occurs when the researcher accepts a false null hypothesis (Shi & Tao, 2008). Alpha represents the likelihood of a Type I error. In this case, the researcher selected alpha at 0.05, which meant that there was a 5% chance that the researcher rejected a true null hypothesis.

The possibility of a Type II error was more complicated in this study. Due to the large sample size, and the small value for degrees of freedom, the beta value was relatively large. The researcher utilized G*Power to calculate beta. G*Power is an open-source tool to compute statistical power analyses (Faul et al., 2007). The researcher first calculated the non-centrality parameter as 0.4255712. This result allowed G*Power to calculate beta as 0.94989. A beta value of this level indicates an increased error potential of accepting the null hypothesis. The large sample size and corresponding small \( p \) value, however, led the researcher to reject the null hypothesis with confidence.

This finding is important because it formed a foundation for the study. The specific problem addressed was suboptimal prenatal care utilization in Tennessee resulting in costly, and preventable, preterm births. As the data indicated there is a link between prenatal care utilization and preterm birth in Tennessee, it was possible to analyze the potential for investing in prenatal
care utilization as a mitigating tactic for preterm birth. Had this relationship not been present, there would have been little purpose to consider the next hypothesis.

**RQ2: How Does Prenatal Care Utilization in Tennessee Compare to States With Lower Preterm Birth Rates?**

With the relationship between prenatal care utilization and preterm birth established, the researcher sought to determine if the prenatal care utilization rate in Tennessee differed from another state. Returning to the specific problem, which was that suboptimal prenatal care utilization in Tennessee results in costly, and preventable, preterm births, the researcher needed to compare Tennessee’s prenatal care utilization rate with a better performing state. If Tennessee’s prenatal care utilization rate did not differ from other states, then no clarity would exist on the prospect of increasing prenatal care utilization. If a statistically significant difference in prenatal care utilization rates existed, then there would be evidence of the possibility to increase prenatal care utilization in Tennessee as a mitigating tactic to decrease preterm birth.

The researcher chose Oregon as the comparison state. Oregon performs better in prenatal care utilization and preterm birth rate. It is a March of Dimes “A”-rated state for preterm birth, compared to Tennessee which is a “D”-rated state (March of Dimes, 2019). Oregon’s preterm birth rate in 2018 was the lowest (best) in the country at 7.8%, while Tennessee’s was one of the highest (worst) at 11.1%. Only nine states performed worse than Tennessee. If a statistically significant difference in prenatal care utilization exists between Oregon and Tennessee, then there would be an objective possibility to increase prenatal care utilization as a tactic to reduce preterm births in Tennessee. Therefore, the researcher tested the following hypotheses:

**H02:** There is no statistically significant difference in prenatal care utilization in Tennessee compared to a state with lower preterm birth rates.
Ha2: There is a statistically significant difference in prenatal care utilization in Tennessee compared to a state with lower preterm birth rates.

The researcher once again utilized the CDC WONDER database to analyze birth records for Tennessee mothers who provided data on prenatal care utilization. To test the hypothesis, the researcher also analyzed records from Oregon mothers who delivered living infants in 2018 and reported data on their prenatal care utilization. As in the previous test, there were 74,113 relevant records for Tennessee mothers. Among those women, 1,186 (1.6%) reported no prenatal care utilization. The Oregon comparison group included 41,726 total records. Among Oregon mothers, 395 (0.9%) reported no prenatal care utilization.

The researcher utilized SPSS to conduct a chi-square test to determine if there was a statistically significant difference in prenatal care utilization rates in Tennessee and Oregon. As described in the previous section, Van Matre and Galbreath (1987) offered the chi-square test as an appropriate option for analyzing nominal, categorical data. Tables 12–14 contain the SPSS output. In Table 13, “utilization” refers to whether the mother utilized prenatal care. “Y” means that the mother did utilize prenatal care, and “N” means that the mother did not utilize prenatal care.

**Table 12**

*SPSS Output for Prenatal Care Utilization by Gestational Age: Case Processing Summary*

<table>
<thead>
<tr>
<th></th>
<th>Valid cases</th>
<th></th>
<th>Missing cases</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Utilization * gestation</td>
<td>115,839</td>
<td>100.0</td>
<td>0</td>
<td>0.0</td>
<td>115,839</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table 13

**SPSS Output for Prenatal Care Utilization by Gestational Age: State * Utilization Cross-Tabulation**

<table>
<thead>
<tr>
<th>State</th>
<th>Utilization</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>Y</td>
<td>Total</td>
</tr>
<tr>
<td>Oregon mothers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>395</td>
<td>41,331</td>
<td>41,726</td>
<td></td>
</tr>
<tr>
<td>% within state</td>
<td>0.9</td>
<td>99.1</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Tennessee mothers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>1,186</td>
<td>72,927</td>
<td>74,113</td>
<td></td>
</tr>
<tr>
<td>% within state</td>
<td>1.6</td>
<td>98.4</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,581</td>
<td>114,258</td>
<td>115,839</td>
<td></td>
</tr>
<tr>
<td>% within state</td>
<td>1.4</td>
<td>98.6</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 14

**SPSS Output for Prenatal Care Utilization by Gestational Age: Chi-Square Tests**

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymptotic significance (two-sided)</th>
<th>Exact significance (two-sided)</th>
<th>Exact significance (one-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson chi-square</td>
<td>84.717a</td>
<td>1</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity correction</td>
<td>84.232</td>
<td>1</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood ratio</td>
<td>89.612</td>
<td>1</td>
<td></td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Fisher’s exact test</td>
<td></td>
<td></td>
<td></td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N of valid cases</td>
<td>115,839</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)0 cells (.0%) have expected count less than 5. The minimum expected count is 569.49.
\(^b\)Computed only for a 2 x 2 table.

SPSS calculated the chi-square statistic as 84.717. The resulting p value is < 0.000. With a standard alpha level of 0.05, the researcher rejected the null hypothesis that there is no statistically significant difference in prenatal care utilization in Tennessee compared to a state with lower preterm birth rates. As with the previous research question, this result is consistent with expected results following the scholarly literature, though now applied to the Tennessee population (Allen et al., 2018; Leneuve-Dorilas et al., 2019; Osman et al., 2018). Prenatal care
utilization positively affects preterm birth rates, so it follows that a state with higher prenatal care utilization would have a lower preterm birth rate.

Like the previous hypothesis test, this test benefited from having a large sample size. The researcher once again defined the chance of a Type I error, alpha, as 0.05. The possibility of a Type II error, beta, was similar to the previous test.

This finding is important because it demonstrated the possibility of increasing prenatal care utilization in Tennessee. Given that the variation between prenatal care utilization in Tennessee and prenatal care utilization in Oregon results from special cause variation, it is possible to develop interventions to increase Tennessee’s utilization rate to within a statistically insignificant range of Oregon’s utilization rate.

**RQ3: How Could Increasing Prenatal Care Utilization Have Affected Health Care Costs in Tennessee During the Study Period?**

Research Question 3 analyzed the investment potential for increasing prenatal care utilization as a tactic to decrease preterm cost. The researcher attempted to determine the cost of caring for Tennessee’s preterm infants in 2018 and determine if that cost represented a material investment opportunity to increase prenatal care utilization. As determined in analysis of the previous two hypotheses, increasing prenatal care utilization in Tennessee is possible, and increased prenatal care utilization could result in decreased preterm births. The following hypothesis continues the line of reasoning by determining if a material investment opportunity exists to exploit that relationship.

**H03:** There was no material investment opportunity to increase prenatal care utilization in Tennessee during the study period as a mitigating tactic to reduce preterm birth costs.
$H_3$: There was a material investment opportunity to increase prenatal care utilization in Tennessee during the study period as a mitigating tactic to reduce preterm birth costs.

Though this hypothesis is quantitative, it required the researcher to make certain judgments and develop certain assumptions. To analyze this question the researcher utilized cost data provided by the Tennessee Hospital Association. The correspondence with the Tennessee Hospital Association is included in Appendix B. The data include cost information for 74,339 infants born in Tennessee in 2018. This number differs from the 74,113 records identified in the CDC WONDER database. There is no direct link between records in the CDC WONDER database and the Tennessee Hospital Association cost database. It was impossible, therefore, to link a specific CDC WONDER data record to the birth cost for the related infant. Also, the Tennessee Hospital Association cost data did not include any information about prenatal care utilization. Though the birth records and cost records are unlinked, the fact that the difference in total records is 0.3% demonstrates that the two data sets generally represent the same population. Although the researcher was mindful of this discrepancy, the most important characteristic of the Tennessee Hospital Association data set was that it stratified cost by infant gestational age. It was possible, therefore, to compare birth costs for those born term to those born preterm. This was the key issue for Research Question 3 to determine if a material investment opportunity exists to increase prenatal care utilization as a tactic to decrease preterm birth costs. Comparing preterm birth costs with term birth costs provided insight into the investment opportunity.

To answer this question and evaluate the hypothesis, the researcher considered how much of a difference must exist between preterm birth costs and term birth costs to justify the investment. This was not a statistical question but rather an economic question. One could conduct a statistical test to determine statistical significance, but statistical significance and
economic significance are different concepts. Research Question 3 sought economic significance, defined in accounting terms as *materiality*.

