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Andrea E Strahan Date

Three Essays on Policies Affecting Women's and Infants' Health in the U.S.

By

Andrea E. Strahan
Doctor of Philosophy

Health Services Research and Health Policy

E. Kathleen Adams, Ph.D.
Advisor

Sarah Blake, Ph.D.
Committee Member

Sara Markowitz, Ph.D.
Committee Member

Accepted:

Lisa A. Tedesco, Ph.D.
Dean of the James T. Laney School of Graduate Studies

Date

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Andrea E. Strahan
M.P.P., University of Chicago, 2011

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An abstract of
A dissertation submitted to the Faculty of the
James T. Laney School of Graduate Studies of Emory University
in partial fulfillment of the requirements for the degree of
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Abstract

Three Essays on Policies Affecting Women's and Infants' Health in the U.S.

By Andrea E. Strahan

Under federalism in the U.S., state and federal governments share power. States can customize health policies within federal standards, acting as laboratories for health policy innovation in pursuit of improved access, utilization, and outcomes. This dissertation focuses on three policies that exist at the intersection of state and national policy to examine how they impact women's and infants' health.

In Chapter One, I investigate if the Affordable Care Act (ACA) dependent coverage provision has affected unintended pregnancy and related prenatal behaviors among young adult mothers. This policy began at the state level and was implemented nationally with the 2010 health reform law. I find the ACA provision is associated with important gains in preconception private insurance for young adult women and declines in smoking during pregnancy, but not with changes to unintended pregnancy.

In Chapter Two, I examine whether variation over time in state scope of practice laws for Certified Nurse-Midwives has affected infant mortality from 1994-2014. Results show that changes in these laws do not impact infant deaths, indicating that allowing Certified Nurse-Midwives to practice without regulatory barriers does not pose a threat to public health in terms of infant mortality. This finding has important implications for access to healthcare in states facing provider shortages.

In Chapter Three, I test the effects of state Medicaid policies on early-term elective deliveries (EEDs) and infant health outcomes. Such Medicaid policies vary widely by state and have gained popularity in recent years due to growing awareness of the increased risks to infants born between 37 and <39 weeks gestation. I find that state policies denying reimbursement for non-medically indicated early-term inductions and cesarean sections are associated with a reduction in EEDs, but also an increase in full-term elective cesarean sections and no changes in infant health.

Together, this research provides new estimates of policies affecting women's and infants' health in the U.S. These findings can inform future policy innovation at the state and national level concerning extensions of dependent coverage, potential solutions to physician shortages, and Medicaid reimbursement policies around childbirth.

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Chapter 1

Association of the Affordable Care Act Dependent Coverage Provision with Unintended Pregnancy and Prenatal Behaviors

Introduction

Approximately half of all U.S. pregnancies are unintended (Finer & Zolna, 2016). Unintended pregnancy is defined as either an unwanted pregnancy (no children, or no more children are desired) or a mistimed pregnancy, occurring earlier than planned (Santelli et al., 2003). Unintended pregnancies are twice as likely to be publicly financed at an approximate $11 billion annual cost to taxpayers, largely through costs for prenatal, labor and delivery, and infant care through the Medicaid program (Sonfield, Kost, Gold, & Finer, 2011). With the exception of teens, young adult women are at higher risk of having an unintended pregnancy than other age groups. In 2011, 59% of pregnancies were unintended among 20-24 year-olds, compared to 42% for ages 25-29 and 31% for ages 30-34 (Finer & Zolna, 2016).

Births resulting from unintended pregnancies are associated with increased risk of negative outcomes, such as low birth weight and preterm birth (Mohllajee, Curtis, Morrow, & Marchbanks, 2007; P. S. Shah et al., 2011). Although the causes of adverse pregnancy outcomes often remain unknown, modifiable risk factors have been identified and maternal intention is a determinant of many pregnancy-related behaviors. Studies have shown that unintended pregnancy is associated with delayed prenatal care (Cheng, Schwarz, Douglas, & Horon, 2009; Joyce, Kaestner, & Korenman, 2000; Korenman, Kaestner, & Joyce, 2002). Pregnant women are encouraged to schedule their initial prenatal visit during the first trimester (Kirkham, Harris, & Grzybowski, 2005), as receiving adequate and timely care during pregnancy has been associated with a reduced risk of low birth weight, stillbirth, and neonatal death (Fiscella, 1995; Loftus, Stewart, Hensley, Enquobahrie, & Hawes, 2015; Moos, 2006; Partridge, Balayla, Holcroft, & Abenhaim, 2012). Pregnancy intention is associated with maternal smoking (Cheng et al., 2009; D'Angelo, Gilbert, Rochat, Santelli, & Herold, 2004; Dott, Rasmussen, Hogue, Reefhuis, & Study, 2010; Joyce et al., 2000), which is associated with increased risk of miscarriage (Armstrong, McDonald, & Sloan, 1992), ectopic pregnancy (Coste, Job-Spira, & Fenandez, 1991), placenta previa and abruption (Handler, Mason, Rosenberg, & Davis, 1994), intrauterine growth restriction (Nordentoft et al., 1996), preterm delivery (N. R. Shah & Bracken, 2000), and low birthweight (US Department of Health and Human Services, 2006). Women with unintended pregnancies are also less likely to take folic acid prior to and after conception (Dott et al., 2010), a recommended supplement in the periconceptional period that prevents neural tube defects in infants (Bibbins-Domingo et al., 2017).

Since preventing unintended pregnancy can improve infant health, policymakers are increasingly interested in finding ways to reduce its occurrence. The 2010 Affordable Care Act (ACA) included several provisions with the potential to impact women's health and unintended pregnancy rates, including a provision granting extended access to private insurance coverage for young adult dependents through age 26. Historically, young adults have had the highest uninsurance rates and young women, in particular, have faced unique barriers in obtaining and maintaining health insurance for numerous reasons, including Medicaid eligibility rules that omitted women without dependent children and limited access to employer sponsored insurance (ESI) (E. Adams, Gavin, Handler, Manning, & Raskind-Hood, 2003; Centers for Disease Control and Prevention, 2009; Glied, Jack, & Rachlin, 2008).

Expanding access to health insurance may decrease unintended pregnancy among reproductive-aged women by increasing prescription contraceptive use (Culwell & Feinglass, 2007). Increases in the proportion of uninsured women are associated with elevated unintended pregnancy rates, particularly among young at-risk women (Kost, Finer, & Singh, 2012; Nearns, 2009). Studies have shown that lowering or eliminating financial barriers to prescription contraceptives leads to their increased use and lower rates of pregnancy, birth, and abortion (Gariepy, Simon, Patel, Creinin, & Schwarz, 2011; Postlethwaite, Trussell, Zoolakis, Shabear, & Petitti, 2007; Secura et al., 2014). This study examines this question of whether the ACA dependent coverage provision had an impact on unintended pregnancy and birth, as well as related prenatal behaviors, among young adult women.

Background

Starting in September 2010, the ACA required private insurance plans held by parents to cover young adults as dependents through age 26. Prior to the ACA, many states had laws extending eligibility for dependent coverage to young adults. These state laws generally applied to adults younger than 26 or had additional eligibility requirements, such as being a student, unmarried, or being a financial dependent of one's parents. These laws also did not apply to self-funded plans, which cover more than half of private sector workers with ESI (Barbaresco, Courtemanche, & Qi, 2015; Monheit, Cantor, DeLia, & Belloff, 2011). Research on these prior state laws has generally found that state dependent coverage laws lead to small shifts away from young adults having their own insurance policies towards dependent coverage (Levine, McKnight, & Heep, 2011; Monheit et al., 2011).

Prior studies of the ACA dependent coverage provision have found it increased insurance coverage among young adults between 3-7 percentage points, though disparities persist among racial and ethnic groups (Akosa Antwi, Moriya, & Simon, 2013; Barbaresco et al., 2015; Cantor, Monheit, DeLia, & Lloyd, 2012; Shane & Ayyagari, 2014; Sommers, Buchmueller, Decker, Carey, & Kronick, 2013). It has also reduced high out-of-pocket medical expenses (Busch, Golberstein, & Meara, 2014). Evidence on utilization has been more mixed. Several studies have found the provision has no effect on the likelihood of having one or more outpatient medical visits or a physical exam (Barbaresco et al., 2015; Chen, Bustamante, & Tom, 2015; Wallace & Sommers, 2015) and two papers found no effect on the likelihood of a PAP test (Barbaresco et al., 2015; Han, Yabroff, Robbins, Zheng, & Jemal, 2014). However, the provision has been shown to increase inpatient visits (Akosa Antwi, Moriya, Simon, & Sommers, 2015), and decrease emergency department use (Hernandez-Boussard, Morrison, Goldstein, & Hsia, 2016). There is less evidence on how the provision has affected health outcomes, though it has been shown to increase the probability of having a primary care doctor and excellent self-rated health (Barbaresco et al., 2015).

Specific to women, the provision has been associated with a decreased likelihood of marriage, childbirth, and abortion, as well as increased use of long-term contraceptives (Abramowitz, 2016, 2017). Using birth certificate data, Akosa Antwi et al. (2016) found the dependent coverage provision has been associated with a shift away from Medicaid coverage to private insurance immediately before and after childbirth. Daw and Sommers (2018) found a 1.9 percentage point increase in private insurance coverage at birth, a one percentage point increase in early prenatal care, and a modest reduction in preterm births (-0.2 percentage points). Another unpublished study using birth certificates found that the provision resulted in an increased share of children born to unmarried, minority, or less educated mothers, earlier prenatal care initiation, and decreased maternal smoking (Ma, 2015). Heim, Lurie, and Simon (2018) use tax data to find the ACA dependent coverage provision led to a modest decrease in childbearing and marriage rates.

This study is the first to examine the effect of the dependent coverage provision on unintended pregnancy and related prenatal behaviors, adding to the growing literature on whether increased private insurance coverage for young adults under this ACA provision has translated into public health gains. Despite the previously cited research on fertility behaviors, the impact on unintended pregnancy remains unknown. For example, prior findings on the decreased likelihood of marriage for young adults (Abramowitz, 2016; Heim et al., 2018) could translate to fewer unintended pregnancies and births, as unmarried women might have fewer sexual encounters, or it could mean an increase since cohabitating women have higher rates of unintended pregnancies than their married counterparts (Finer & Zolna, 2016). Knowing the provision's effect on unintended pregnancy has important implications for associated prenatal behaviors—such as prenatal care initiation, smoking, and taking folic acid—which impact birth outcomes and infant health.

The dependent coverage provision is unique from other insurance expansions under the ACA in that it specifically targets young adults, a group at higher risk of unintended pregnancy. This study adds to the evidence base on how policymakers can more effectively reduce unintended pregnancy and contributes to the broader research on how the Affordable Care Act has affected women's reproductive health.

Conceptual Framework

This research uses a conceptual framework (Figure 1) based on a standard health services research model, Anderson's Behavioral Model of Health Services Use, which asserts that the utilization of health services is influenced by individuals' predisposing, enabling, and need characteristics (Andersen, Davidson, & Baumeister, 2007).

I hypothesized a positive relationship between the ACA dependent coverage provision and increased insurance coverage for young adult mothers. Before the ACA, women in the U.S. commonly experienced gaps and transitions in insurance coverage prior to pregnancy (D'Angelo et al., 2015). I hypothesized a shift from uninsured to privately insured among young adult mothers.

Next, I hypothesized the ACA dependent coverage provision increases contraception use because increased health coverage for young adult women should lower financial barriers to birth control. If private insurance offered more generous benefits for prenatal, labor and delivery, and infant care, this would lower the cost of childbirth and the provision could also be associated with an increase in intended pregnancy and birth as more women become pregnant. However, a gap in the coverage of maternity care for young adult women covered as dependents under the ACA makes this unlikely. Federal regulations require new private plans to cover well-woman preventive services, including preconception and prenatal care, without cost sharing for dependents (Kaiser Family Foundation, 2015). Large employers (<50 employees) are not required to extend complete maternity care coverage to employees' dependents, resulting in potential gaps of coverage around labor and delivery costs, as well as newborn care (Andrews, 2012; Salganicoff & Sobel, 2016). For this reason, any effect that the provision has on pregnancy intention likely works through fewer unwanted and mistimed pregnancies due to greater access to contraception via preconception care. Contraception use is noted with a dashed line on the theoretical framework because I am unable to measure it due to data limitations.

I hypothesized that increased access to and use of contraception decreases the number of unwanted and mistimed pregnancies, decreasing unintended pregnancy and birth. Based on prior literature, fewer unintended births should be associated with earlier prenatal care initiation (in the first trimester), decreased smoking during pregnancy, and increased preconception consumption of folic acid and multivitamins (Cheng et al., 2009; Dott et al., 2010; Joyce et al., 2000). These relationships work both directly and through the provision's effect on insurance coverage and unintended birth.

I control for demographic and social characteristics that may affect the dependent variables. At the individual level, I control for maternal race, ethnicity, parity, as well as marital and education status. Women who are college-educated, non-Hispanic, white, and have no previous births are less likely to have an unintended pregnancy (Finer & Zolna, 2011, 2016). While income and employment status are also associated with the likelihood of having an unintended pregnancy, these are unmeasured in the data and are noted with dashed lines on the theoretical framework. At the state level, I control for real income per capita and unemployment to account for the decline in fertility during the 2007-2009 recession (Schneider, 2015). I also control for state-level abortion rates, which would affect unintended birth rates, and state excise taxes on cigarettes which affect maternal smoking rates (E.K. Adams et al., 2012).

Study Design

Data

I use data from Pregnancy Risk Assessment Monitoring System (PRAMS) from 2009-2014. PRAMS is an ongoing state- and population-based survey designed to monitor selected maternal behaviors and experiences that occur before, during, and shortly after pregnancy among women that deliver live-born infants (D'Angelo et al., 2015). PRAMS is a joint research project between state health departments and the Centers for Disease Control and Prevention (CDC), Division of Reproductive Health.

PRAMS uses mixed-mode data collection: up to three self-administered surveys are mailed to a sample of mothers, after which those who do not respond are contacted for telephone interviews (D'Angelo et al., 2015). Self-reported survey data are linked to birth certificate data and weighted for sample design, nonresponse, and noncoverage (D'Angelo et al., 2015). PRAMS only releases data when a minimum overall response rate is met. From 2007-2010, the threshold was 65%, while from 2012-2013, it was changed to 60% (Centers for Disease Control and Prevention, 2017). This response rate threshold means that the number of states with available data varies from year to year. During my study years, 27 states have available PRAMS data. The remaining 23 states and the District of Columbia are excluded from the study due to a lack of participation in PRAMS or missing data years surrounding the ACA dependent coverage provision (listed in Appendix Table A1). While each state's PRAMS is unique, all states include a pretested list of core questions developed by the CDC. The topics addressed and standardized data collection methods allow data to be compared among states and make it well-suited to research such as this (Centers for Disease Control and Prevention, 2015).

Study Sample

I focus on young adult mothers at the time of conception. PRAMS surveys from 2009-2014 represent mothers that conceived between 2008 and 2013. I use 2008-2009 as my pre-treatment period and 2011-2013 is my post-period. 2010 is excluded as a transition year and the post period ends prior to 2014 to avoid complications from the ACA individual mandate provision and other insurance coverage expansions that were implemented that year.

I use mother's age at conception, calculated by subtracting gestational age (in weeks) listed on the birth certificate from maternal age at delivery. My treatment group includes women ages 20-24 years old at conception who would have been eligible for extended dependent coverage under the ACA provision. Women ages 28-30 years old, who would not have qualified for the provision based on their age, are the control group.

Comparing young adults to those slightly older is an approach consistent with prior literature, however, I use slightly different age groups (excluding 25 and 27 year olds) to account for measurement error in the PRAMS around mothers' age. In addition, I leave out 26 year old mothers to avoid confusion over whether they were treated.

Of the 27 states with available PRAMS data, 15 states had state dependent coverage laws in place during the pre-period and one implemented a law in 2009. These states are excluded for being partially treated prior to the national law going into effect, leaving 11 states in the study sample (Alaska, Arkansas, Hawaii, Illinois, Michigan, Nebraska, Ohio, Oklahoma, Pennsylvania, Vermont, and Wisconsin). Table 1 lists all states and laws. I categorize states based on original policy research, as well as prior published data (Cauchi & Noble, 2016; Gamino, 2016).

Among the 11 study states and after excluding respondents with missing data, the treatment group (20-24 year olds) consists of 12,758 mothers (619,152 using PRAMS survey weights), while the control group (28-30 year olds) has 9,453 women (506,641 using PRAMS survey weights).

Analytic Strategy

All analyses are performed in Stata Version 14. I use a reduced form differences-in-differences (DD) model using the timing and eligibility of the ACA dependent coverage provision to estimate its effect on the likelihood of: 1) having private, public, or no insurance pre-pregnancy, 2) having an unintended birth, 3) initiating prenatal care during the first trimester, 4) smoking during pregnancy, and 5) taking a multivitamin, prenatal vitamin, or folic acid in the preconception period. I also use a measure unique to the PRAMS to investigate whether the probability of receiving insurance through ESI or dependent coverage changes among those with private insurance in the preconception period.

I use logistic regression (multinomial logistic regression for type of insurance) with robust standard errors clustered at the state level and PRAMS survey-weights. The base version of these models is as follows:

$$\mathrm{P}(Y_{iast}) = \beta_0 + \beta_1(Post_t \text{ x } Treat_i) + \beta_2 X_{iast} + \beta_3 Z_{st} + \alpha_a + \varphi_s + \tau_t + \epsilon_{ist}$$

Here $\mathrm{P}(Y_{iast})$ is the probability of the outcome of interest for a mother, where *i* indexes an individual, *a* indexes an individual's age, *s* indexes an individual's state, and *t* indexes time. $\beta_1$is the coefficient of interest. $Post_t$ is a dummy variable indicating the time period after the provision went into effect in 2010. $Treat_i$ is an indicator for membership in the 20-24 age range.

α_a, φ_s and τ_t are age, state, and conception year fixed effects, respectively. X_{iast} is a vector of individual control variables for race, ethnicity, marital status, education, and parity. Z_{st} includes state-level controls for real income per capita, unemployment, and cigarette excise taxes. I also include abortion as a state-level covariate because the PRAMS data only includes mothers whose pregnancy resulted in a live birth, so trends in abortion rates may change the sample composition. From 2004-2013, abortion rates have decreased among all women, yet remain highest for women in their twenties (Jatlaoui et al., 2016). If there are increasing trends in abortion, I might overstate the effect of the dependent coverage provision as fewer unintended pregnancies are brought to term, and, conversely, if trends are decreasing, my estimates may underestimate effects.

In a DD analysis, the common trends assumption must hold that absent any policy changes, trends among the treatment and control group would continue in parallel. To test this assumption, I regressed the outcomes of interest on dummies for the treatment group interacted with those indicating the pre-period (2008–2009). Appendix Table A2 reports these results. For the majority of outcomes the parallel trends assumption is satisfied, though results for smoking during pregnancy are jointly significant ($P<0.05$). In addition, I plot trends pre- and post-implementation of the ACA dependent coverage mandate. Appendix Figure A1 presents graphs of weighted means for all outcomes of interest for the treatment and control groups. These trends show the means for each outcome are generally parallel between 20-24 year olds and 28-30 year olds in states with no prior dependent coverage laws in place during the study pre-period (2008-2009).

Sensitivity Analysis

In addition to the main model using age-based control groups (20-24 year olds versus 28-30 year olds), I run two additional models using alternate state-based treatment and control groups. As previously mentioned, 15 of the 27 states with PRAMS data have state dependent coverage laws in place during the pre-period (listed in Table 1). Of these states, four have state laws that extend eligibility for private dependent coverage to young adults through age 26 or older (Massachusetts, Missouri, New Jersey, and Utah), coverage that is equivalent or more generous than that available under the ACA dependent coverage provision.

I construct a second model using 20-24 year olds in the eleven states with no dependent coverage laws in place during the pre-period as the treatment group, and 20-24 year olds in the four states with state laws extending coverage through age 26 or older as the control group. In addition, I create a third model using these same state-based treatment and control groups, but including New York in the control group (which implemented a state law extending dependent coverage to age 30 in 2009, during the pre-period). I tested the parallel trends assumption separately for each model. Appendix Tables A3-A4 present results for the statistical tests and all outcomes are insignificant for both models. In addition, Appendix Figures A2-A3 show trends in weighted means for all outcomes.

Measures

Insurance Status: I classify respondents as having private insurance, public insurance, or being uninsured prior to pregnancy using questions from the PRAMS core survey per Johnston and Adams (2017). Using Adams et al.'s (2003) hierarchy, women who reported private insurance coverage for a given period alone or in combination with any other kind of insurance (including Medicaid), were categorized as private insurance. Per D'Angelo et al. (2015), women with TRICARE or other military insurance were included with the private insurance group and those who reported only Indian Health Service (IHS) were included with the uninsured group.

ESI/Dependent Coverage: From 2012-2013, one of the response options to the pre-pregnancy insurance question was "Private health insurance from my job or the job of my husband, partner, or parents" and from 2009-2011 it was "Health insurance from your job or the job of your husband, partner, or parents." I use these questions to construct a dichotomous measure of ESI/dependent coverage among those mothers with private insurance.

Unintended Birth: Unintended birth is measured as unintended/intended using a measure that accounts for changes in PRAMS questionnaires over time. From 2009-2011, answer choices to the question "Thinking back to just before you got pregnant with your new baby, how did you feel about becoming pregnant?" included: 1) "I wanted to be pregnant sooner;" 2) "I wanted to be pregnant later;" 3) "I wanted to be pregnant then;" and 4) "I didn't want to be pregnant then or at any time in the future." In 2012, a fifth answer choice was added to the questionnaire: 5) "I wasn't sure what I wanted." Pregnancies are classified as unintended if a mother answered either that she wanted to be pregnant later or that she did not want to be pregnant then or at any time in the future. Pregnancies are classified as intended if a mother answered either that she wanted to be pregnant then or that she wanted to be pregnant sooner. Pregnancies in 2012, for which the mother answered that she was not sure what she wanted, are classified based on her answer to a second question: “When you got pregnant with your new baby, were you trying to get pregnant?” Births about which mothers were not sure how they felt, but were not trying to get pregnant are classified as unintended. Births about which mothers were not sure how they felt, but were trying to get pregnant are classified as intended.

Prenatal Care Initiation: Prenatal care initiation is a dichotomous measure of whether the initial prenatal care visit took place during the first twelve weeks of pregnancy (the first trimester) or later based on birth certificate variables included in the PRAMS.

Maternal Smoking: Maternal smoking is measured per Adams et al. (2013), as a dichotomous measure based on respondents’ self-reported third trimester smoking behaviors. A mother is considered a smoker if she reports smoking in the third trimester of pregnancy.

Prenatal Vitamins: In all study years, the PRAMS core questionnaire asked, “During the month before you got pregnant with your new baby, how many times a week did you take a multivitamin, a prenatal vitamin, or a folic acid vitamin?” Mothers are considered to have taken vitamins if they reported any consumption during this period.

Covariates: All models include a series of categorical individual-level control variables to account for maternal characteristics that may impact the dependent variables. Mothers will be classified into three racial groups (white, black, or other), as well as two ethnic groups (Hispanic or non-Hispanic). Maternal education measures a mother’s highest educational attainment in the categories: no high school; some high school; high school graduate; some college; and college graduate or more. Marriage is a dichotomous measure of married or not married. The number of prior live births is counted in the categories: 0; 1; 2; 3-5; 6 or more. At the state level, real per capita income, annual unemployment rates, cigarette excise taxes, and annual abortion rates (number of abortions per 1,000 women aged 15-44 years) by state of residence are also included in all models as continuous variables.

Results

Figures 2 and 3 show unadjusted trends in private insurance coverage and uninsurance among 20-24 year olds in states with no state dependent coverage laws pre- and post-implementation of the ACA dependent coverage provision. Figure 2 shows that private insurance coverage generally increased among young adult mothers in the post-period and among privately insured mothers there was a corresponding increase in ESI and dependent coverage. Figure 3 shows that the number of uninsured young adult mothers trended down in the period after the ACA dependent coverage provision was implemented.

Table 2 presents logistic regression results (multinomial logistic regression for type of insurance) as marginal effects. The first column shows results for the base model (Model 1) using age-based control groups, 20-24 year olds versus 28-30 year olds in states with no prior state law in place during the pre-period. In Model 1, there is a 12.6 percentage point increase in the probability of being privately insured ($P<0.001$), a 2.8 percentage point decrease in probability being publicly insured ($P<0.05$), and a 9.9 percentage point decrease in the probability of being uninsured ($P<0.01$) for 20-24 year olds in the post-period, compared to the pre-period and net of trends observed among 28-30 year olds. Among those privately insured in the treatment group, the probability of being covered by ESI or dependent coverage increases by 16.7 percentage points in the post-period, compared to the pre-period and net of trends among

28-30 year olds (P<0.001). There are no significant effects for pregnancy intention or prenatal behaviors.

The second column of Table 2 presents results using 20-24 year old mothers in states with no prior dependent coverage laws as the treatment group, and 20-24 year old mothers in states with prior laws extending coverage through age 26 or older as the control group (Model 2). In Model 2, being in the treatment group after the implementation of the ACA dependent coverage provision is associated with a 5.3 percentage point increase in the probability of being privately insured, compared to the pre-period and net of trends in the control group (P<0.01). In addition, there is a 2.7 percentage point decrease in the probability of smoking during pregnancy among young adult mothers after implementation of the ACA dependent coverage provision, compared to the pre-period and net of trends in the control group (P<0.05). No other outcomes are significant in Model 2.

The third column of Table 2 shows results using the same treatment group as the second model and a control group that includes New York, a state that implemented a generous state dependent coverage law in 2009 during the pre-period. Model 3 shows similar results as the second model, with a slightly smaller increase in the probability of private insurance coverage (5.2 percentage points, P<0.01) and a slightly larger decrease in the probability of smoking during pregnancy (2.9 percentage points, P<0.05).

Discussion

Results show that the ACA dependent coverage provision increased pre-pregnancy insurance coverage through an increase in private insurance. Model 1 results (using age-based treatment and control groups) suggest young adult mothers were more likely to receive their coverage through ESI/dependent coverage plans and less likely to be uninsured after the implementation of the ACA dependent coverage provision. The 12 percentage point increase in the probability of private insurance coverage is greater in magnitude than the 3-7 percentage point increases found in prior studies using other data sources. Part of this discrepancy may be due to the fact that only one of these earlier studies accounted for prior state laws (Cantor et al., 2012), so some prior estimates may underestimate the true effect of the national ACA provision.