Referencing materiality, the American Institute of Certified Public Accountants and the Auditing Standards Board state, “Misstatements, including omissions, are material if there is a substantial likelihood that, individually or in the aggregate, they would influence the judgment made by a reasonable user based on the financial statements” (American Institute of Certified Public Accountants, 2019, para. 6). This definition indicates that judgment, rather than a defined benchmark, determines materiality. This definition is enlightening but added no utility to the study.

The researcher sought greater clarity on the definition of materiality. Generally Accepted Accounting Principles are accounting standards controlled by the U.S. Securities and Exchange Commission but typically left to the private sector to define (U.S. Securities and Exchange Commission, n.d.). While the Commission makes it clear that there is no standard threshold for materiality, Acito et al. (2019) cited 5% as a rule of thumb when determining materiality. This means that if an accounting adjustment would result in a 5% or greater change, then the adjustment is material. Based on this guidance, the researcher employed the 5% rule of thumb for materiality to test the hypothesis that there was no material investment opportunity to increase prenatal care utilization in Tennessee during the study period as a mitigating tactic to reduce preterm birth costs.

The researcher utilized Microsoft Excel to calculate materiality based on the data provided by Tennessee Hospital Association. The researcher only used data records with linked gestational age and birth costs. Table 15 summarizes the Tennessee Hospital Association data. In 2018, there were 42,621 records linking a baby’s gestational age at birth to his or her initial
hospitalization cost. Of these records, 38,765 infants were born term, and 3,856 were born preterm. The total hospitalization cost for the 38,765 infants who were born term was $50,950,714. The total hospitalization cost for the 3,856 infants who were born preterm was $39,626,482. Of note, the infants born preterm represent 9% of births in the data set, yet account for 44% of the total cost.

**Table 15**

*Tennessee Hospital Association Birth Cost*

<table>
<thead>
<tr>
<th>Gestational age</th>
<th>Count</th>
<th>Count %</th>
<th>Total cost</th>
<th>Cost %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm (&lt; 37 weeks)</td>
<td>3,856</td>
<td>9%</td>
<td>$39,626,482</td>
<td>44%</td>
</tr>
<tr>
<td>Term (&gt; 36 weeks)</td>
<td>38,765</td>
<td>91%</td>
<td>$50,950,714</td>
<td>56%</td>
</tr>
<tr>
<td>Total</td>
<td>42,621</td>
<td></td>
<td>$90,577,196</td>
<td></td>
</tr>
</tbody>
</table>

The fact that 9% of the births account for 44% of the costs might lead to an assumption of statistical significance. The data contained significant variation, however. Term delivery birth costs range from $803 to $510,413, with a standard deviation of $5,794. Similarly, preterm birth costs range from $1,561 to $581,040. The standard deviation for preterm birth is $31,024. The amount of variation indicates that the difference between preterm birth costs and term birth costs must be very large to be statistically significant. At an alpha of 0.05, or 95% confidence, the difference between preterm birth cost and term birth cost would have to be within 1.96 standard deviations of the mean (Van Matre & Gilbreath, 1987).

In this case, with a $5,794 standard deviation in term birth costs, the upper limit of a 95% confidence interval would be $12,670. The mean preterm birth cost, $10,277, fell below the upper limit. Since the mean preterm birth cost fell below the upper limit, the researcher could not reject a null hypothesis testing statistical significance at a 0.05 alpha level. Table 16 summarizes the information.
Table 16

*Preterm Birth Cost Statistical Analysis*

<table>
<thead>
<tr>
<th>Gestational age</th>
<th>Count</th>
<th>Mean cost</th>
<th>Standard deviation</th>
<th>95% confidence interval upper limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm (&lt; 37 Weeks)</td>
<td>3,856</td>
<td>$10,277</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term (&gt; 36 Weeks)</td>
<td>38,765</td>
<td>$1,314</td>
<td>$5,794</td>
<td>$12,670</td>
</tr>
</tbody>
</table>

As previously discussed in this section, Research Question 3 and the associated hypothesis test sought to understand economic significance rather than statistical significance. Table 17 summarizes the economic difference between mean preterm birth costs and term birth costs. The $8,963 difference between preterm birth costs and term birth costs represented a 582% difference. This far exceeded the 5% rule of thumb for materiality cited by Acito et al. (2019). This result, however, did not fully satisfy the research question seeking to determine if a material investment opportunity exists. To determine this, the researcher made assumptions about the potential to avoid preterm births with increased prenatal care utilization. For this assumption, the researcher once again considered Oregon’s performance.

Table 17

*Preterm Birth Cost Materiality*

<table>
<thead>
<tr>
<th>Gestational age</th>
<th>Count</th>
<th>Mean cost</th>
<th>Cost Difference</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm (&lt; 37 Weeks)</td>
<td>3,856</td>
<td>$10,277</td>
<td>$8,963</td>
<td>582%</td>
</tr>
<tr>
<td>Term (&gt; 36 Weeks)</td>
<td>38,765</td>
<td>$1,314</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Oregon’s preterm birth rate in 2018 was 7.6% compared to a 10.3% preterm birth rate in Tennessee (March of Dimes, 2019). Oregon’s preterm birth rate was the best in the United States in 2018 and was, therefore, the benchmark for Tennessee. To determine if a material investment
opportunity exists, the researcher utilized the existing data to create a theoretical situation in which Tennessee’s preterm birth rate matched that of Oregon. The researcher first calculated the number of preterm births that would have occurred if Tennessee experienced the same preterm birth rate as Oregon. The calculation allowed the researcher to determine how many fewer preterm births would have occurred if Tennessee’s preterm birth rate had been 7.6% rather than 10.3%. Table 18 summarizes this calculation. At a 7.6% preterm birth rate, there would have been 2,001 fewer preterm births in Tennessee.

Next, the researcher utilized the Tennessee Hospital Association mean preterm birth cost data to calculate the cost difference between the actual preterm birth rate and the potential (Oregon) preterm birth rate based on the total number of Tennessee births. Table 18 reveals that the difference in total preterm birth costs, had Tennessee achieved Oregon’s preterm birth rate, is $17.9 million. This amount represents a 23% decrease in total cost, which exceeds the 5% materiality rule of thumb.

Table 18

*Investment Potential Materiality*

<table>
<thead>
<tr>
<th></th>
<th>Total births</th>
<th>Preterm birth rate</th>
<th>Preterm births</th>
<th>Mean preterm birth cost</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tennessee actual</td>
<td>74,113</td>
<td>10.3%</td>
<td>7,634</td>
<td>$ 10,277</td>
<td>$ 78,450,908</td>
</tr>
<tr>
<td>Tennessee potential</td>
<td>74,113</td>
<td>7.6%</td>
<td>5,633</td>
<td>$ 10,277</td>
<td>$ 57,886,107</td>
</tr>
<tr>
<td>Gross savings</td>
<td></td>
<td></td>
<td>2,001</td>
<td></td>
<td>$ 20,564,801</td>
</tr>
<tr>
<td>Less cost of term birth</td>
<td></td>
<td></td>
<td></td>
<td>$ 2,629,314</td>
<td></td>
</tr>
<tr>
<td>Net cost difference</td>
<td></td>
<td></td>
<td></td>
<td>$ 17,935,487</td>
<td></td>
</tr>
<tr>
<td>% difference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23%</td>
</tr>
</tbody>
</table>

\(^1\text{Mean preterm birth cost} = $1,314\)
Given this result, the researcher rejected the null hypothesis that there was no material investment opportunity to increase prenatal care utilization in Tennessee during the study period as a mitigating tactic to reduce preterm birth costs. The 23% difference of $17.9 million points to investment potential to increase prenatal care utilization as a mitigating tactic to reduce preterm birth cost. The result, however, contains inconclusive findings. While the null hypothesis was rejected based on materiality, the Tennessee Hospital Association data did not prove a statistically significant difference in preterm birth costs. Even so, the research question that asked how increasing prenatal care utilization could have affected health care costs in Tennessee during the study period was answered: it could have reduced total health care costs in Tennessee by $17.9 million.

**Relationship of the Findings**

This section discusses the relationship of the findings. It includes a discussion on how the findings relate to the research questions and how they relate to each of the theoretical framework elements. The section also includes a discussion on similarities and differences with existing scholarly research. Lastly, the section concludes by relating the findings to the original problem.

**Relationship to the Research Questions**

Research Question 1 was as follows: How does preterm birth relate to prenatal care utilization? The findings identified a link between prenatal care utilization and preterm birth. Although 29.7% of babies born to mothers who did not utilize prenatal care were born preterm, only 10.6% of babies born preterm to mothers who utilized prenatal care. The analysis revealed that this difference is statistically significant. Prenatal care utilization indeed relates to preterm birth and thus the researcher considers the next research question.
Research Question 2 was as follows: How does prenatal care utilization in Tennessee compare to states with lower preterm birth rates? Utilizing March of Dimes (2019) data, the researcher selected Oregon as the benchmark for comparison to Tennessee. Oregon’s preterm birth rate of 7.8% compared favorably to Tennessee’s preterm birth rate of 11.1%. The statistical analysis revealed a significant difference in prenatal care utilization rates between Oregon and Tennessee. The first research question indicated that prenatal care utilization positively affects preterm birth rates. Research Question 2 advanced the discussion by determining that a state with higher prenatal care utilization enjoys a lower (better) preterm birth rate. This finding led the researcher to consider Research Question 3 because there exists an opportunity to reduce preterm birth incidence through increasing prenatal care utilization in Tennessee.