Additionally, this study examines insurance coverage in the months prior to pregnancy, a time when women tend to fall into coverage gaps and may find themselves uninsured at higher rates than other young adult groups. Using data from the Behavioral Risk Factor Surveillance System, Barbaresco et al. (2014) estimated that 26% of young adult women in their sample were uninsured prior to the ACA dependent coverage mandate; in this study sample approximately 38% of mothers 20-24 years old were uninsured pre-pregnancy during the pre-period. While results on insurance outcomes from this study represent important findings for young adult mothers in states without prior laws, they may not generalize to young adults more broadly.

Results from Models 2 and 3 using state-based control groups show an approximate five percentage point increase in the probability of private insurance in the post-period. These estimates are more consistent with prior studies, but there are still concerns about using states with more generous state dependent coverage laws (up to age 26 or older) as the control group in these models. Cantor et al. (2012) found take-up of dependent coverage in 2010 may have been greater among those who were targeted by a state expansion, arguing that state dependent coverage laws may have “primed the pump” for the roll-out of the national provision. If this is the case, young adult mothers in states with pre-existing dependent coverage laws would have also been affected by the ACA dependent coverage provision and do not serve as an accurate counterfactual. However, Cantor et al. include thirty states with prior dependent coverage laws in the study, the majority of which ended eligibility at younger ages than the national mandate and often had additional restrictions regarding student and marital status. In addition, Cantor et al. use a list of state laws that had several omissions and inaccuracies. Therefore, in considering the three models used in this study, one can reasonably assume the ACA dependent coverage provision is associated with an increase in the range of 5-12 percentage points in the probability of private insurance coverage among mothers in the treatment group in the post-period.

Models 2 and 3 both show approximate three percentage point decreases in the probability of mothers in the treatment group smoking during pregnancy in the post-period versus the pre-period. This finding confirms earlier analysis by Ma (2015) using birth certificate data. This effect does not appear to work through the causal pathway of pregnancy intention and may be a direct effect of the mandate. For example, uninsured women are less likely to receive preconception care, so increasing insurance coverage and access to preconception counseling may promote healthy maternal behaviors, regardless of pregnancy intention (Williams, Zapata, D'Angelo, Harrison, & Morrow, 2012). Findings for maternal smoking are not confirmed in Model 1, but the age-based treatment and control groups did not meet the common trends assumption in statistical tests, lending greater confidence to results from models 2 and 3 on maternal smoking.

None of the models tested in this study showed significant results for unintended pregnancy. These findings suggest that the ACA dependent coverage provision has not had an effect on unintended pregnancy among young adults.

Strengths and Limitations

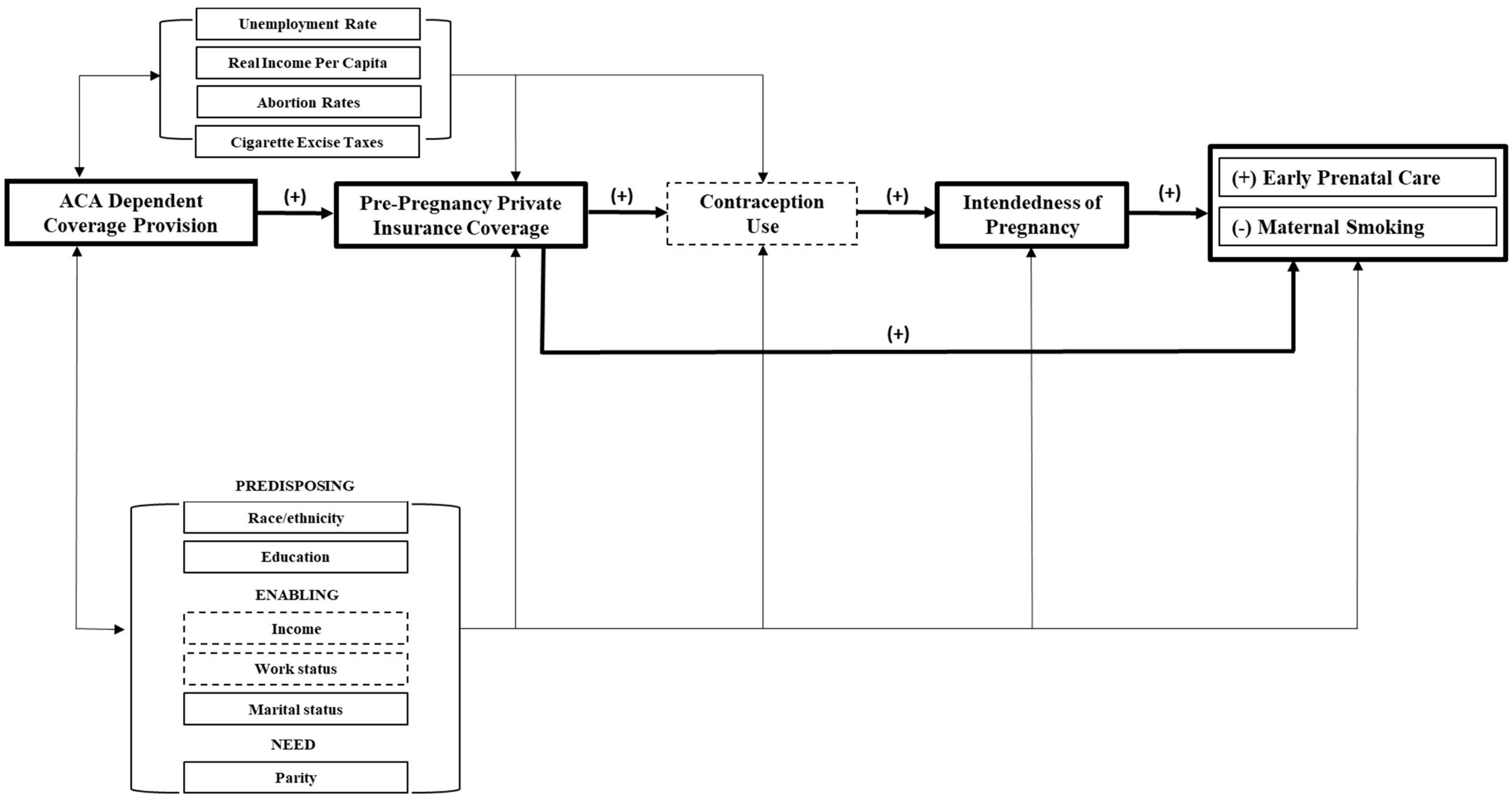
A noted limitation of this study is that pre-conception prescription contraceptives cannot be measured because the PRAMS questionnaire does not differentiate between types of pregnancy prevention efforts. An important future direction for research is identifying if prescription contraceptive use has changed as a result of the ACA dependent coverage provision.

Another limitation of this research is the short post-period, which may limit the ability to detect second-order effects, or outcomes that are expected to change owing to changes in health insurance coverage. I end the post-period in 2013 to avoid confounding from other insurance expansions under the ACA in 2014, but three years may not be long enough to detect long-term effects.

In addition, I cannot directly attribute results identified here to the ACA dependent coverage provision. Though unlikely, other events in these states, years, and age groups may have driven changes in insurance coverage and maternal smoking. As regards unintended pregnancy, I looked for any notable changes in the study states to family planning waivers, abortion access (such a number of providers), or state contraception mandates, but did not find any developments coinciding with study years.

These limitations notwithstanding, my findings represent a timely contribution to the literature. States continue to pass new dependent coverage laws, extending eligibility beyond that of the ACA dependent coverage provision. My results show that extending eligibility for parental dependent coverage increases preconception private insurance at a time when many young adult women experience gaps and instability in coverage. Further, gaining coverage during this period may contribute to reductions in smoking during pregnancy and improve infant health. As states considering expanding these laws, these effects may have important benefits for both mother and baby. However, the ACA dependent coverage expansion has not affected unintended pregnancy among young adult mothers, therefore states hoping to address unintended pregnancy will need utilize other approaches to address pregnancy intention among this high risk group.

Figure 1. Conceptual Framework



Note: Author's adaptation of Anderson's Behavioral Model of Access to Health Care (2007).

Table 1: State Dependent Coverage Laws

MAIN STUDY STATES	
No Such Law in Place in 2008-2009	Alaska, Arkansas, Hawaii, Illinois, Michigan, Nebraska, Ohio, Oklahoma, Pennsylvania, Vermont, Wisconsin
EXCLUDED STATES	
Dependent Coverage Law (≥ 26 Years) Implemented During Study Period	New York, [Sep 1] 2009 (up to age 30)
Dependent Coverage Law (≥ 26 Years) In Place	Massachusetts, 2007 (up to age 26); Missouri, [Jan 1] 2008 (up to age 26); New Jersey, 2006 (up to age 31); Utah, 1995 (up to 26)
Dependent Coverage Law (≤ 25 Years) In Place	Colorado, 2005 (up to age 25); Delaware, 2007 (up to age 24); Georgia, 2006 (up to age 25); Maine, 2007 (up to age 25); Maryland, [Jan 1] 2008 (up to age 25); Minnesota, [Jan 1] 2008 (up to age 25); Oregon, 2005 (up to age 23); Rhode Island, 2007 (up to age 25); Tennessee, 2004 (up to age 24); West Virginia, 2007 (up to age 25); Wyoming, 2003 (up to age 23)
No PRAMS Data	Alabama, Arizona, California, Connecticut, District of Columbia, Florida, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Montana, Nevada, New Hampshire, New Mexico, North Carolina, North Dakota, South Carolina, South Dakota, Texas, Virginia, Washington

Sources: Author's original research; NCSL legal research, 2016; State Health Facts by KFF. Legal review, 2011-2015: Richard Cauchi, NCSL Health Program (Update 2016 research: Ashley Noble, J.D., NCSL Health Program). Available from: http://www.ncsl.org/research/health/dependent-health-coverage-state-implementation.aspx#1; and Gamino, A. 2016. New Evidence on the Effects of Dependent Coverage Provisions (Working Paper).

Figure 2. Trends in Pre-Pregnancy Private Insurance Coverage among 20-24 Year Old Young Adult Mothers, 2008-2013

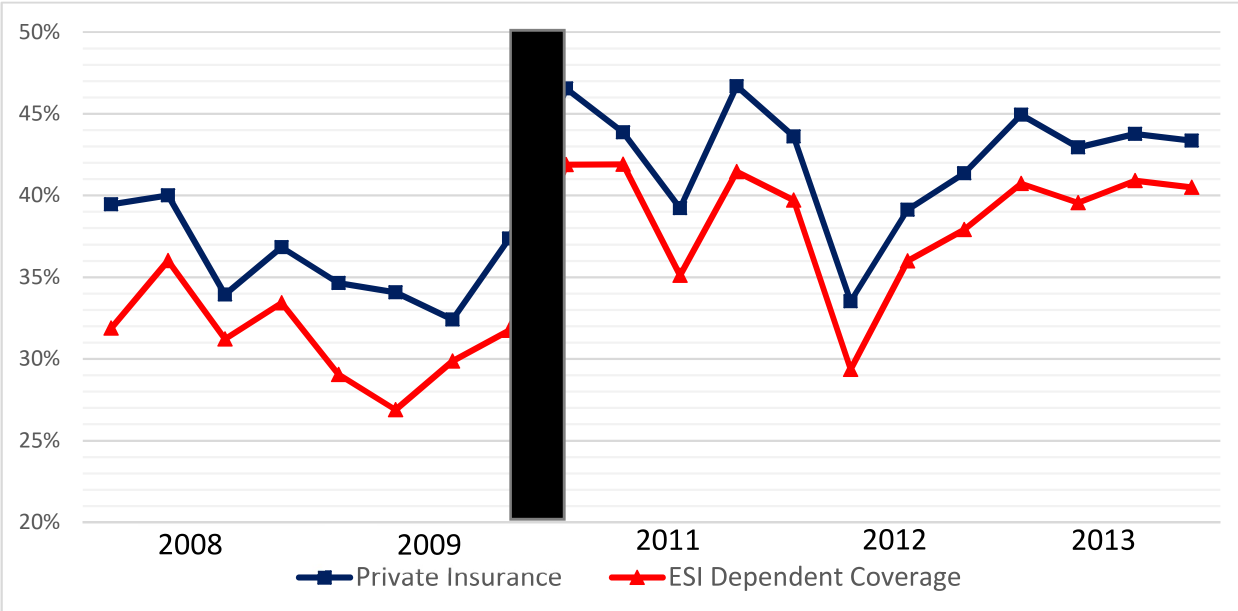


Figure 3. Trends in Pre-Pregnancy Uninsurance among 20-24 Year Old Young Adult Mothers, 2008-2013

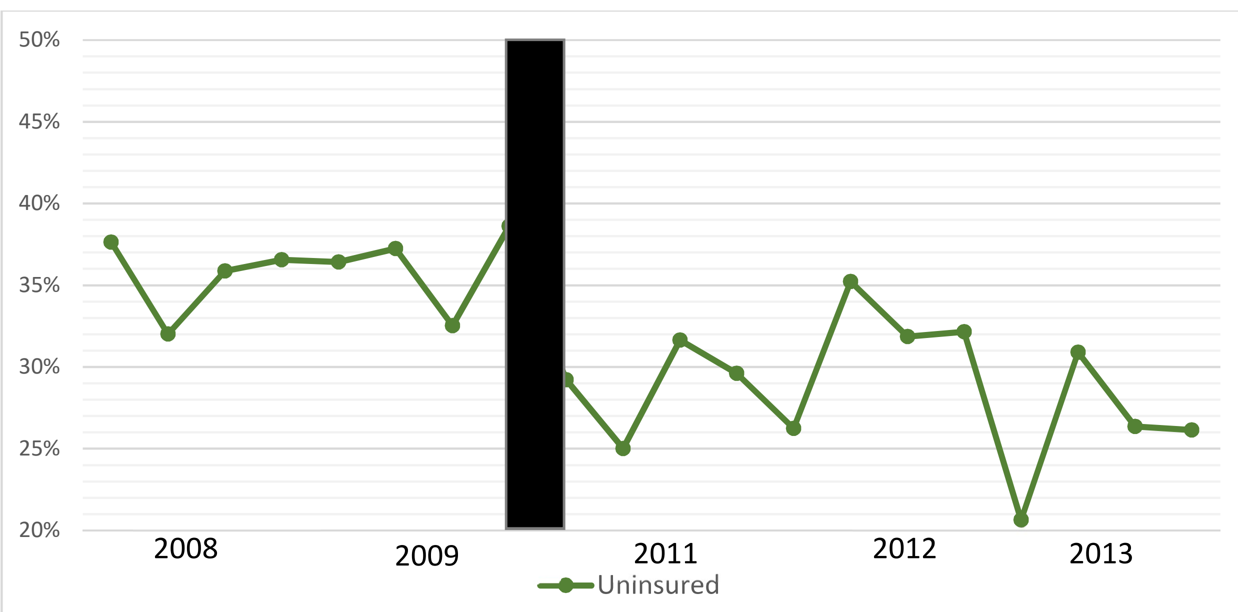


Table 2. Effects of the ACA Dependent Coverage Provision on Young Adult Mothers

	Model 1: Age-Based Treatment and Control Groups	**Model 2: State-Based Treatment and Control Groups**	**Model 3: State-Based Treatment and Control (Includes NY) Groups**
Pre-Pregnancy Health Insurance			
Private	**0.126*****	**0.053****	**0.052****
Public	**-0.028***	-0.012	-0.033
Uninsured	**-0.099****	-0.041	-0.019
ESI/Dependent Coverage	**0.167*****	0.018	0.018
Pregnancy Intention			
Unintended Birth	0.015	-0.028	-0.034
Maternal Behaviors			
First Trimester Prenatal Care	0.010	0.005	0.004
Smoking During Pregnancy	-0.001	**-0.027***	**-0.029***
Took Vitamins	0.015	0.016	0.009
Weighted *N*	1,125,792	866,510	921,965
Unweighted *N*	22,211	17,651	18,109

Source: Boldface indicates statistical significance *p<0.05, **p<0.01, ***p<0.001. Authors' analysis of the Pregnancy Risk Assessment Monitoring System (PRAMS) data. All effects are estimated with logistic regression, except for the outcome insurance type, which is estimated with multinomial logistic regression. Models control for maternal characteristics (race, ethnicity, education, marriage, and parity) and state level characteristics (annual unemployment rates, real per capita income, abortion rate, and cigarette excise taxes). All models include age, state, and year fixed effects and use PRAMS survey weights.

Chapter 2

Scope of Practice Laws and Certified Nurse-Midwives: Effects of Changing Regulatory Environments on Infant Mortality

Introduction

Approximately one-half (49%) of U.S. counties, often rural, lack a single obstetrician-gynecologist (Rayburn, 2017). Family physicians can provide obstetric care in such areas, however, provision of maternity care by family physicians has declined from 23% in 2000 to 7% in 2016 (Tong et al., 2013). These trends are not expected to reverse in coming years. Due to population growth, demographic trends, and health insurance expansion under the Affordable Care Act, a national shortage of 35,000-52,000 adult primary care physicians, including approximately 5,000 obstetrician-gynecologists is anticipated by 2025 (Petterson et al., 2012; U.S. Department of Health and Human Services, 2016). These barriers to care have important implications for reproductive-aged women and their infants, as research has shown an increased supply of practitioners (primary care, as well as family practitioners and obstetrician-gynecologists) is negatively associated with infant mortality (Larimore & Davis, 1995; Shi et al., 2004).

Despite several decades of declines in the overall infant mortality rate (from 7.57 infant deaths per 1,000 live births in 1995 to a 5.27 rate in 2014), the United States continues to have one of the highest infant mortality rates in the developed world (MacDorman, Mathews, Mohangoo, & Zeitlin, 2014). In 2016, the five leading causes of death were congenital malformations, low birthweight, sudden infant death syndrome (SIDS), maternal complications during pregnancy, and unintentional injuries (such as suffocation) (Kochanek, Murphy, Xu, & Arias, 2017).

Even as the overall infant mortality rate has declined, disparities among racial and ethnic groups have persisted. In particular, non-Hispanic black infants have an infant mortality rate twice that of non-Hispanic white infants, in 2014 it was 10.9 versus 4.89, respectively (Mathews & Driscoll, 2017). Disparities in infant mortality also exist by maternal marital status, education, and age, as well in urban versus rural areas (Ely, Driscoll, & Mathews, 2017; Haider, 2014; Rossen & Schoendorf, 2014). These disparities are important to consider in light of provider shortages. A recent study found counties lacking hospital obstetric services also had higher odds of having fewer obstetricians and family physicians per women of reproductive age, a higher percentage of non-Hispanic black women of reproductive age, and lower median household incomes (Hung, Henning-Smith, Casey, & Kozhimannil, 2017). These findings suggest that women most likely to experience provider shortages may also be at higher risk of experiencing infant mortality.

One potential solution to provider shortages affecting reproductive-aged women is greater utilization of non-physician practitioners such as Certified Nurse-Midwives (CNMs). CNMs are advanced practice registered nurses (APRNs) who have graduated from an accredited nurse-midwifery education program and have passed a national certification examination (American College of Nurse-Midwives, ND). As non-physician health care providers, CNMs face additional scope of practice (SOP) restrictions that vary widely by state and legally define the range of tasks they are allowed to perform. For example, in some states CNMs may practice independently with no requirement for a written collaborative agreement, no supervision, and no conditions for practice; while in other states CNMs may be required to have direct supervision from a licensed MD with a written practice agreement (National Council of State Boards of Nursing, 2018). Such restrictive laws may raise the cost of care due to additional efforts needed to perform oversight tasks (such as additional chart reviews) and fees that must be paid to participate in collaborative practices (U.S. Department of Health and Human Services, 2016; Westat, 2015)

Restrictive CNM SOP laws are the source of some contention. In 2017, the American Medical Association's House of Delegates interim meeting passed a resolution to oppose nationwide efforts to grant independent practice to non-physician practitioners, including APRNs, arguing that quality may suffer due to shorter training and clinical experience requirements (Frieden, 2017). Proponents of independent practice include organizations such as the Institute of Medicine and National Governors Association, who counter that APRNs provide care similar in quality to that of physicians, but at a lower cost (Committee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing at the Institute of Medicine, 2010; Schiff, 2012).

The controversy over CNM SOP restrictions may have important implications for the infant mortality rate, as CNMs are involved in care during the prenatal, perinatal (22 weeks gestation through seven days after birth), as well as postpartum periods. While prior studies have examined APRNs, quality of care, and effects of changes in SOP laws on maternal and infant health, no research has specifically focused on CNM SOP laws and infant mortality.

Multiple studies have examined related questions regarding nurse practitioners (NPs) and primary care physicians. Newhouse et al. (2011) and the National Governors Association (2012) conducted separate systematic reviews of the literature focused on general nurse practitioners and found they provide similar quality of care to that of physicians using measures including patient satisfaction, time spent with patients, prescription accuracy, and changes in physiological measures (Newhouse et al., 2011; Schiff, 2012). Traczynski and Udalova find that independent practice laws for NPs increase the frequency of routine checkups, improve care quality, and decrease emergency room use by patients with ambulatory care sensitive conditions through decreased administrative costs for providers and indirect costs for patients accessing medical care (Traczynski & Udalova, 2018). Kleiner et al. found that independence in scope of practice for NPs increases their wages and lowers physicians' wages with no effects on quality of care, including infant mortality which might have been impacted through the quality of well-child visits conducted by NPs versus pediatricians (Kleiner, Marier, Park, & Wing, 2016).

Several correlational studies take the regulatory environment for CNMs into account. A 1998 study by DeClercq et al. found high legislative support for CNM practice is associated with lower rates of infant mortality (Declercq, Paine, Simmes, & DeJoseph, 1998). More recently, Yang et al. (2016) found autonomous CNM practice is associated with lower probabilities of labor induction, cesarean delivery, preterm birth and low birth weight (Yang, Attanasio, & Kozhimannil., 2016). Vedam et al. (2018) find that higher integration of midwives in regional health systems is correlated with higher rates of spontaneous vaginal delivery, vaginal birth after cesarean, and breastfeeding, as well as lower rates of cesarean, preterm birth, low birth weight infants, and neonatal death (Vedam et al., 2018).

Two studies examine the effect of related laws impacting CNM practice on infant mortality. Anderson et al. (2016) focuses on the period from 1900-1940 and find stricter licensing requirements are associated with reductions in maternal mortality and nonwhite infant mortality (Anderson, Brown, Charles, & Rees, 2016). Miller (2006) focuses on the years 1989-1999 and finds that state laws mandating insurance coverage of midwifery services are associated with a rise in midwife-attended births and drop in neonatal deaths (Miller, 2006).

In 2017, Markowitz et al. examined changes in CNM SOP laws and their effects on maternal and infant health from 1994-2013. They found that mothers in states with moderate or high barriers to CNM practice have an almost a 3.5 percentage point higher probability of apparent elective induction and a 2 percentage point higher probability of cesarean and apparent elective cesarean deliveries than mothers in states with no barriers. Infants in high or moderate states also have a 1.4 percentage point higher probability of being born at a gestational age greater than 39 weeks (Markowitz, Adams, Lewitt, & Dunlop, 2017).

This research contributes to the evidence base informing debate over allowing full-practice authority for CNMs by examining whether changes in the restrictiveness of CNM SOP laws during the period from 1994-2014 affected infant mortality using publicly restricted linked infant birth and death data. It is the first study to look at the impact of CNM SOP laws on infant mortality outcomes in this period.

Background

CNMs are most commonly known for providing care to mothers with low-risk pregnancies (e.g., singleton, no serious medical complications) during childbirth and the postpartum period (Johantgen et al., 2012). In addition, they also provide primary health care services for women throughout the life-course, including primary care, gynecologic and family planning services, preconception and prenatal care, care of the normal newborn during the first 28 days of life, and treatment of male partners for sexually transmitted infections (American College of Nurse-Midwives, 2004). While providing such care, CNMs conduct physical examinations, prescribe medication (including controlled substances and contraceptive methods), and order and interpret laboratory and diagnostic tests. How they are allowed to carry out these duties depends on the regulatory environment in the state. State SOP laws vary widely on several dimensions: they allow varying levels of autonomy to CNMs in terms of both their practice and/or prescriptive authority; they may require supervisory arrangements with physicians; and these supervisory relationships may or may not have to be formalized under a written collaborative practice agreement.

Scope of Practice Law Categorizations

I use Markowitz et al.'s (2017) classification of the laws based on information gathered from *The Nurse Practitioner's* legislative update, as well as directly from state statutes. This classification scheme takes both practice and prescriptive authority into account and categorizes states according to the more restrictive regulation, accounting for state statutes that may allow more independence in one area than the other (Markowitz et al., 2017). For example, according to this classification scheme, a state that allows independent prescriptive authority, but requires protocols for practice would be categorized as having moderate barriers.

This classification scheme groups these laws into the following categories:

1) *No barriers*: CNMs practice to the full extent of their training with no barriers to providing care; 2) *Low barriers*: CNMs must have collaborative practice agreements, but do not have to have written protocols; 3) *Moderate barriers*: CNMs must have a written protocol describing allowable practices; and 4) *High barriers*: CNMs must practice under the direct supervision of a physician, with supervision requirements specified.

Generally, states are trending away from more restrictive practice environments for CNMs: Figures 1-2 illustrate the change in CNM SOP laws between 1994 and 2014. This pattern is also seen in SOP laws for nurse practitioners and physician assistants (Gadbois, Miller, & Tyler, 2015) and no one reason has been identified as to why states are moving away from restrictive practice environments. One potential explanation is offered by a recent study that found higher political spending by physician interest groups increases the probability that a state maintains restrictive licensing laws for NPs and physician assistants, while increased spending by hospital interest groups increases the probability that a state allows them to practice with more autonomy (McMichael, 2017).

Conceptual Framework

This research uses a conceptual framework (Figure 3) based on Anderson's Behavioral Model of Health Services Use, including controls for predisposing, enabling, and need characteristics at the individual and state level (Andersen et al., 2007). According to this causal pathway, I hypothesized that changes in CNM SOP laws would not affect infant deaths in states that allow CNMs independent scope of practice.