Research Question 3 was as follows: How could increasing prenatal care utilization have affected health care costs in Tennessee during the study period? The findings relating to this research question are complicated. This question rested on the foundation of the first two research questions. Given that there is a relationship between prenatal care utilization and preterm birth, and given that an opportunity exists to increase Tennessee’s prenatal care utilization as a tactic to reduce preterm births, Research Question 3 asks whether such a change would materially affect health care costs. As stated previously, this research question has mixed conclusions. The data did not reveal a statistically significant difference in birth costs between those infants born term and those born preterm during the study period. Based on this result, it is unclear whether increasing prenatal care utilization and decreasing preterm births in Tennessee would have affected health care costs. When considering financial materiality, however, there is a material difference in the total cost of preterm births when compared to term births. The hypothetical scenario where Tennessee achieves the same preterm birth rate as Oregon results in
a $17.9 million reduction in health care costs. Referring to the research question, the analysis indicates that increasing prenatal care utilization could have resulted in a $17.9 million reduction in health care costs. This finding falls short, however, of proving a statistically significant relationship between the mean cost of preterm birth and the mean cost of term birth.

**Relationship to the Theoretical Framework**

The conceptual framework, illustrated in Figure 1, summarized the constraints that limit prenatal care utilization. The constraints include accessibility, awareness, cultural norms, and education levels (Ayers et al., 2018; Cook et al., 1999; Melnikow et al., 1997). These constraints reduce prenatal care utilization and produce consequences including uncontrolled gestational diabetes, preeclampsia, maternal mortality, untreated maternal infections, and maternal dyslipidemia (Helmo et al., 2018; Izoton de Sadovsky et al., 2018; Ju et al., 2018; Martín et al., 2017; Smith et al., 2018; Sonchak, 2015; Wood et al., 2017). Preterm birth results from these consequences and produces both human and economic costs (Allen et al., 2018; Iskusnykh et al., 2018; Kelly, 2016; Leneuve-Dorilas et al., 2019; Osman et al., 2018). The economic costs create investment potential, assuming the investment could ultimately reduce preterm birth costs. An investment that would increase prenatal care utilization would also reduce preterm birth incidence. Reducing preterm births would reduce the associated human and economic costs (Mangham et al., 2009). The findings validate this theoretical framework. The Research Question 1 finding demonstrates that there is a relationship between prenatal care utilization and preterm birth. The Research Question 2 finding demonstrates that there is an opportunity to increase prenatal care utilization in Tennessee as a tactic to reduce preterm births. Finally, the Research Question 3 results indicate that there is a material investment opportunity to increase
prenatal care utilization as a tactic to reduce preterm birth rates and therefore reduce the human and economic costs of preterm birth.

**Relationship to the Literature**

There are areas where these findings are consistent with the existing scholarly literature, areas where the findings add to the scholarly literature, and areas of difference from the existing scholarly literature. The findings are consistent with a substantial amount of research about the relationship between prenatal care utilization and preterm birth. Scholarly research consistently demonstrates that prenatal care utilization reduces preterm birth (Newnham et al., 2014; Nianogo et al., 2019; Osman et al., 2018). This study’s findings also demonstrated this relationship between prenatal care utilization and preterm birth.

The findings add to the scholarly literature through a focus on Tennessee mothers. The existing literature is broader or focuses on other regional or demographic groups (Chen et al., 2005; Snowden et al., 2018; Sperling et al., 2018). This study focused on Tennessee births. The findings are consistent with the broader findings and support generalizing the concept.

The findings differ from the existing scholarly literature in calculating the economic effect of preterm birth. In previous studies, researchers used different cost calculation methods. As in this study, other researchers evaluated initial hospitalization costs (Mangham et al., 2009; Zainal et al., 2019). Jacob et al. (2017) evaluated 3-year health care costs, and Stevenson et al. (1998) considered longer term costs. Marinopoulou (2018) took a different path by including maternal costs. Mangham et al. (2009) estimated that the lifetime economic consequences for all the infants born preterm in a single year was $4.567 billion in 2006 U.S. dollars. The various methods researchers used to calculate costs led to widely varying estimates of the costs of preterm birth. This study utilized Tennessee Hospital Association’s initial hospitalization cost
data. The findings are consistent with those of other researchers who have identified significant preterm birth costs. This study’s findings likely understate the actual preterm birth costs by limiting the analysis to initial hospitalization.

**Relationship to the Problem**

The findings relate to both the general and the specific research problem. The general problem to be addressed is the failure of the U.S. health care system to invest sufficiently in primary care, which results in poor health outcomes relative to the cost of care. The findings relate to this problem by demonstrating that a lack of primary care, in the form of prenatal care, results in poor birth outcomes. The specific problem to be addressed is suboptimal prenatal care utilization in Tennessee, which results in costly, and preventable, preterm births. The findings relate to the specific problem by demonstrating that Tennessee’s prenatal care utilization is suboptimal, and this suboptimization results in costly and preventable preterm births. The findings reveal an investment opportunity to increase prenatal care utilization as a tactic to reduce costly and preventable preterm births in Tennessee.

**Summary of the Findings**

The findings demonstrate that a relationship exists between prenatal care utilization and preterm birth in Tennessee. The findings also demonstrate that Tennessee’s prenatal care utilization rate differs significantly from that in Oregon, which has a lower (better) preterm birth rate. This difference indicates that Tennessee could reduce its preterm birth rate by increasing prenatal care utilization. Initial hospitalization cost data identified a material, though not statistically significant, investment potential to increase prenatal care utilization as a tactic to reduce preterm birth incidence. The resulting savings in the hypothetical scenario where Tennessee achieved Oregon’s preterm birth rate is $17.9 million in initial hospital costs. This is a
material investment opportunity that, if invested to increase prenatal care utilization, could produce a substantial economic and human return.

**Application to Professional Practice**

Reducing preterm births through investing in prenatal care utilization offers a compelling case for businesses, insurance companies, and government entities because of its economic scale and short time horizon. Programs designed to reduce health care expenditures typically focus on chronic disease avoidance and management. These programs seek long-term cost reductions such as reducing the risk of heart attack and stroke. With long time horizons, it can be difficult for organizations to justify such investment outside of a moral obligation. An organization might invest in disease avoidance interventions for an employee, but that employee may not work with the company long enough to demonstrate those benefits. Prenatal care, however, generates a return on investment within 9 months. This short-term return is much easier to justify to business leaders who consider quarterly earnings, government leaders who focus on an election cycle timeline, and insurance company executives who calculate returns during defined contract periods.

The study findings apply to business performance and public policy decisions. They may be meaningful to business leaders, government officials, and health insurance company executives. The opportunity to reduce preterm birth rates through increased prenatal care utilization represents an investment that will benefit businesses and society. The benefits include reduced insurance costs, increased employee productivity, and lower government health care expenditures. The following section describes those benefits in detail.
Improving General Business Practice

Perhaps the most obvious business application is reducing employee costs. Many organizations that offer health insurance to their employees pay a portion of the premiums as a fringe benefit (Vistnes et al., 2015). This cost is included in total employment costs, along with wages, payroll taxes, and unemployment insurance. Several variables affect an organization’s health insurance premiums, including the number of participants, geographic region, insurance plan design, claims history, and actuarial risk profile. An organization that can mitigate insurance risk will decrease its premiums (Steck, 2018). Depending on the number of participants, these savings could be substantial.

The study findings inform business leaders that increasing prenatal care utilization and reducing preterm births will decrease total health care expenditures. This reduction could reduce health insurance premium expenses and therefore decrease employee costs. Organizations could reinvest the savings to advance their mission and strategy.

Reducing health care expenditures would have more immediate benefits to self-insured organizations. Self-insured companies tend to be larger organizations that can accept the risk of paying directly for the health care costs of their employees. These organizations typically contract with a health insurance company to design and administer the plan. For these organizations, health care expenditure reductions create direct and immediate benefits. Such savings accrue to the organization’s bottom line rather than that of the health insurance company.

The same principle applies to government insurance payers Medicare and Medicaid. Medicaid, which is state-operated public health insurance, is more relevant to discussions about prenatal care and preterm delivery because Medicaid plans are often the source of payment for such services. Low-income families rely on Medicaid to cover health care costs. Medicaid plans
receive funding through taxes at both the state and the federal level. The study findings indicated that reducing preterm births will reduce total health care expenditures. For Medicaid beneficiaries, reducing health care costs directly reduces government spending. This reduction benefits the public by reducing government income requirements and therefore reducing the possibility of deficit spending.

The costs described above can be both short term and long term. The short-term costs are more obvious and include the cost of initial hospitalization. The scholarly literature frequently points to initial hospitalization as the key driver for preterm birth total cost (Jacob et al., 2017; Zainal et al., 2019). As it relates to birth costs, this is a short-term financial issue affecting organizations in 9-month time horizons. The longer term consequences, however, depend on the child’s long-term health care needs. Extremely premature infants often require significant health care services, including outpatient clinic visits and home therapy well beyond their initial hospitalization (Jacob et al., 2017). These costs are outside of this study’s scope but are also relevant to business practice.