If allowing CNMs to practice independently posed a public health risk in terms of infant mortality, one would expect infant deaths to increase in the neonatal period, or the first month after birth, when most infant deaths occur (Centers for Disease Control and Prevention, 2018). Such an increase might occur if CNMs provided inferior care in the perinatal period or utilized risky practices during childbirth and infant care in the first month of life. Research does not support this and instead suggests that CNMs deliver comparable care to physicians for low-risk births. In their systematic review of the literature, Johantgen et al. (2012) found lower rates of cesarean deliveries, operative vaginal deliveries (forceps or vacuum), and episiotomies among CNMS, as well as comparable birth outcomes including APGAR scores, low birth weight, and NICU admissions between CNMs and physicians.

Generally, midwives view birth as a normal process and emphasize the use of nonpharmacologic approaches, though they also support the appropriate use of interventions and technology for current or potential health problems (American College of Nurse-Midwives, N.D.). As mentioned previously, Markowitz et al. (2017) find that changing CNM SOP laws results in women carrying babies to longer gestational ages and having fewer cesarean deliveries in states with no barriers compared to those with moderate or high barriers. These findings fit with the CNM's stated philosophy of care.

Markowitz et al. (2017) also show that relaxing CNM SOP laws in a state does not increase the supply of CNMs, but instead may cause physicians to respond to increased competition by changing their practices. These findings fit with Anderson's framework, as changing state SOP laws for CNMs alters the overall healthcare environment, changing health practices and utilization of services in the form of babies gestating longer and fewer cesarean deliveries. I hypothesized that these in turn reduce the risk of respiratory distress syndrome and tachypnea of the newborn (TTN) and result in improved infant health, rather than changes in infant mortality (Rawlings & Smith, 1984; Usher, Allen, & McLean, 1971).

Based on this evidence, I hypothesized that compared to those with barriers, state scope of practice laws that allow Certified Nurse-Midwives to practice with no, or fewer, barriers will not be associated with a change in overall infant mortality, neonatal infant mortality, or infant mortality attributable to preterm or perinatal causes of death. Perinatal deaths involve brief survival (days or weeks) following a live birth (Barfield, 2016), while preterm causes of death refer to common causes of death for infants born before the 37th week of gestation is completed (Centers for Disease Control, 2017).

According to the causal pathway outlined in Figure 3, any change in infant mortality should work through complications due to pregnancy or childbirth in the perinatal period. There is no evidence that the midwifery model of care differs in its delivery of primary care in such a way as would affect infant health. For example, there is no evidence that there is a difference in smoking cessation based on whether prenatal or routine obstetric care was delivered by a CNM or a physician, which could affect incidence of Sudden Infant Death Syndrome (SIDS) during the first year of life. In addition, findings from Kleiner et al. (2016) indicate APRN care for infants in the first year of life is comparable to that delivered by physicians. Therefore, I hypothesized that compared to those with barriers, state SOP laws that allow CNMs to practice with no barriers will not be associated with a change in postneonatal infant mortality, nor be associated with effects on deaths from sleep related, accidental, or other causes in the first year of life. Sleep-related causes of infant death include SIDs and any sudden unexpected infant death (SUID), whether explained or unexplained, occurring during a sleep period (Task Force on Sudden Infant Death Syndrome, 2016). Detailed information on how causes of death are defined follows in the *Measures* section.

Study Design

Data

This research uses linked birth and death certificate data for the years 1994-2014 from the Center for Disease Control's National Vital Statistics System, part of the National Center for Health Statistics (NCHS). Each year, states submit birth and death certificate information to the National Center for Health Statistics (NCHS), which links it into a single national file. These linked birth and death records capture all infant deaths occurring in a given year linked to their corresponding birth certificates, whether the birth occurred in that year or the previous year. For the 2014 linked file, 99.3% of all infant death records were linked to corresponding birth certificates (Centers for Disease Control and Prevention, N.D.).

This linked data includes the infant's demographic information (such as date of birth and death, race, and sex), maternal characteristics (age, educational attainment, and marital status), as well as health information including cause of death. For this research, I use publicly restricted files that include geographic detail on state of mother's residence and state of birth.

Several changes occurred to the linked birth and death files during the study period that may affect my findings. In 2003, a revised version of the U.S. Standard Certificate of Live Birth was introduced, but transition to the revised form was inconsistent and delayed across states (Centers for Disease Control and Prevention, N.D.). As available, measures were selected to be consistent across certificate revisions and reporting areas. In addition, mortality statistics by cause of death are compiled from death certificates. From 1995-1998, the International Classification of Diseases 9th Revision (ICD 9) codes are used to specify underlying cause of death. From 1999-2014, cause of death is specified with the International Classification of Diseases 10th Revision (ICD 10) codes. The implementation of the new ICD revision, along with other occasional modifications to coding, may affect comparability of some causes of death across years. However, as long as the measurement error in the dependent variable is uncorrelated with the explanatory variable of interest—changes in CNM SOP laws—multivariate analysis should still produce consistent estimates (Markowitz, 2007).

Study Sample

The analytic sample is all infants who died in the first year of life that were born during the years 1995-2014. To deal with selection bias, as CNMs cannot attend high-risk births and women with prior knowledge of health conditions may be more likely to choose or avoid CNMs, the study sample is limited to singleton, first births, as well as mothers with no history of any of four pregnancy risk factors: 1) diabetes (pre-pregnancy or gestational), 2) eclampsia, 3) chronic hypertension, and 4) pregnancy associated hypertension). The sample is also limited to mothers who reside in the state where they gave birth.

Analytic Strategy

All analyses are performed in Stata Version 14 and SAS 9.4. I use a multi-state multi-time period difference-in-differences methodology to evaluate the effects of varying SOP laws on the following outcomes (all counts): 1) all deaths; 2) neonatal deaths; 3) postneonatal deaths; 4) perinatal causes of death; 5) preterm causes of death; 6) sleep-related causes of death; 7) accidental causes of death, and 8) other causes of death.

Per Markowitz (2007), I use a Fixed Effects Poisson (FEP) to estimate all models. The unit of observation is at the state level and each state is observed quarterly. The FEP is a quasi-maximum likelihood estimator that includes fixed effects to account for unobserved heterogeneity across units of observation (states and quarters) and has consistent estimates, regardless of whether the counts actually have a Poisson distribution (Wooldridge, 2002). Each model includes the number of singleton, live first births in the state in each quarter as a logged right-hand side variable, with the coefficient constrained to equal one. The births were also limited to those with no history of diabetes (pre-pregnancy or gestational), eclampsia, chronic hypertension, and pregnancy associated hypertension, as well as to mothers who reside in the state where they gave birth.

The base version the models is as follows:

$$Y_{st} = \beta_0 + \beta_1 CNMSOP_{st} + \beta_2 X_{st} + \beta_3 Z_{st} + \varphi_s + \tau_t + \epsilon_{st}$$

Y_{st} is the count of infant deaths in state s at the time of delivery t. $CNMSOP_{st}$ are indicator variables for the restrictiveness of the CNM scope of practice laws in effect in state s during the quarter of delivery t. X_{st} is a vector of maternal control variables that are state-level averages of maternal age, race, ethnicity, marital status, education, and smoking status during pregnancy for all births in a given state and quarter. At the state level, Z_{st} is a vector of controls that are state-level averages of the number of obstetricians (per 1,000 females age 15-44), population size (females age 15-44), real income per capita, unemployment rate, and poverty rate. φ_s and τ_t are state and year-by-quarter fixed effects and all models include robust standard errors.

Description of Measures

Neonatal and Postneonatal Death: Following the NCHS definitions, a death is considered a neonatal death if it happens during days 1-27 and postneonatal if it happens on days 28-364.

Perinatal, Preterm, and Sleep-Related Causes of Death: Deaths are categorized by cause on the assumption that similar factors are associated with these losses. Causes of death are defined using ICD-9 codes for the years 1995-1998 and ICD 10 codes from 1999-2014. NCHS has defined selected "recodes" of the ICD-9 and -10 codes that group these codes into “Selected Causes of Death.” All causes of death are measured in the first year after birth. In consultation with a clinician, pertinent Selected Causes of Death groups are selected to define perinatal, preterm, sleep-related, accidental, and other causes of death (see Appendix Table B.2 for cross-walk of Selected Causes of Death Groups codes, ICD-9, and ICD-10 codes).

SOP laws: As described previously, state scope of practice laws for Certified Nurse-Midwives are classified into four categories according the more restrictive regulation concerning either practice or prescriptive authority: 1) no barriers, 2) low barriers, 3) moderate barriers, and 4) high barriers.

Covariates: All models include state-level averages for maternal characteristics that may impact the dependent variables. Maternal race, ethnicity, education, age, and marital status are all correlated with increased infant mortality rates (Haider, 2014; Mathews & Driscoll, 2017; Rossen & Schoendorf, 2014). Mothers are classified into four bridged race categories: white, black, Native American, and Asian. Maternal ethnicity is classified as Hispanic or unknown. Maternal education measures a mother's highest educational attainment in the categories: less than high school; high school; some college; college, or education unknown. Maternal age is reported in years. Marriage is a dichotomous measure of married or unknown. I also control for cigarette smoking during pregnancy which increases the risk of preterm birth and SIDS, both common causes of infant mortality (Andres & Day, 2000; DiFranza, Aligne, & Weitzman, 2004). Cigarette smoking is a dichotomous variable of any cigarette smoking during pregnancy or unknown.

Education and smoking include "unknown" categories because of issues around states adopting the 2003 birth certificate revision, resulting in these measures not being available in all states and quarters during the study period. States that did not report a consistent measure in certain quarters and subsequently had missing data are considered "unknown."

All models also include state-level controls including the number of obstetricians per 1,000 females (ages 15-44), female population (ages 15-44), inflation-adjusted income per capita, unemployment rate, and poverty rate.

Results

Table 1 reports unadjusted means of all variables by categories of SOP laws. Mothers across state categories are similar in age and marital status. Compared to mothers in states with moderate, those in states with no barriers are less likely to be black, (5% versus 17%) and more likely to be of Hispanic ethnicity (15% versus 11%). While smoking behavior is similar across state categories, 17% of mothers in high barrier states have unknown smoking behavior versus 11% in no barrier states. In terms of education, mothers in high barrier states are more likely to have their highest level of education as high school (30% versus 25% in low barrier states) or less than high school (20% versus 15% in states with no barriers). States with no or low barriers also have higher percentages of unknown education data than those with high barriers (both have 10% unknown versus 1% in states with high barriers). States with moderate barriers have the lowest average real income per capita, and highest unemployment and poverty rates compared to the other categories. All categories have similar ratios of providers.

According to Table 1, the mean overall infant mortality rate is highest in states with moderate barriers, followed by states with high barriers. Similar trends hold true for all other categories, except other causes of death, where high barrier states have the highest infant mortality rate. Across all subcategories, states with no barriers have the lowest infant mortality rates, except for sleep-related and accidental causes of death, where the infant mortality rates are higher and equivalent to those in low barrier states, respectively.

Figure 4 plots these annual average overall infant mortality rates (overall infant deaths per 1,000 live births), grouping states by CNM SOP law category. Figure 4 shows that while overall infant mortality rates are trending down in all states over time, states with no barriers have the lowest overall infant mortality rates at the start of the study period and continue to do so over time.

Regression results by age at death and cause are presented in Tables 2-3. For ease of interpretation, I also present the marginal effect in brackets which shows the absolute change in the number of infant deaths from a change in SOP category.

Regression results for effects of CNM SOP on infant mortality categorized by age at death are reported in Table 3. There are no statistically significant differences in overall, neonatal, or postneonatal infant mortality in states with no barriers, compared to those with low, moderate, or high CNM SOP barriers.

Table 4 shows effects of CNM SOP laws on infant mortality by cause. There are no statistically significant differences in infant deaths in the first year from preterm, perinatal, sleep related, or accidental causes in states with no barriers, compared to those with low, moderate, or high CNM SOP barriers. There are significant results for infant mortality from other causes for moderate and high SOP barrier states. An indicator for moderate SOP barriers is associated with an average increase of 1.29 quarterly infant deaths ($P<0.01$) and an indicator for high SOP barriers is associated with an average increase of 1.27 quarterly infant deaths from other causes ($P<0.05$).

Sensitivity Analysis

As sensitivity analysis I run all models with a linear time trend instead of year-by-quarter fixed effects. Results are reported in Tables 4-5. Overall little changes from results in the main analysis. There are no statistically significant differences in overall infant mortality, in infant deaths in the neonatal or postneonatal periods, or in those from preterm, perinatal, sleep related, accidental causes in states with no barriers, compared to those with low, moderate, or high CNM SOP barriers. Infant mortality from other causes is significant for moderate and high SOP barrier states at the same level as in the main model, with slightly different marginal effects. Here, an indicator for moderate SOP barriers is associated with an average increase of 1.33 quarterly infant deaths ($P<0.01$) and an indicator for high SOP barriers is associated with an average increase of 1.26 quarterly infant deaths from other causes ($P<0.05$).

Discussion

Overall, results from the empirical analysis show CNM SOP laws, as defined here, generally have no effect on infant mortality. In the one category of death where effects are seen, an indicator for high or moderate barrier states is associated with higher infant mortality counts compared to states with no barriers. These findings suggest that states granting independent scope of practice to CNMs attending low-risk births are not posing a public health risk to mothers and babies in the state in terms of infant mortality.