Reducing preterm births could also reduce lost employee productivity. Preterm births increase health care costs not only for the child but also for the mother (Merinopoulou et al., 2019). These costs include lost productivity, as parents must take time away from work to provide care for the preterm infant. This lost productivity can extend well beyond the child’s initial hospitalization (Mangham et al., 2009). The productivity consequences could affect both the mother and the father, including any extended family that might have to support the child’s care needs. If the child has significant morbidity related to prematurity, the parent may be unable to continue working given the child’s daily care needs. These consequences are harder to quantify but represent a real cost to any organization.
Potential Application Strategies

The scholarly literature describes various interventions shown to be effective at increasing prenatal care utilization and decreasing preterm birth costs. Some of the interventions are already in use in Tennessee. These interventions offer proven strategies worthy of investment to reduce preterm births.

Home-based prenatal care visits have proven to be effective at increasing prenatal care utilization (Holland et al., 2018; Meadows et al., 2019). These programs send health care professionals into the home and help eliminate some of the barriers described in this study’s theoretical framework, most notably, transportation issues. Not all home-based models are effective, according to Liu et al. (2019), but some models demonstrate significant benefits.

The group prenatal visit model is another application strategy. Carter et al. (2016) demonstrated its efficacy in reducing prenatal care utilization barriers such as cultural issues. Such models help mothers appreciate the need for and benefits of prenatal care. These programs also create a heightened level of accountability for expecting mothers to complete the series of prenatal care visits.

Other prenatal care models exist and demonstrate effectiveness at removing one or more barriers to prenatal care utilization. These programs include the Centering Pregnancy and the OB Nest model (Butler et al., 2019; Kolb et al., 2017). The Nurse–Family Partnership program also demonstrates benefits related to preterm birth, though it also focuses on factors other than prenatal care (Thorland & Currie, 2017). All the interventions listed above could reduce preterm birth costs if implemented effectively, and each represents a reasonable investment opportunity.

The interventions described in the previous paragraph relate to the prenatal care visit model utilized by obstetricians. The study’s problem statement referenced a lack of primary care
services. Medical providers other than obstetricians, however, can deliver these services. Family practice physicians and nurse practitioners also provide primary care services and can provide some level of prenatal care. The scholarly literature demonstrates that prenatal care can be effectively delivered in such settings (Jack et al., 2017; Oliveira et al., 2016). Such models are especially important application strategies in rural states such as Tennessee. As the study’s theoretical framework indicates, access can be a significant barrier to prenatal care utilization. Tennessee mothers living in rural areas may not have immediate access to obstetric services. It is more likely that these mothers will have access to family practice physicians or nurse practitioners. Investing in providing prenatal care services in these settings would increase access and reduce preterm births in underserved areas.

All the interventions discussed in this section have demonstrated efficacy in previous studies. Each intervention requires in-person participation by the mother, whether she is at home, in a group setting, or in a health care provider’s clinic. Even the OB Nest program, which includes some virtual monitoring, requires in-person participation (Meylor de Mooij et al., 2018). The coronavirus disease 2019 pandemic has challenged health care providers to reevaluate telehealth services. Recent studies continue to advance virtual health as a model for increasing prenatal care utilization (Peahl et al., 2020; Whittington et al., 2020). Even in these studies, virtual health augments rather than replaces in-person prenatal care. Such models are effective at reducing, though not eliminating, barriers identified in the study’s theoretical framework such as access and transportation. The current scholarly literature does not currently demonstrate the efficacy of solely virtual prenatal care. Since prenatal care requires some physical examination, it is unlikely that exclusively virtual prenatal care can be as effective as in-person prenatal care. Virtual care may be a worthy investment, however, if the alternative is no prenatal care.
The interventions described above can increase prenatal care utilization and therefore reduce preterm birth incidence. They are worthy investments to reduce preterm birth costs. Each is demonstrated effective in various populations and regions. Because of their broad application, it is reasonable to expect that they would be effective in Tennessee as well.

**Application to Professional Practice Summary**

Investing in prenatal care utilization demonstrates a material return on investment from preterm birth savings. Such an investment could benefit businesses, government payers, health insurance carriers, and the public at large through reducing health care expenditures and lost productivity. These savings are both short term and long term. Several strategies have been effective in increasing prenatal care utilization. Any of these strategies, and perhaps a combination of several, would be worthy investment vehicles in Tennessee to increase prenatal care utilization and reduce preterm birth costs.

**Recommendations for Further Study**

The study presented several opportunities for advancing knowledge on the research topic. The researcher did not explore some of these opportunities and therefore recommends them for future study. These opportunities include prenatal care utilization variance across other states, study group stratification, prenatal care quality, and additional cost exploration.

The March of Dimes Report Card (March of Dimes, 2019) highlights variation among states. This study evaluated prenatal care utilization and the preterm birth rate in Tennessee. The researcher chose Tennessee based on familiarity with the state and access to cost data. It is possible to conduct the same study for other states to determine if the relationship applies in those states. Such studies would also identify variation in potential cost savings and could reveal
more significant investment opportunities. This study revealed significant variation among states and therefore invites further study to analyze that variation.

The researcher compared Oregon to Tennessee because Oregon had the lowest preterm birth rate in the United States in 2018. Oregon had fewer births than Tennessee, however. A future researcher may consider comparing Tennessee’s prenatal care utilization and preterm birth rates to a state with a similar number of births. Arizona (80,723), Indiana (81,646), and Missouri (73,269) had a similar number of births in 2018 (CDC WONDER, 2021). Though these states had similar preterm birth rates to Tennessee, further study could reveal useful comparisons and opportunities to improve prenatal care utilization.

A future researcher may also consider comparing states with a similar performing health care infrastructure. Topics such as access to care, integrated health system prevalence, and health care performance metrics could add useful information to this field. Such studies could include qualitative aspects allowing researchers to explore themes and experiences to add to the richness of understanding.

The CDC WONDER database provides significant opportunities to study subgroups within the population. This study considered all women who gave birth to living infants in Tennessee in 2018 and reported on their prenatal care utilization. The data set allows further stratification. Appendix E contains the full database field list. These fields include multiple variables describing maternal history, paternal history, pregnancy characteristics, and birth characteristics. The scholarly literature includes studies on various subgroups, including lower socioeconomic groups, at-risk pregnancies, and different nationalities (Ayers et al., 2018; Baron et al., 2015; Boerleider et al., 2015). The CDC WONDER database allows stratification by these and other characteristics. Future researchers could explore this study’s topic in the context of any
of those strata. Perhaps high-risk pregnancies would receive greater benefit from prenatal care
than those with uncomplicated pregnancies. Perhaps the return on investment would be much
larger in those situations. Similar questions about other strata within the group could yield
similarly interesting study topics.

The scholarly literature references the ideal number of prenatal visits based on
information from the American College of Obstetricians and Gynecologists (Butler et al., 2019).
During the study, the researcher noted that the CDC WONDER database query model allowed
for reporting based on the number of prenatal visits. The researcher chose to evaluate two groups
of mothers, those who utilized prenatal care and those who did not, without regard to the number
of prenatal care visits. As a result, the group of mothers who utilized prenatal care includes those
who attended only one prenatal visit as well as those who attended the recommended number of
prenatal visits. This presents another opportunity for further study in which a researcher
distinguishes between those who attended the recommended number of visits from those who did
not. The effects noted in this study might vary based on the number of prenatal visits attended.

Similarly, a researcher might consider the month or trimester in which prenatal care
began. The CDC WONDER database allows the researcher to query based on either the trimester
in which prenatal care began or the month in which prenatal care began. Exploring this topic
could reveal whether early access to prenatal care has a greater effect on preterm birth than later
access.

Finally, the scholarly literature reveals several methods for evaluating preterm birth costs
(Frey & Klebanoff, 2016; Hall & Greenburg, 2016; Jacob et al., 2017). Some include only first-
year costs for the infant, while others attempt to calculate lifetime health care costs. Others
include factors such as future lost wages, maternal expenses, and other societal costs. This study
limited its scope to the infant’s initial hospitalization cost at the birthing hospital. This limitation resulted from limitations in the Tennessee Hospital Association cost data, and the constraint likely underestimated preterm birth costs in Tennessee. Other data sets, including Tennessee’s Medicaid data, which the researcher attempted to access, could provide more detail on total preterm birth costs. For example, infants with significant medical and surgical issues resulting from prematurity typically transfer from the birthing hospital to a children’s hospital or similar institution offering a higher level of specialized neonatal care. The study did not include costs associated with these transfers and subsequent hospital care. Such data would provide a more robust view of short-term preterm birth costs that investments to increase prenatal care utilization would mitigate.

Each of these topics offers opportunities for further study. Challenges for these studies might include smaller study groups, difficulty linking outcomes, and data access challenges. The resulting knowledge increase and potential for improving birth outcomes, however, may be worth accepting the challenges.

Reflections

This research project challenged me both personally and professionally. It eliminated certain preconceived ideas and expanded my perspective on the topic. The project helped me become a better researcher, led me to evaluate related situations more objectively, and motivated me to be a better advocate.

Personal and Professional Growth

The project challenged me to evaluate my prenatal care utilization assumptions. It was tempting to attribute low prenatal care utilization solely to maternal characteristics. I believed these characteristics likely included lack of motivation, lack of awareness, and possibly
inconvenience. The study revealed a variety of factors leading to low prenatal care utilization, many of which are outside the mother’s control. These factors included work constraints, cultural norms, and access barriers (Ayers et al., 2018; Cook et al., 1999; Fransen et al., 2012; Melnikow et al., 1997). Understanding these barriers gave me a better perspective for policy initiatives that would increase prenatal care utilization and therefore reduce preterm births.