Strengths and Limitations

Though statistically significant effects are found in ‘other causes of death,’ I am unable to pinpoint exactly which types of death are driving these results. The ‘other’ category is an aggregation of 80 NCHS Select Causes of Death based on ICD-10 codes and 37 NCHS Select Causes of Death based on ICD-9 codes (Appendix Table B.1). Before any conclusions can be reached on the mechanism by which changes in CNM SOP laws are affecting these deaths, future research needs to be done to divide these causes into subcategories for more detailed analysis.

I would ideally like be able to identify births attended by CNMs in my analysis. However, there is underreporting of CNMs as birth attendants on the birth certificate forms (Walker, Schmunk, & Summers, 2004). As Markowitz et al. (2017) note, the NCHS guidance that a physician supervised, but CNM attended, delivery should be reported with the physician as the attendant, means the attendant reported on the birth certificates may be systematically related to the SOP laws (Markowitz et al., 2017). For this reason, I do not limit the analysis to infants who had CNM attended births.

Despite these limitations, this research represents an important contribution to the literature on informing the debate over allowing Certified Nurse-Midwives to practice to the full extent of their training. This study improves on prior correlational studies, looks at the impact of changes in CNM SOP laws over a twenty-year period, and builds on the findings of Markowitz et al. (2017). In the debate over allowing CNMs to practice with no barriers, the argument often comes down to those arguing that independent practice represents an improvement in efficiency versus those arguing CNM care is inferior to that under physicians. This study shows that allowing CNMs to practice with no SOP barriers does not result in changes to infant mortality, suggesting quality does not suffer under their care for this outcome. As the research on the effects of CNM SOP laws continues to grow, this study adds to the literature indicating that CNMs pose a promising solution to growing provider shortages affecting the provision of maternal and infant care in the U.S.

Figure 1. Certified Nurse-Midwife Scope of Practice Laws, 1994.

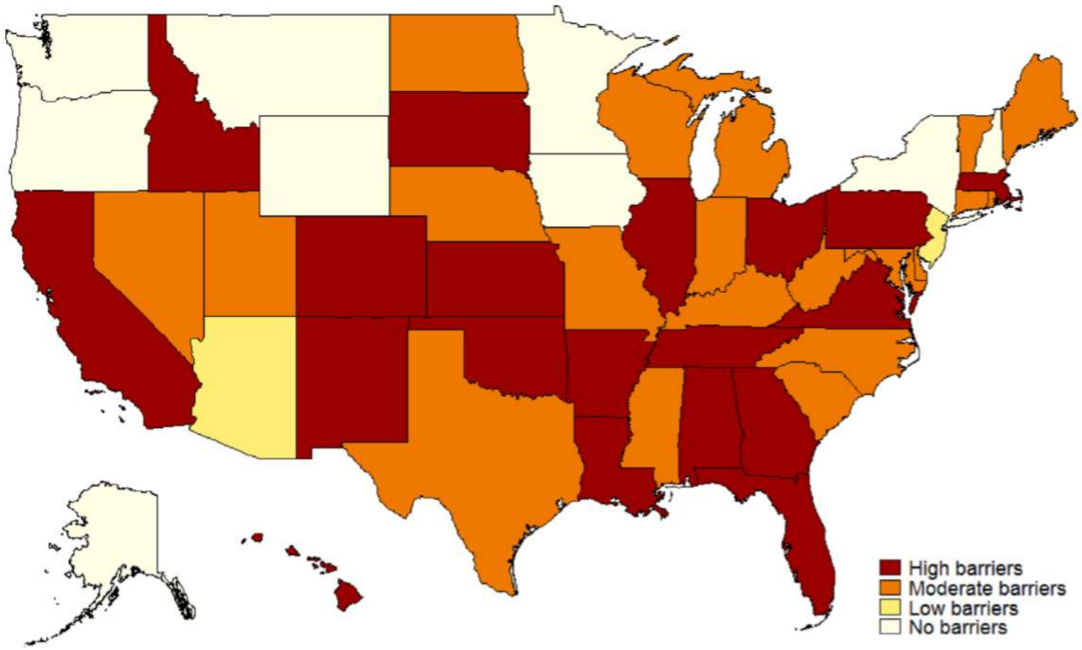
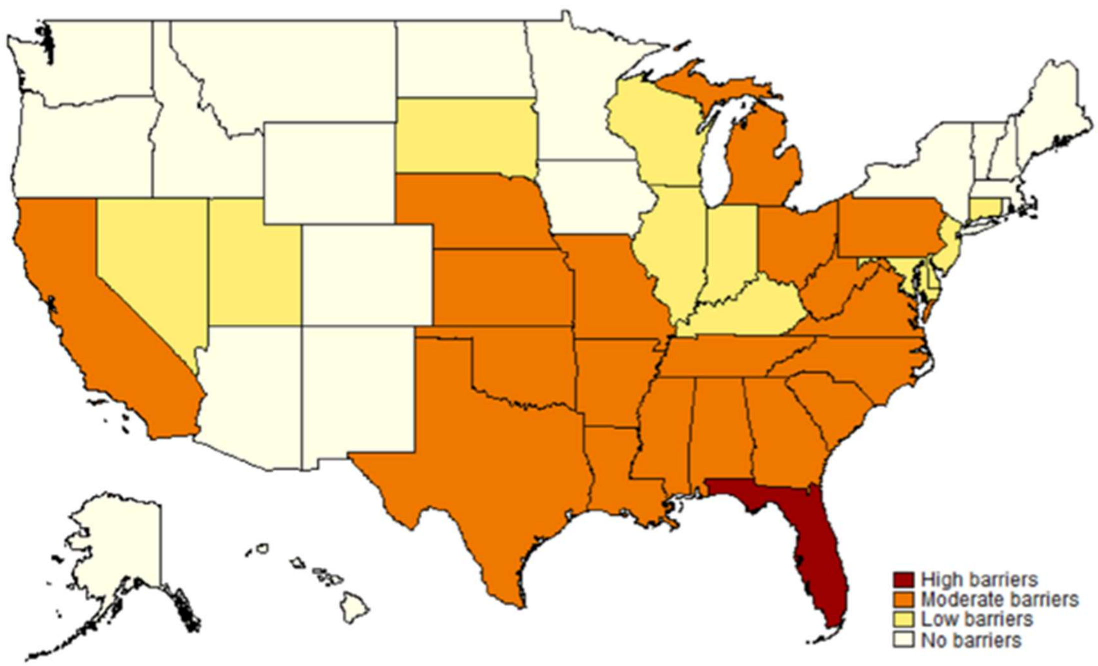
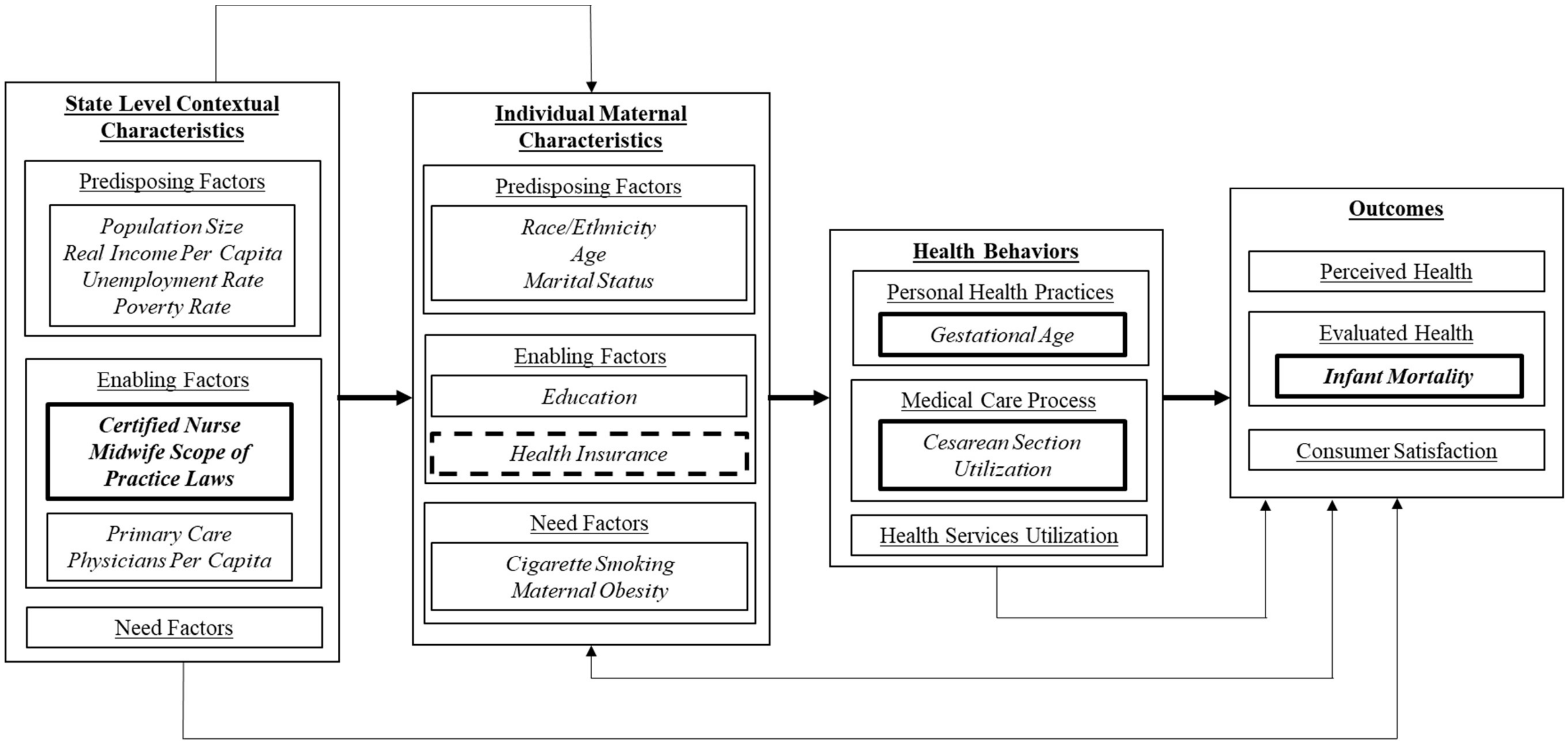


Figure 2. Certified Nurse-Midwife Scope of Practice Laws, 2014



Note. Figures 1 & 2 reprinted from "Competitive effects of scope of practice restrictions: Public health or public harm?," by Markowitz, S., Adams, E.K., Lewitt, M.J., & A.L. Dunlop, 2017, Journal of Health Economics, 55, 201-218. Copyright (2017) by Elsevier B.V. Reprinted with permission.

Figure 3. Conceptual Framework



Note: Author's adaptation of Anderson's Behavioral Model of Access to Health Care (2007)

Table 1. Means and Proportions, First Birth, by Scope of Practice Laws, 1995–2014

	No Barriers	Low Barriers	Moderate Barriers	High Barriers
Individual Characteristics				
Maternal age				
19 and Under	0.20	0.20	0.24	0.23
20-24	0.31	0.32	0.32	0.29
25-29	0.26	0.28	0.25	0.25
30-34	0.16	0.16	0.14	0.17
35-44	0.07	0.06	0.06	0.07
45 and Over	0.00	0.00	0.00	0.00
Married	0.56	0.56	0.54	0.58
Race				
White	0.83	0.81	0.78	0.77
Black	0.05	0.12	0.17	0.16
Native American	0.04	0.02	0.01	0.01
Asian	0.08	0.05	0.04	0.06
Hispanic Ethnicity	0.15	0.12	0.11	0.14
Cigarette Smoking During Pregnancy				
Yes	0.10	0.09	0.10	0.08
No	0.79	0.78	0.78	0.75
Unknown	0.11	0.13	0.12	0.17
Education				
Less than high school	0.15	0.16	0.18	0.20
High school	0.26	0.25	0.27	0.30
Some college	0.23	0.23	0.22	0.22
College	0.26	0.27	0.25	0.27
Education unknown	0.10	0.10	0.08	0.01
State Characteristics				
Number of OB/GYNs per 1000 women (Ages 15–44)	0.54	0.54	0.54	0.54
Population (Women Ages 15-44)	793,746	1,024,619	1,363,029	2,229,918
Real Income Per Capita	42,791	44,235	39,573	40,430
Unemployment Rate	5.62	5.59	5.76	4.91
Poverty Rate	11.95	11.03	13.56	12.57
Infant Mortality Rate (Number of infant deaths per 1,000 live births)				
All Deaths	4.93	5.80	6.47	6.26
By Time Period				
Neonatal Deaths	3.33	4.12	4.50	4.39
Postneonatal Deaths	1.60	1.67	1.97	1.86
By Cause				
Perinatal Causes of Death	2.42	3.15	3.40	3.28
Preterm Causes of Death	1.79	2.47	2.68	2.64
Sleep-Related Causes of Death	0.75	0.68	0.85	0.75
Accidental Causes of Death	0.07	0.07	0.09	0.09
Other Causes of Death	1.66	1.86	2.09	2.10

Figure 4. Annual Total Infant Mortality Rate by Category of CNM SOP Law, 1995-2014