The research project also expanded my professional perspective. I now understand better why the United States operates one of the costliest health care systems in the world and yet performs poorer than other countries on various health care metrics (Koller & Khullar, 2017). As the research problem statement asserted, the United States underinvests in primary care (Kluge et al., 2018). As a result, it performs poorly on primary-care-related metrics that are the basis for comparing national health care systems (Papanicolas et al., 2018). The U.S. health care system’s design effectively treats significant illness and injury as opposed to preventing illness and injury. This study helped me understand the magnitude of this issue. The results indicated material savings available in a single clinical situation: preterm birth. The magnitude of similar interventions across multiple clinical conditions could be substantial.

Lastly, the study challenged me professionally to be a better advocate. As the chief executive of a children’s hospital, I routinely encounter the human and economic consequences of preterm birth. This study revealed an opportunity to reduce those consequences. I will use the study results to advocate for increased prenatal care investment and am confident that such an investment will positively affect children and families throughout the region served by the hospital.
Biblical Perspective

The study applies to a Christian worldview in several ways. It applies to resource stewardship, respect for human life, reducing human suffering, and love for people. This section discusses each of these areas and includes relevant scripture references.

Followers of Christ strive to be good managers. The relevant biblical concept is stewardship. Jesus taught on this subject in his parable of the wise manager, recorded in Luke, Chapter 12. The story teaches followers of Christ that they must not only account for the use of God’s resources, but they must also work to maximize their benefit (Haymond, 2017). The study identified an opportunity to be better stewards of health care resources. It revealed that a small economic investment could yield better health outcomes. It also revealed that significant savings could result and that reinvesting these savings would produce meaningful returns. Followers of Christ are obligated to seek such opportunities.

Interventions to reduce preterm birth would demonstrate good stewardship, and such interventions would also reduce human suffering. The literature review conducted as part of this project revealed that reducing preterm births could save lives (Jha, 2019). Health care leaders who are followers of Christ will be motivated to reduce preterm births to reduce human suffering. Jesus taught about his followers’ obligation to help others in need. Luke, Chapter 10, provides an example of this teaching in the parable of the Good Samaritan, in which Jesus teaches the importance of caring for those in need regardless of their cultural or socioeconomic status. Jesus further challenged his followers to intervene on behalf of those in need when he addressed the religious leaders’ hypocrisy in Matthew, Chapter 23. In each case, Jesus makes it clear that his followers are obligated to do good for others whenever they can. The study revealed that investing in prenatal care utilization would diminish human suffering.
This study focuses on women and children and on ways to keep them healthy. This concept aligns with the biblical concept of treating children with compassion. Jesus demonstrates compassion for children in Matthew, Chapter 19, when his disciples scolded people who were bringing children to see him. Jesus’s disciples saw this as an annoyance and a distraction. Jesus, however, told the disciples to allow the children to come to him and he used their presence to discuss the need for openness and receptiveness. Other scriptural references point to the importance God places on children, such as Psalm 139:13, where the author credits God with forming him in his mother’s womb. The study aligns with Jesus’s expectation for his followers. His followers endeavor to demonstrate compassion for children and improve their health and well-being whenever possible.

Each issue described above relates to the most important commandment Jesus requires of his followers. Matthew, Chapter 23, records this commandment. In the New International Version translation, the commandment reads, “Love the Lord your God with all your heart and with all your soul and with all your mind. This is the first and greatest commandment. And the second is like it: ‘Love your neighbor as yourself.’” The interventions described in this study relate to demonstrating love. Knowing that increasing prenatal care utilization will reduce human suffering obligates followers of Christ to act. Followers of Christ should advocate for others on behalf of this issue because it will demonstrate love for others by decreasing human suffering.

Reflections Summary

This study challenged me personally, professionally, and spiritually. It caused me to reevaluate personal biases and consider my spiritual flaws that created those biases. The study helped me understand issues that create challenges in my profession and offered insight into how I could improve the situation. Finally, the study helped me connect with significant aspects of a
biblical worldview. It allowed me to see how I could be a better person, a better leader, and a better follower of Christ.

**Summary of Section 3**

Section 3 described the study’s results and discussed its implications. It outlined the various hypotheses and statistical tests performed to reach the conclusion. The section related the findings to the research questions, the theoretical framework, the current scholarly literature, the general problem, and the specific problem. Section 3 also described the implications for general business practice and potential application strategies. The researcher provided recommendations for further study and offered personal reflections. The section concluded with a reflection of the study within a Christian worldview and a biblical perspective.

**Study Conclusion**

The study concluded that a material investment opportunity exists for increasing prenatal care utilization as a tactic to decrease preterm birth costs in Tennessee. Reducing preterm birth rates reduces not only health care costs but also the associated human suffering. These concepts are important to individuals, policy makers, and business leaders. They are also consistent with Christian values and provide an opportunity to improve the human experience.
References


https://doi.org/10.1111/1471-0528.14273


https://doi.org/10.1001/jama.2017.15927


https://doi.org/10.1016/j.siny.2015.12.011


https://doi.org/10.1001/jama.2018.16475


https://doi.org/10.1016/S0140-6736(18)32859-9


https://doi.org/10.1056/NEJMp1709538


https://doi.org/10.1080/14767058.2017.1403578


https://doi.org/10.1111/ppe.12588


[https://doi.org/10.1371/journal.pone.0209579](https://doi.org/10.1371/journal.pone.0209579)


[https://doi.org/10.1016/S0002-9378(98)70037-7](https://doi.org/10.1016/S0002-9378(98)70037-7)


[https://doi.org/10.1016/j.jclinepi.2008.08.001](https://doi.org/10.1016/j.jclinepi.2008.08.001)

Van Duzer, J. (2010). *Why business matters to God (And what still needs to be fixed).*

InterVarsity Press.


https://doi.org/10.1016/j.pop.2019.07.003

https://doi.org/10.1016/j.ogc.2020.02.006


https://doi.org/10.1080/09513590.2020.1727432


https://doi.org/10.1371/journal.pone.0211997
Appendix A: Application to Conduct Research Involving TennCare Member Protected Health Information

APPLICATION TO CONDUCT RESEARCH INVOLVING TENNCARE MEMBER PROTECTED HEALTH INFORMATION

PROJECT SUMMARY

Date of Application: 03/08/2020
Proposed Start Date of Project: 05/01/2020
Target Completion Date of Project: 12/31/2020
Project title: Exploring the relationship between prenatal care utilization and the cost of preterm birth
Project Duration: 8 months
Brief Project Summary: The project is a doctoral dissertation exploring the economic relationship between prenatal care utilization and preterm birth

I. ORGANIZATION INFORMATION

A. Applicant Organization (Legal Name): Michael Wiggins, Doctoral Candidate, Liberty University

Project Director:
Street Address or P.O. Box: 50 N. Dunlap Street
City, State, Zip Code: Memphis, TN 38103
Telephone: 866705570/ Email: michael.s.wiggins@gmail.com

B. Other persons who should be contacted if more information is needed:

1. Name: N/A
Title: 
Address (if different from above): 
Telephone: Email: 

2. Name: 
Title: 
Address (if different from above): 
Telephone: Email: 

C. Name and address of sponsor(s) or funding organization(s) for this project:

Liberty University
1971 University Blvd
Lynchburg, VA 24515
D. OTHER ORGANIZATIONS PARTICIPATING IN THIS STUDY OR PROJECT. Name(s) of organization(s) and/or individual(s) who will obtain the protected health information (PHI) of any TennCare member and describe their roles in this study (include organization, address, and phone number):


A "Supplemental Assurances Form" must be completed by EACH organization (or individual) listed and must be signed by responsible officials of that organization. The completed forms must be submitted as an attachment(s) to this application form. (See Attachment A)

II. INSTITUTIONAL REVIEW BOARD

Has this research project been reviewed and approved by an Institutional Review Board? IRB approval is required if the study requires the receipt of TennCare member PHI.

If YES, provide the name of the board, date of approval and attach a copy to this application.

If NO, indicate reason:
Not seeking to use PHI

III. STUDY PROTOCOL OR PROJECT ACTIVITIES

You may attach a copy of your complete study protocol (or selected sections) to this application; however, the abstract that you provide in response to these questions should be self-contained so that it can serve as a complete and accurate description of the project separate from any appended document.

A. Describe the health or medical problem or question addressed by your study or activities.

Analyze TennCare reimbursement data for infants born < 37 weeks gestation age;
Will use aggregate descriptive data, not individual data;
min, max, average, median, standard deviation, and count (n)

B. List the primary study or project objectives, and include a description of the hypotheses to be tested.

The primary purpose is to consider the cost of preterm birth (< 37 weeks gestational age)
and evaluate the potential to invest in prenatal care utilization in order to reduce the incidence and cost of preterm birth
C. Summarize the project's data collection methods, indicating specific follow-up procedures, if they apply. We would like descriptive statistics for 1 year of reimbursement data to include:
count (n), min, max, average, median, and standard deviation of reimbursement for all TennCare infants born < 37 weeks gestational age

D. Summarize the project's analysis, indicating how the data will be used.
The data will be used to analyze resources available to redeploy to prenatal care utilization that could reduce the incidence and therefore cost of preterm birth

E. Describe any data files that will be linked with the data provided and specify the source of these data files.
None

F. In what form and to whom will the results of your study or activities be released?
Doctoral dissertation

IV. RECORDS AND/OR IDENTIFIABLE DATA REQUIRED

A. Identify the records you will require to address the needs of this project.
Descriptive statistics for reimbursement on infants born < 37 weeks gestational age

B. Please list the data variables that you need:
Descriptive statistics for reimbursement in dollars
Count (n), Min, Max, Average, Median, and Standard Deviation
C. List the data years you require for this project: e.g.; 2007 or 2002-2005, etc.;

2018

D. In what form and to whom will the results of your study or activities be released

Doctoral dissertation

E. How many future requests do you expect to make?

None

V. CONFIDENTIALITY AND SECURITY OF IDENTIFIABLE DATA

A. How will you maintain the confidentiality and security of identifiable data obtained from the TennCare records?

No PHI or individual patient records requested

B. Disposition of identifiable data: (NOTE: TennCare requires that paper records or electronic data files be destroyed at the end of the study, or as soon thereafter as possible. This includes all data files with or without personal identifiers.)

a. How long will you store copies of records or other identifiable data?  
   N/A

b. How will you dispose of copies of records or other identifiable data?  
   N/A

C. Approximate date of study completion: 12/31/2020

D. Will you require follow-up investigations based on information provided by TennCare records to obtain additional information from decedent’s next-of-kin, study subjects, physicians, hospitals, and/or other individuals or facilities mentioned in the records?

☐ YES  ✔ NO

If YES, briefly describe the following:

1. Types of follow-up respondents to be contacted. (If the answer to this question includes families, next-of-kin, or the study subject, please answer the following questions 2 and 3.)

2. Information to be obtained from respondents. (A copy of the survey form or questionnaire must also be attached and labeled appropriately).
3. Methods to be used in conducting such investigations. (A copy of consent form and initial contact letter to be mailed to follow-up individual must also be attached and labeled appropriately.)

E. Will any of the identifiable data obtained from the records and/or follow-up investigations be used as a basis for legal, administrative, or other actions which may directly affect particular individuals as a result of their specific identification in this project?

☐ YES  ☑ NO

If YES, please explain.

F. Will the identifiable data obtained from the records or follow-up investigations be used either directly or indirectly for any project or purpose other than the one described in Part III?

☐ YES  ☑ NO

If YES, briefly describe the other research project(s) or purpose(s) for which the data will be used. A separate application form must be submitted for each project which will be using protected data obtained from TennCare records.

VI. APPLICANT ASSURANCES

The undersigned hereby agrees to the following terms and conditions related to this application and to the use of information obtained from TennCare.

The identifiable data obtained following written approval from TennCare shall be used only for the proposed study and the purposes described in the “Summary of Study Protocol or Project Activities” (Part III).

Use of the information for a project or purpose other than that described in Parts III and IV shall not be undertaken unless a separate application form for the subsequent project has been submitted to and approved by TennCare.

No individually identifiable data shall be released without prior written approval by TennCare.

Paper records and electronic data files containing TennCare member data shall be destroyed upon completion of the study or as soon as possible thereafter.

If data extracted from TennCare records are used in any publication, the following statement must be included in such publication or any other release of the data:

These data were supplied by the State of Tennessee, Department of Finance and Administration, Division of TennCare, Nashville, TN. TennCare specifically disclaims responsibility for any analyses, interpretations or conclusions.
A copy of any published materials or study results shall be made available to TennCare upon request.

I have thoroughly reviewed the contents of the TennCare policy on Use of Enrollee Records in Research, available on the TennCare website, and I shall adhere to the applicable guidelines set forth therein. All statements entered in this application are true, complete, and correct to the best of my knowledge and belief.

Michael Wiggins  
Project Director's Name (Print)

Doctoral Candidate

Project Director's Title

Liberty University

Organization

Signature  Date
ATTACHMENT A
TENNCARE APPLICATION FOR RESEARCH DATA
SUPPLEMENTAL ASSURANCES FORM

Each additional organization listed on the Research application form as participating in this study must complete and sign this separate Supplemental Assurances Form. The Research applicant must submit the Supplemental Assurances Form(s) as an attachment to the Research applicant’s application form.

Name: __________________________________________

Title: __________________________________________

Organization: __________________________________

Street Address or P.O. Box: _______________________

City, State, Zip Code: ____________________________

Telephone: ____________________ Email: ____________

A. How will you maintain the confidentiality and security of identifiable data obtained from TennCare records?

________________________________________________________________________________________

B. Disposition of identifiable data:

1. How long will you store copies of records or other identifiable data?

________________________________________________________________________________________

2. How will you dispose of copies of records or other identifiable data?

________________________________________________________________________________________

C. Approximate date of study completion: ________

D. Will you require follow-up investigations to obtain additional information from decedent’s next- of-kin, study subjects, physicians, hospitals, and/or other individuals or facilities mentioned on the records?

☐ YES   ☐ NO

If YES, briefly describe the following:

1. Types of follow-up respondents to be contacted. (If the answer to this question includes families, next-of-kin, or the study subject, please answer the following questions 2 and 3.)

________________________________________________________________________________________

________________________________________________________________________________________

2. Information to be obtained from respondents. (A copy of the survey form or questionnaire must also be attached and labeled appropriately.)

________________________________________________________________________________________

________________________________________________________________________________________

TennCare Research Data Application
Rev: 05/2018

Page 7 of 9
3. Methods to be used in conducting such investigations. (A copy of consent form and initial contact letter to be mailed to follow-up individual must also be attached and labeled appropriately.)

E. Will any of the identifiable data obtained from the records and/or follow-up investigations be used as a basis for legal, administrative, or other actions which may directly affect particular individuals as a result of their specific identification in this project?

[ ] YES   [ ] NO

If YES, please explain.

F. Will the identifiable data obtained from the records or follow-up investigations be used either directly or indirectly for any project or purpose other than the one described in Part III of the Application for Access to Protected Data?

[ ] YES   [ ] NO

If YES, briefly describe the other research project(s) or purpose(s) for which the data will be used. A separate application form must be submitted for each project which will be using protected data obtained from TennCare.

APPLICANT ASSURANCES

The undersigned hereby agrees to the following terms and conditions related to this application and to the use of information obtained from TennCare.

The identifiable data obtained following written approval from TennCare shall be used only for the proposed study and the purposes described in the “Summary of Study Protocol or Project Activities” (Part III).

Use of the information for a project or purpose other than that described in Parts III and IV shall not be undertaken unless a separate application form for the subsequent project has been submitted to and approved by TennCare.

No individually identifiable data shall be released without prior written approval by TennCare.

Paper records and electronic data files containing TennCare member data shall be destroyed upon completion of the study or as soon as possible thereafter.

If data extracted from TennCare records are used in any publication, the following statement must be included in such publication or any other release of the data:

These data were supplied by the State of Tennessee, Department of Finance and Administration, Division of TennCare, Nashville, TN. TennCare specifically disclaims responsibility for any analyses, interpretations or conclusions.
A copy of any published materials or study results shall be made available to the Tennessee TennCare upon request.

All the statements entered in this application are true, complete, and correct to the best of my knowledge and belief.

Project Director's Name (Print)

Project Director's Title

Organization

Signature __________________________ Date __________________________
Appendix B: Tennessee Hospital Association Data Request

From: Pat Turri  
Sent: Monday, October 5, 2020 12:48 PM  
To: Michael Wiggins  
Subject: RE: [EXTERNAL] Re: Data Request

Michael,

Here are the stats for 2018 Moms’ and Babies’ claims that reside in Tennessee. The status shows if the mothers and babies were matched and where they do match, the statistics you requested.

<table>
<thead>
<tr>
<th>Status</th>
<th>Mom Total Claims</th>
<th>Baby Total Claims</th>
<th>Est Cost</th>
<th>Median Cost</th>
<th>Mean Cost</th>
<th>Max Cost</th>
<th>Min Cost</th>
<th>Std Dev Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Match</td>
<td>31,718</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;37 Weeks</td>
<td>3,856</td>
<td>3,856</td>
<td>$39,626,482</td>
<td>$1,561</td>
<td>$10,277</td>
<td>$581,040</td>
<td>$0</td>
<td>$31,024</td>
</tr>
<tr>
<td>&gt;36 Weeks</td>
<td>38,765</td>
<td>38,765</td>
<td>$50,950,714</td>
<td>$803</td>
<td>$1,314</td>
<td>$510,413</td>
<td>($1,649)</td>
<td>$5,794</td>
</tr>
</tbody>
</table>

My matching was based on the moms and babies that had the same physical address and the babies birth date was between the mom’s admit date and her discharge date and both were in the same hospital.

I realize this is not complete but maybe it will help with your project. Let me know if you have any other questions or need clarification.