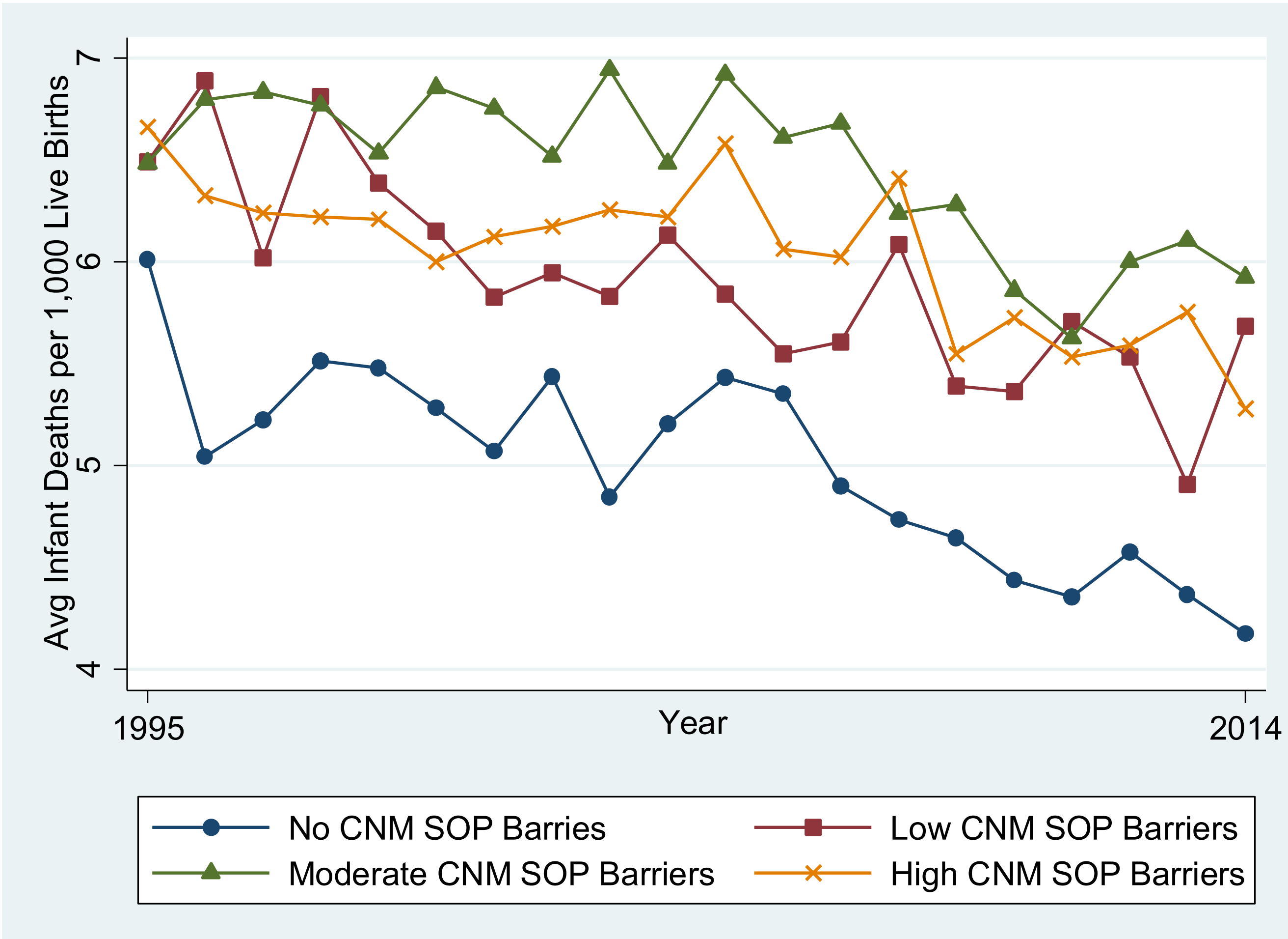


Table 2. Effects of Certified Nurse-Midwife Scope of Practice Laws on State Infant Mortality by Age at Death

	Low SOP Barriers	**Moderate SOP Barriers**	**High SOP Barriers**
	Coefficient	**Coefficient**	**Coefficient**
Neonatal Deaths (0- 27 days)	-0.01 [-0.30]	0.03 [0.73]	0.03 [0.98]
Postneonatal Deaths (28-364 days)	-0.01 [-0.14]	0.07 [0.83]	0.07 [0.87]
All deaths	-0.01 [-0.48]	0.04 [1.46]	0.04 [1.73]

Note: Boldface indicates statistical significance *p<0.05, **p<0.01, ***p<0.001). Brackets show marginal effects; the change in average quarterly infant deaths from change to the independent variable from the "no barriers" SOP law category. All models include robust standard errors and state and year-by-quarter dummy variables.

Table 3. Effects of Certified Nurse-Midwife Scope of Practice Laws on State Infant Mortality by Causes of Death

	Low SOP Barriers	**Moderate SOP Barriers**	**High SOP Barriers**
	Coefficient	**Coefficient**	**Coefficient**
Perinatal Causes	-0.04 [-0.81]	-0.01 [-0.13]	-0.00 [-0.01]
Preterm Causes	-0.06 [-1.00]	-0.03 [-0.48]	-0.02 [-0.42]
Sleep-Related Causes	-0.06 [-0.26]	0.04 [0.20]	0.06 [0.28]
Accidental Causes	0.05 [0.03]	0.03 [0.02]	0.13 [0.07]
Other Causes	0.03 [0.43]	**0.10** [1.29]**	**0.10*[1.27]**

Note: Boldface indicates statistical significance *p<0.05, **p<0.01, ***p<0.001. Brackets show marginal effects; the change in average quarterly infant deaths from change to the independent variable from the "no barriers" SOP law category. All models include robust standard errors and state and year-by-quarter dummy variables.

Table 4. Effects of Certified Nurse-Midwife Scope of Practice Laws on State Infant Mortality by Age at Death with Linear Time Trends

	Low SOP Barriers	**Moderate SOP Barriers**	**High SOP Barriers**
	Coefficient	**Coefficient**	**Coefficient**
Neonatal Deaths (0- 27 days)	0.00 [0.01]	0.03 [0.98]	0.04 [1.00]
Postneonatal Deaths (28-364 days)	-0.02 [-0.23]	0.07 [0.82]	0.07 [0.83]
All deaths	-0.01 [-0.32]	0.04 [1.63]	0.04 [1.65]

Note: Boldface indicates statistical significance *p<0.05, **p<0.01, ***p<0.001. Brackets show marginal effects; the change in average quarterly infant deaths from change to the independent variable from the "no barriers" SOP law category. All models include robust standard errors and state and year-by-quarter dummy variables.

Table 5. Effects of Certified Nurse-Midwife Scope of Practice Laws on State Infant Mortality by Causes of Death with Linear Time Trends

	Low SOP Barriers	**Moderate SOP Barriers**	**High SOP Barriers**
	Coefficient	**Coefficient**	**Coefficient**
Perinatal Causes	-0.02 [-0.33]	0.01 [0.16]	0.00 [0.04]
Preterm Causes	-0.05 [-0.81]	-0.02 [-0.29]	-0.03 [-0.45]
Sleep-Related Causes	-0.08 [-0.38]	0.04 [0.21]	0.07 [0.32]
Accidental Causes	-0.00 [-0.00]	0.01 [0.01]	0.10 [0.05]
Other Causes	0.03 [0.36]	**0.10** [1.33]**	**0.10*[1.26]**

Note: Boldface indicates statistical significance *p<0.05, **p<0.01, ***p<0.001. Brackets show marginal effects; the change in average quarterly infant deaths from change to the independent variable from the "no barriers" SOP law category. All models include robust standard errors and state and year-by-quarter dummy variables.

Chapter 3

The Impact of Medicaid Policies on Early Elective Deliveries and Infant Health

Introduction

An early elective delivery (EED) refers to a non-medically indicated delivery that occurs via cesarean section (C-section) or induction of labor during the “early term” period from 37 weeks gestation through 38 weeks and six days. In the past, a baby born anywhere between 37 and 42 weeks was considered full-term. This definition has changed in recent years though, as research has shown that neonatal outcomes vary depending on the timing of delivery within this five week gestational age range. Specifically, early-term infants have higher risks for neonatal morbidities including respiratory distress syndrome, transient tachypnea of the newborn (TTN), ventilator use, pneumonia, respiratory failure, hypoglycemia, and five-minute Apgar scores less than seven compared with full-term neonates (American College of Obstetricians and Gynecologists, 2013b). In accordance with such findings, the American College of Obstetricians and Gynecologists (ACOG) issued two committee opinions in 2013: the first designated a “full-term birth” as one that occurs between 39 weeks through 40 weeks and six days of gestation, and the second recommended no delivery prior to 39 weeks gestation unless medically indicated (American College of Obstetricians and Gynecologists, 2013a, 2013b).

Reasons motivating EEDs are unclear, but may include non-medical reasons such as convenience, relief of symptoms in the final stages of pregnancy, and perceived liability concerns (Centers for Medicare & Medicaid Services, 2012). The exact number of EEDs is unknown. One study using hospital discharge data linked with birth certificates in three states estimated that 3.74% of births in 2009 were early-term non-medically indicated deliveries, with more than half of those from non-indicated C-sections (Kozhimannil, Macheras, & Lorch, 2014). Overall, births in the early-term period were 25.47% of all births in 2016, a slight rise after a general decrease in recent years (in 2007 29.5% of births were in the early-term period versus 24.9% in 2015) (Martin, Hamilton, Osterman, Driscoll, & Drake, 2018). The reason for this downward trend is unknown, though there is growing awareness of the increased neonatal risks for babies born in the early-term period. Over the past 15 years, there have been hospital-level prevention efforts, regional perinatal quality collaboratives (often led by organizations such as the March of Dimes) to raise awareness of the issue among practitioners and the public, and state Medicaid policies aimed at reducing EEDs. This research focuses on these Medicaid policy efforts that have been implemented in recent years.

Medicaid policies on EEDs vary by state: some have policies that refuse payment for any non-medically indicated early-term delivery, others offer hospital level incentive payments and include the EED rate as a quality indicator, while many still have no policies in place. On average, Medicaid pays for half of all births in the United States, ranging from 27% in New Hampshire to 72% of births in New Mexico in 2015 (Smith et al., 2016). Though the exact number is unknown, many of these births may be EEDs. One study of Medicaid singleton births in 22 states estimated that approximately 7% (59,007) of the births in 2014 were early-term elective deliveries (Fowler, Schiff, Applegate, Griffith, & Fairbrother, 2014).

The motivation behind state Medicaid efforts to reduce early elective deliveries is to decrease adverse infant health outcomes and realize resulting cost-savings. In addition to negative health outcomes for infants, early elective deliveries are often more expensive than similar deliveries at full-term through associated costs for services such as NICU care and longer lengths of hospital stay for C-section deliveries (Fowler et al., 2014). One study estimates that policies restricting EEDs among all births have the potential to reduce NICU days by half a million per year, resulting in annual cost savings of almost $1 billion (Clark et al., 2010). In 2013, HHS estimated that a 10% reduction in deliveries occurring prior to 39 weeks would generate over $75 million in annual Medicaid savings (National Conference of State Legislatures, 2013).

Not everyone agrees that Medicaid policies discouraging early elective deliveries are beneficial. In ACOG's 2013 opinion on non-medically indicated early-term deliveries, the committee expressed concern over policies that deny reimbursement for early elective deliveries, as they believe more research is needed to characterize 'at-risk' pregnancies (American College of Obstetricians and Gynecologists, 2013b). Overall, births covered by Medicaid have lower odds of C-section and induction than those covered by private insurance, even though Medicaid recipients are more likely to have risk factors for adverse outcomes (Anum, Retchin, & Strauss, 2010; Kozhimannil, Shippee, Adegoke, & Vemig, 2013). Some have argued this indicates that C-section rates may be too low for Medicaid covered births and that policies disincentivizing the procedure for these mothers could adversely affect infant health (Alexander, 2015).

This analysis contributes new evidence on the effect of Medicaid policies targeting EEDs on birth practices. I use changes in state Medicaid policies during the years 2009-2016 as a natural experiment and focus on policies affecting financial reimbursement for providers and hospitals. I use a reduced form equation to link Medicaid policies directly to procedure utilization and outcomes for births likely covered by Medicaid.

Background

Across the country, there have been voluntary interventions at the hospital-level to try to reduce EED rates. Studies have shown that "hard-stop" hospital-level policies and practice guidelines can reduce early-term birth in these small-scale targeted settings (Clark et al., 2010; Oshiro et al., 2013). There have also been numerous collaborative campaigns taking many forms: some are public-private collaborations, others involve hospital and health care systems, and still others are led by non-profits such as March of Dimes. Oshiro et al. (2013) evaluated one such campaign, the Big 5 State Prematurity Initiative. As part of the initiative, hospitals in California, Florida, Illinois, New York, and Texas implemented a voluntary process improvement program that was associated with decreased scheduling of EEDs.

Research has looked at the effect of Medicaid EED policies in individual states. In 2011, Texas implemented a Medicaid policy to refuse payment for early elective deliveries. Dahlen et al. (2017) found this change in Texas Medicaid policy decreased early elective deliveries for singleton Medicaid-financed births in Texas by 10-14% and increased birthweights. Similarly, dissertation research by Byanova (2015) found an 18.5% reduction in early elective deliveries among singleton Medicaid-financed births in Texas. Byanova also found no effects on the use of C-sections among Medicaid-covered births, but increases among non-Medicaid patients (13.1%). Unpublished research from Allen and Grossman (2018) looks at a similar policy change in South Carolina and found it reduced the probability of having an early-term elective delivery by 2.5 percentage points, an effect driven by a reduction in probability of having an early-term induction.