Patrick Turri  
AVP Data Analysis  
THA IS/IT
Appendix C: March of Dimes 2018 State Report Card and Technical Notes

Removed to comply with copyright. Available for download at

**Appendix D: 2003 U.S. Standard Certificate of Live Birth**

### U.S. STANDARD CERTIFICATE OF LIVE BIRTH

#### CHILD

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Child's Name (First, Middle, Last, Suffix)</td>
</tr>
<tr>
<td>2.</td>
<td>Date of Birth (MM/DD/YYYY)</td>
</tr>
<tr>
<td>3.</td>
<td>Sex</td>
</tr>
<tr>
<td>4.</td>
<td>County of Birth</td>
</tr>
</tbody>
</table>

#### MOTHER

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5a.</td>
<td>Mother's Current Legal Name (First, Middle, Last, Suffix)</td>
</tr>
<tr>
<td>5b.</td>
<td>Mother's Name Prior to First Marriage (First, Middle, Last, Suffix)</td>
</tr>
<tr>
<td>6.</td>
<td>Residence of Mother-State</td>
</tr>
<tr>
<td>7.</td>
<td>County</td>
</tr>
<tr>
<td>8a.</td>
<td>Street and Number</td>
</tr>
<tr>
<td>8b.</td>
<td>APT No.</td>
</tr>
<tr>
<td>8c.</td>
<td>Zip Code</td>
</tr>
</tbody>
</table>

#### FATHER

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9a.</td>
<td>Father's Current Legal Name (First, Middle, Last, Suffix)</td>
</tr>
<tr>
<td>9b.</td>
<td>Birthplace (State, Territory, or Foreign Country)</td>
</tr>
</tbody>
</table>

#### CERTIFIER

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12a.</td>
<td>Date Certified</td>
</tr>
<tr>
<td>13a.</td>
<td>Date Filed By Registrar</td>
</tr>
</tbody>
</table>

### INFORMATION FOR ADMINISTRATIVE USE

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.</td>
<td>Mother's Mailing Address</td>
</tr>
<tr>
<td>15.</td>
<td>City, Town, or Location</td>
</tr>
<tr>
<td>16.</td>
<td>Mother's Social Security Number</td>
</tr>
</tbody>
</table>

#### MOTHER

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.</td>
<td>Mother's Education</td>
</tr>
</tbody>
</table>

#### FATHER

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.</td>
<td>Father's Education</td>
</tr>
</tbody>
</table>

### MOTHER OF HISPANIC ORIGIN

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.</td>
<td>Mother of Hispanic Origin</td>
</tr>
</tbody>
</table>

### FATHER OF HISPANIC ORIGIN

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.</td>
<td>Father of Hispanic Origin</td>
</tr>
</tbody>
</table>

### FATHER'S RACE

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.</td>
<td>Father's Race</td>
</tr>
</tbody>
</table>

### PLACE WHERE BIRTH OCCURRED

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>26a.</td>
<td>Hospital</td>
</tr>
<tr>
<td>26b.</td>
<td>OutofState Birth Planned to Deliver at Home?</td>
</tr>
</tbody>
</table>

### ATTENDANT'S NAME, TITLE, AND NPI

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>27a.</td>
<td>Attendant's Name</td>
</tr>
<tr>
<td>27b.</td>
<td>Title</td>
</tr>
<tr>
<td>27c.</td>
<td>NPI</td>
</tr>
</tbody>
</table>

### BIRTH RECORDS TRANSFERRED FOR MEDICAL OR FETAL INDICATIONS FOR DELIVERY

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28a.</td>
<td>Name of Facility Moved From</td>
</tr>
<tr>
<td>28b.</td>
<td>Date Moved From</td>
</tr>
</tbody>
</table>

**Rev. 11/2006**
### MOTHER

- **DATE OF FIRST PREGNATAL CARE VISIT**
  - MM DD YYYY

- **DATE OF LAST PREGNATAL CARE VISIT**
  - MM DD YYYY

- **TOTAL NUMBER OF PREGNATAL VISITS FOR THIS PREGNANCY**
  - (If none, enter NA)

### MEDICAL AND HEALTH INFORMATION

#### 31. MOTHER'S HEART (Specify)
- Previous
- Present

#### 32. SMOKING FOR POSTPARTUM PERIOD
- None
- Yes

#### 33. CIGARETTE SMOKING DURING PREGNANCY
- Regularly used
- None

#### 34. MOTHER'S MEDICAL HISTORY
- Heart disease
- Hypertension
- Diabetes
- Rheumatic fever
- Other

#### 35. PREGNANCY OUTCOMES
- Live births
- Stillbirths
- Abortions
- Miscarriages

#### 36. MOTHER'S MEDICAL RECORD NUMBER

### NEWBORN

#### 44. NEWBORN MEDICAL RECORD NUMBER
- (Check all that apply)

#### 45. OBSTETRIC PROCEDURES (Check all that apply)
- Cervical cerclage
- Tocolysis
- External cephalic version
- Vaginal delivery

#### 46. METHOD OF DELIVERY
- Vaginal delivery
- Caesarean section

#### 47. INFERIORITY OF NEWBORN
- (Check all that apply)

#### 48. ABNORMAL CONDITIONS OF THE NEWBORN
- Anomalies
- Congenital malformations
- Birth injuries
- Jaundice
- Respiratory distress

#### 49. CONGENITAL MALFORMATIONS OF THE NEWBORN
- (Check all that apply)

### INFANT INFORMATION

#### 51. CONGENITAL DEFORMITIES
- (Specify)

#### 52. CEGHOF TRANSFERRED WITHIN 24 HOURS OF DELIVERY
- Yes
- No

- Yes
- No

### MOTHER'S MEDICAL RECORD NUMBER
- (Check all that apply)

### INFANT'S MEDICAL RECORD NUMBER
- (Check all that apply)

### INFANT'S NAME"
## Appendix E: CDC WONDER Natality Data Set Coding Chart

Centers for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research

### CDC WONDER

http://wonder.cdc.gov

### Data Fields and Variables

<table>
<thead>
<tr>
<th>Sect.</th>
<th>Section Description</th>
<th>Item / Variable</th>
<th>Selected Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Table Layout</td>
<td>Results Grouping</td>
<td>By Census Region of Residence</td>
</tr>
<tr>
<td>2</td>
<td>Maternal Residence</td>
<td>State</td>
<td>Tennessee</td>
</tr>
<tr>
<td>2.a.</td>
<td>Urbanization</td>
<td>2013 Metro/Nonmetro</td>
<td>All Categories</td>
</tr>
<tr>
<td>2.a.</td>
<td>Classification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>Mother's Single Race 6</td>
<td>All Races</td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>Mother's Hispanic Origin</td>
<td>All Origins</td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>Age of Mother 9</td>
<td>All Ages</td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>Mother's Education</td>
<td>All Levels</td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>Marital Status</td>
<td>All Values</td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>Paternity Acknowledgement</td>
<td>All Values</td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>(if mother unmarried)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>Mother's Nativity</td>
<td>All Values</td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>Mother's Birth Country</td>
<td>All Countries</td>
</tr>
<tr>
<td>3</td>
<td>Maternal Characteristics</td>
<td>Mother's Birth State</td>
<td>The United States</td>
</tr>
<tr>
<td></td>
<td>Paternal Characteristics</td>
<td>Father's Single Race 6</td>
<td>All Races</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------</td>
<td>------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>4</td>
<td>Paternal Characteristics</td>
<td>Father's Hispanic Origin</td>
<td>All Origins</td>
</tr>
<tr>
<td>4</td>
<td>Paternal Characteristics</td>
<td>Age of Father</td>
<td>All Ages</td>
</tr>
<tr>
<td>4</td>
<td>Paternal Characteristics</td>
<td>Father's Education</td>
<td>All Levels</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Interval Since Last Live Birth</td>
<td>All Intervals</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Interval Since Last Other Pregnancy Outcome</td>
<td>All Intervals</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Interval of Last Pregnancy</td>
<td>All Intervals</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Prior Births Now Living</td>
<td>All Values</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Prior Births Now Dead</td>
<td>All Values</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Prior Other Pregnancy Outcomes</td>
<td>All Values</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Live Birth Order</td>
<td>All Orders</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------</td>
<td>-----------------</td>
<td>-----------</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Total Birth Order</td>
<td>All Orders</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>WIC</td>
<td>All Values</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Successful External Cephalic Version</td>
<td>All Values</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Failed External Cephalic Version</td>
<td>All Values</td>
</tr>
<tr>
<td>5</td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Number of Prenatal Visits Recode¹</td>
<td>1 to 2 visits, 3 to 4 visits, 5 to 6 visits, 7 to 8 visits, 9 to 10 visits, 11 to 12 visits, 13 to 14 visits, 15 to 16 visits, 17 to 18 visits, 19 or more visits</td>
</tr>
<tr>
<td></td>
<td>Select Pregnancy History and Prenatal Care Characteristics</td>
<td>Trimester Prenatal Care Began</td>
<td>All Months</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------</td>
<td>--------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select Maternal Risk Factors</td>
<td>Mother's Height in Inches</td>
<td>All Heights</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Mother's Pre-pregnancy BMI</td>
<td>All Values</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Mother's Weight Gain</td>
<td>All Weights</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Mother's Pre-pregnancy Weight</td>
<td>All Weights</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Mother's Delivery Weight</td>
<td>All Weights</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Tobacco Use</td>
<td>All Values</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Number of Cigarettes Before Pregnancy Recode²</td>
<td>All Values</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Number of Cigarettes 1st Trimester Recode³</td>
<td>All Values</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Number of Cigarettes 2nd Trimester Recode⁴</td>
<td>All Values</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Number of Cigarettes 3rd Trimester Recode⁵</td>
<td>All Values</td>
</tr>
<tr>
<td>#</td>
<td>Select Pregnancy Risk Factors</td>
<td>Pre-pregnancy Diabetes</td>
<td>All Values</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------</td>
<td>------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Gestational Diabetes</td>
<td>All Values</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Pre-pregnancy Hypertension</td>
<td>All Values</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Gestational Hypertension</td>
<td>All Values</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Eclampsia</td>
<td>All Values</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Previous Preterm Birth</td>
<td>All Values</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Infertility Treatment Used</td>
<td>All Values</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Fertility Enhancing Drugs</td>
<td>All Values</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Assistive Reproductive Technology</td>
<td>All Values</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Previous Cesarean Delivery</td>
<td>All Values</td>
</tr>
<tr>
<td>7</td>
<td>Select Pregnancy Risk Factors</td>
<td>Number of Previous Cesareans</td>
<td>All Values</td>
</tr>
<tr>
<td></td>
<td>Select Pregnancy Risk Factors</td>
<td>Risk Factors Checked</td>
<td>All Values</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------</td>
<td>----------------------</td>
<td>------------</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Select Maternal Infections Present and/or Treated During Pregnancy</td>
<td>Gonorrhea</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Select Maternal Infections Present and/or Treated During Pregnancy</td>
<td>Syphilis</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Select Maternal Infections Present and/or Treated During Pregnancy</td>
<td>Chlamydia</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Select Maternal Infections Present and/or Treated During Pregnancy</td>
<td>Hepatitis B</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Select Maternal Infections Present and/or Treated During Pregnancy</td>
<td>Hepatitis C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select Maternal Infections Present and/or Treated During Pregnancy</td>
<td>Infections Checked</td>
<td>All Values</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------</td>
<td>--------------------</td>
<td>------------</td>
</tr>
<tr>
<td>8</td>
<td>Select Labor Characteristics</td>
<td>Induction of Labor</td>
<td>All Values</td>
</tr>
<tr>
<td>9</td>
<td>Select Labor Characteristics</td>
<td>Augmentation of Labor</td>
<td>All Values</td>
</tr>
<tr>
<td>9</td>
<td>Select Labor Characteristics</td>
<td>Steroids</td>
<td>All Values</td>
</tr>
<tr>
<td>9</td>
<td>Select Labor Characteristics</td>
<td>Antibiotics for Mother</td>
<td>All Values</td>
</tr>
<tr>
<td>9</td>
<td>Select Labor Characteristics</td>
<td>Chorioamnionitis</td>
<td>All Values</td>
</tr>
<tr>
<td>9</td>
<td>Select Labor Characteristics</td>
<td>Anesthesia</td>
<td>All Values</td>
</tr>
<tr>
<td>9</td>
<td>Select Labor Characteristics</td>
<td>Characteristics of Labor Checked</td>
<td>All Values</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Year</td>
<td>2018</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Month</td>
<td>All Months</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Weekday</td>
<td>All Days</td>
</tr>
<tr>
<td>----</td>
<td>---------------------------------</td>
<td>---------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Time of Day</td>
<td>All Times</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Birthplace</td>
<td>All Locations</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Medical Attendant</td>
<td>All Attendants</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Mother Transferred</td>
<td>All Values</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Fetal Presentation</td>
<td>All Values</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Final Route and Delivery Method</td>
<td>All Values</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Delivery Method Expanded</td>
<td>All Methods</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Trial of Labor Attempted (if Cesarean)</td>
<td>All Values</td>
</tr>
<tr>
<td>10</td>
<td>Select Delivery Characteristics</td>
<td>Source of Payment for Delivery</td>
<td>All Sources</td>
</tr>
<tr>
<td>11</td>
<td>Select Maternal Morbidity</td>
<td>Maternal Transfusion</td>
<td>All Values</td>
</tr>
<tr>
<td></td>
<td>Select Maternal Morbidity</td>
<td>Perineal Laceration</td>
<td>All Values</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>Select Maternal Morbidity</td>
<td>Ruptured Uterus</td>
<td>All Values</td>
</tr>
<tr>
<td></td>
<td>Select Maternal Morbidity</td>
<td>Unplanned Hysterectomy</td>
<td>All Values</td>
</tr>
<tr>
<td></td>
<td>Select Maternal Morbidity</td>
<td>Admission to Intensive Care Unit</td>
<td>All Values</td>
</tr>
<tr>
<td></td>
<td>Select Maternal Morbidity</td>
<td>Maternal Morbidity Checked</td>
<td>All Values</td>
</tr>
<tr>
<td></td>
<td>Select Infant Characteristics</td>
<td>OE Gestational Age Recode 11</td>
<td>Under 20 weeks, 20-27 weeks, 20-27 weeks, 28-31 weeks, 32-33 weeks, 34-36 weeks</td>
</tr>
<tr>
<td></td>
<td>Select Infant Characteristics</td>
<td>LMP Gestational Recode 11</td>
<td>Under 20 weeks, 20-27 weeks, 20-27 weeks, 28-31 weeks, 32-33 weeks, 34-36 weeks</td>
</tr>
<tr>
<td></td>
<td>Select Infant Characteristics</td>
<td>Sex of Infant</td>
<td>All Genders</td>
</tr>
<tr>
<td></td>
<td>Select Infant Characteristics</td>
<td>Plurality</td>
<td>All Pluralities</td>
</tr>
<tr>
<td>12</td>
<td>Select Infant Characteristics</td>
<td>Set Order</td>
<td>All Orders</td>
</tr>
<tr>
<td>12</td>
<td>Select Infant Characteristics</td>
<td>Infant Birth Weight 12</td>
<td>All Weights</td>
</tr>
<tr>
<td>12</td>
<td>Select Infant Characteristics</td>
<td>Five Minute APGAR Score</td>
<td>All Scores</td>
</tr>
<tr>
<td>12</td>
<td>Select Infant Characteristics</td>
<td>Ten Minute APGAR Score</td>
<td>All Scores</td>
</tr>
<tr>
<td>12</td>
<td>Select Infant Characteristics</td>
<td>Infant Transferred</td>
<td>All Values</td>
</tr>
<tr>
<td>12</td>
<td>Select Infant Characteristics</td>
<td>Infant Living at Time of Report</td>
<td>All Values</td>
</tr>
<tr>
<td>12</td>
<td>Select Infant Characteristics</td>
<td>Infant Breastfed at Discharge</td>
<td>All Values</td>
</tr>
<tr>
<td>13</td>
<td>Select Abnormal Conditions of Newborn</td>
<td>Assisted Ventilation</td>
<td>All Values</td>
</tr>
<tr>
<td>13</td>
<td>Select Abnormal Conditions of Newborn</td>
<td>Assisted Ventilation &gt; 6 Hrs</td>
<td>All Values</td>
</tr>
<tr>
<td>13</td>
<td>Select Abnormal Conditions of Newborn</td>
<td>NICU Admission</td>
<td>All Values</td>
</tr>
<tr>
<td>13</td>
<td>Select Abnormal Conditions of Newborn</td>
<td>Surfactant Replacement Therapy</td>
<td>All Values</td>
</tr>
<tr>
<td>13</td>
<td>Select Abnormal Conditions of Newborn</td>
<td>Antibiotics for Suspected Neonatal Sepsis</td>
<td>All Values</td>
</tr>
<tr>
<td>13</td>
<td>Select Abnormal Conditions of Newborn</td>
<td>Seizures</td>
<td>All Values</td>
</tr>
<tr>
<td>13</td>
<td>Select Abnormal Conditions of Newborn</td>
<td>Abnormal Conditions Checked</td>
<td>All Values</td>
</tr>
<tr>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Anencephaly</td>
<td>All Values</td>
</tr>
<tr>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Meningomyelocele / Spina Bifida</td>
<td>All Values</td>
</tr>
<tr>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Cyanotic Congenital Heart Disease</td>
<td>All Values</td>
</tr>
<tr>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Congenital Diaphragmatic Hernia</td>
<td>All Values</td>
</tr>
<tr>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Omphalocele</td>
<td>All Values</td>
</tr>
<tr>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Gastrochisis</td>
<td>All Values</td>
</tr>
<tr>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Limb Reduction Defect</td>
<td>All Values</td>
</tr>
<tr>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Cleft Lip With or Without Cleft Palate</td>
<td>All Values</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Cleft Palate Alone</td>
</tr>
<tr>
<td>---</td>
<td>----</td>
<td>---------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Down Syndrome</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Suspected Chromosomal Disorder</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Hypospadias</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Select Congenital Anomalies of Newborn</td>
<td>Congenital Anomalies Checked</td>
</tr>
<tr>
<td>15</td>
<td>Other Options</td>
<td>Show Totals</td>
<td>Selected</td>
</tr>
<tr>
<td>15</td>
<td>Other Options</td>
<td>Precision / Decimal Places</td>
<td>2</td>
</tr>
</tbody>
</table>
Appendix F: Institutional Review Board Approval

November 10, 2020

Michael Wiggins
Terrance Duncan

Re: IRB Application - IRB-FY20-21-320 Analyzing the Investment Potential to Increase Prenatal Care Utilization as a Tactic to Decrease Preterm Birth Costs in Tennessee

Dear Michael Wiggins and Terrance Duncan,

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Decision: No Human Subjects Research

Explanation: Your study is not considered human subjects research for the following reason:

(1) it will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued non-human subjects research status. You may report these changes by completing a modification submission through your Cayuse IRB account.

Also, although you are welcome to use our recruitment and consent templates, you are not required to do so. If you choose to use our documents, please replace the word research with the word project throughout both documents.

If you have any questions about this determination or need assistance in determining whether possible modifications to your protocol would change your application’s status, please email us at irb@liberty.edu.

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office

https://outlook.office.com/mail/inbox?id=AAQkAgM4MDA2NmY4LTZhZDgnNDowNS1fY2ExLTNhNjE5Y2E4ZmRiNQAGAPk6LEz19MrXH6S0VHd%3D