Only one published study has examined the national effect of Medicaid policies targeting early-term elective deliveries. Buckles and Guldi (2017) use natality files (1989-2013) to examine the effects of Medicaid policy on early-term inductions and infant health. They find Medicaid policies reduced early-term inductions and that, in turn, early-term inductions are associated with lower birth weights and increased risk of precipitous labor, birth injury, and required ventilation. Their paper has substantial weaknesses that this study will address, including incomplete and inaccurate Medicaid policy classifications, a limited post-period, and no identification of Medicaid-eligible mothers.

This research contributes to the growing literature on this topic with new estimates of the national impact of state Medicaid policies on early-term elective deliveries. I use data from the National Vital Statistics System for the years 2009-2016, as well as better defined Medicaid policies that include fee schedule data in my definition of state policies. I also address measurement error in the birth certificates by predicting Medicaid coverage at delivery, allowing for the identification of separate effects for the Medicaid and overall population.

Medicaid Policy Categorizations

State Medicaid policies targeting EEDs vary in form. Some states have policies denying payment for any non-medically indicated early elective delivery, while others reduce payments or offer hospital level incentive payments. In addition, states can eliminate the fee differential between C-sections and vaginal births by setting Medicaid reimbursements for both at the same rate. While several state Medicaid programs have had equal reimbursement rates in place for over a decade, the earliest Medicaid policy specifically targeting early-term elective deliveries went into effect in 2009. By 2016, 21 states have Medicaid policies in place and eight have payment reform policies (see Figures 1-2).

For my analysis, I group Medicaid policies based on the type of provider incentive used to change behavior around early elective deliveries. All state policies and implementation dates are listed in Appendix Table C1. I classify state Medicaid policies into the following five categories:

EED Policies: This category includes state Medicaid programs that completely deny reimbursement for non-medically indicated elective deliveries at less than 39 weeks gestation.

Partial EED Policies: This category includes policies that still reimburse for early-term elective deliveries, but have mechanisms to discourage the practice. In some states, this means payment is reduced by a small percentage for non-medically indicated deliveries at less than 39 weeks gestation or that elective delivery reduction is a required quality indicator for incentive payments to hospitals. Finally, a small number of states instituted “hard-stop” policies that banned any non-medically indicated elective birth before 39 weeks gestation, but did not alter reimbursement.

Payment Reform Policies: This category includes policies that affect Medicaid reimbursement rates for C-sections and vaginal deliveries overall. These policies include episodic perinatal bundles, blended payment models, or changes to the Medicaid fee schedule resulting in equal reimbursement rates for C-section and vaginal deliveries. While these policies are not targeted at deliveries prior to 39 weeks specifically, they may translate to lower rates of early-term elective deliveries due to decreased use of C-sections with the Medicaid population.

Combination Policies: This group includes states with an EED policy (full or partial) and payment reform in place. For example, some states have an EED policy that denies reimbursement for an early-term elective delivery and a fee schedule change for equal Medicaid reimbursement for C-section and vaginal deliveries.

No Policies

This category includes states with no policies targeting early-term elective deliveries or reimbursement for vaginal and C-section births.

Conceptual Framework

This research uses a conceptual framework (Figure 3) based on Anderson's Behavioral Model of Health Services Use, including controls for predisposing, enabling, and need characteristics (Anderson et al., 2007). This framework illustrates the causal pathway through which I hypothesized that state Medicaid policies targeting early-term elective deliveries affect infant health outcomes.

According to Anderson, enabling conditions (such as policy decisions) at the aggregate level facilitate or impede use of health care services. In my conceptual model, state Medicaid policies alter incentives for physicians to offer and use different procedures in the early-term period. For example, in a state with a full EED policy, a physician would not be compensated for an induction or a C-section that is not documented as medically necessary. Such a policy change would act as negative financial shock and likely result in providers only offering these elective procedures to mothers covered by Medicaid in the period after 39 weeks gestation, when their fees would not be affected.

I hypothesized that physicians would change their behavior in the presence of new Medicaid policies based on the theory of physician-induced demand (PID). According to PID, physicians take advantage of the information asymmetry between doctors and their patients to increase the intensity and quantity of treatment in response to financial shocks (McGuire, 2000). Evidence is lacking on whether PID or patient requests are driving EED trends. A recent surveys of pregnant women found that a majority of women believe that full-term is reached before 39 weeks and that a safe delivery does not require waiting to 39 weeks of gestation (Baldwin, Swamy, & Wheeler, 2018). While this may indicate that women are requesting EEDs in the early-term period without understanding the risks, it also shows that a substantial asymmetry of information exists between doctors and patients on the costs and benefits of elective delivery before 39 weeks.

Much of the empirical evidence on PID regarding childbirth concerns C-section utilization. Studies focused on fee differentials for C-sections versus vaginal births find that when reimbursements are higher for C-sections, there is a strong positive effect on the use of cesarean delivery (Foo, Lee, & Fong, 2017; Gruber, Kim, & Mayzlin, 1999). Interestingly, Alexander (2015) uses birth certificate data and finds that more C-sections are performed when Medicaid pays doctors relatively more for the procedure, but that increased C-section use is associated with fewer infant deaths for Medicaid covered births.

Based on these empirical findings, I hypothesized that physicians in states without payment reform will react to Medicaid policies differently than those in states with equal Medicaid payment for C-sections and vaginal births. In states without payment reform, physicians risk losing income by waiting until a pregnancy is full-term, as a birth that would have been an elective C-section in the early-term period may be a spontaneous vaginal birth instead. Therefore, a physician worried about declining Medicaid reimbursement might increase the use of C-sections in the full-term period. In states with payment reform, I hypothesized there would only be a decline in inductions during the early-term period.

Among the Medicaid eligible, I hypothesized the reduction in inductions and shifting of C-sections to the full-term period will lead to improved infant health outcomes. As fewer early elective Medicaid deliveries occur, women carry babies to longer gestational ages, reducing the risk of respiratory distress syndrome and infants requiring ventilation and surfactant after delivery.

According to Anderson et al., the effects of these aggregate enabling decisions work through individual characteristics. I hypothesized one of the key individual characteristics is insurance coverage and that the policy will have different impacts for mothers covered by Medicaid versus other types of insurance. Prior research using the birth certificates only looked at overall inductions by gestational age. This research predicts which mothers are likely to have a Medicaid coverage at delivery to estimate specific effects for Medicaid paid births.

EED utilization is also influenced by individual characteristics such as race, ethnicity, age, and marital and health status. White, married, non-Hispanic, and college-educated women over the age of 35 are more likely to have an early-elective delivery, therefore I control for these individual demographic characteristics in all models (Kozhimannil et al., 2014).

In addition, a policy at the state level that could affect the dependent variables is the presence of a collaborative campaign, particularly if a physician works in a participating hospital. These campaigns range from increasing awareness among practitioners to interventions that change hospital procedures for scheduling inductions and C-sections prior to 39 weeks. Depending on the specifics of the campaign, these might also influence provider willingness to offer or agree to early-term elective C-sections and inductions. I control for the presence of these campaigns (listed in Appendix Table C.3).

According this theoretical framework, I hypothesized that compared to states with no policies, Medicaid policies targeting early elective delivery reduction are associated with the following among Medicaid paid births: 1) decreases in EEDs; 2) decreases in early-term non-medically indicated inductions and C-sections; 3) increases in non-medically indicated C-sections at ≥39 weeks gestation among states with EED policies and no payment reform; and 4) decreases in infants requiring ventilation and surfactant. I use mutually exclusive definitions of inductions and C-sections because inductions often result in C-section deliveries. Detailed information about these definitions follows in the *Measures* section.

Study Design

Data

I use natality data for the years 2009-2016 from the Center for Disease Control's National Vital Statistics System, part of the National Center for Health Statistics (NCHS). This data comes from the standard birth certificate form completed for all births in the United States and includes maternal and infant demographic characteristics, as well as information on health outcomes. I use restricted files that include geographic data at the state and county level. In 2003, a revised version of the U.S. Standard Certificate of Live Birth was introduced, but transition to the revised form was inconsistent and delayed across states (Centers for Disease Control and Prevention, N.D.). As available, measures were selected to be consistent across certificate revisions and reporting areas, however inconsistent reporting of the revised measures may affect comparability of some characteristics and health outcomes across years.

I also use data from the Pregnancy Risk Assessment Monitoring System (PRAMS) from 2009-2011 to predict insurance coverage at delivery. PRAMS is an ongoing state- and population-based survey of women that deliver live-born infants (D'Angelo et al., 2015). Self-reported survey data are linked to birth certificate data and weighted for sample design, nonresponse, and noncoverage. PRAMS only releases data when a minimum overall response rate is met. From 2007-2010, the threshold was 65%, while from 2012-2013, it was changed to 60% (Centers for Disease Control and Prevention, 2017). This response rate threshold means that the number of states with available data varies from year to year. During the period 2009-2011, 33 states had PRAMS data available.

Study Sample

The analytic sample is all births at 37 weeks gestation or later during the years 2009-2016. The sample will also be limited to mothers who reside in the state where they gave birth. My sample size after limiting on these factors is 27,594,531 births. For models that use the full sample of births, I use a 25% random sample of birth certificates based on states to manage computer file size. All sample sizes based on the 25% random sample are reported in Figure 4.

Predicting Medicaid Coverage at Birth

The 2003 revision of the U.S. Standard Certificate of Live Birth included a question on principal source of payment for delivery (including the options Medicaid, private insurance, self-pay, other, or unknown source of payment). As of 2010, only 33 states had adopted the revised birth certificate and the number of births reported as having an "unknown" payment source varied widely among them, from 0.2% in Texas to 27.2% in Nevada (Curtin, Osterman, Uddin, Sutton, & Reed, 2013). For the years 2009 and prior, the birth certificate payment source has been shown to be less valid and reliable for racial and ethnic minorities, women younger than age 24, and those with less education (Kane & Sappenfield, 2014). Further, the birth certificates do not include income in reported data, which could be used as a proxy for Medicaid eligibility.

Therefore, to better identify the Medicaid covered births, I follow and build on Alexander's (2015) approach to predict Medicaid for mothers in the study sample using the PRAMS data, which provides a more reliable measure of Medicaid insurance at birth during my study years (Ahluwalia, Helms, & Morrow, 2013). The model for doing so is specified as follows:

$$Medicaid_{ist} = f\ (FPL_{st}, X_{it}, \lambda_{st})$$

Here, Medicaid coverage for individual i in state s at time of birth t ($Medicaid_{ist}$), is a function of Medicaid eligibility in state s at time t (FPL_{st}), individual maternal characteristics (X_i) including age, race, ethnicity, marital status, education, and health risk factors (smoking, gestational diabetes, and hypertension), and state characteristics including female population of reproductive age and poverty rate (λ_s). To calculate this predictive function, I assembled a data set of all Medicaid eligibility thresholds for pregnant women (which vary among states and over time) in terms of the federal poverty level (FPL), female population (ages 15-44), and state level poverty rates and merged this data into both the PRAMS and the birth certificate files.

Results from the logistic regression using PRAMS data for the years 2009-2010 are reported in Appendix Table C2. Based on these coefficients, I predict Medicaid coverage with the 2011 PRAMS data and compare results to reported Medicaid at birth. The correlation between predicted Medicaid and reported Medicaid coverage on PRAMS is 0.55. I correctly predict Medicaid coverage for 70.1% of mothers who reported it on the 2011 PRAMS and incorrectly predict it for 15.6% of those who did not.

When applied to the birth certificates, I can predict Medicaid coverage for 27,455,157 births. I also compare births with predicted Medicaid coverage to those with Medicaid reported as source of payment for delivery from 2013-2016, when the question was more widely reported by states. The correlation between predicted Medicaid and reported Medicaid coverage on the birth certificates is 0.49. I correctly predict Medicaid for 75.8% of births with reported Medicaid payment and for 25.8% that did not report it.

Analytic Strategy

All analyses are performed in Stata Version 14 and SAS 9.4. I use a multi-state multi-time period difference-in-differences methodology to evaluate the effects of varying EED

Medicaid policies on the probability of outcomes of interest. I use logistic regressions to estimate the probabilities of all outcomes and I separately examine effects for overall and Medicaid covered births. The base version of these models is as follows:

$$Y_{ist} = \beta_0 + \beta_1 MEDPAY_{st} + \beta_2 X_{icst} + \beta_3 Z_{cst} + \varphi_s + \tau_t + \epsilon_{st}$$

Y_{ist} is outcome of interest for infant i in state s at time t. β_1 is the coefficient of interest. $MEDPAY_{st}$ are indicator variables for Medicaid EED policies in effect in state s at time of birth t. X_{ist} is a vector of maternal control variables including age, race, marital status, and education. Z_{st} is a state-level control for whether there was a collaborative EED reduction campaign in a state during a given quarter. While these campaigns are not considered Medicaid policies, they may have affected early elective delivery rates in a state, so I control for them here (identified campaigns are listed in Appendix Table C3). φ_s and τ_t are state and year-by-quarter fixed effects.

Description of Measures

Defining Medical Indication: There is no specific measure for EEDs in the birth certificate data, raising a concern about separating medically necessary C-sections and inductions from elective procedures. Earlier analysis by Buckles and Guldi (2017) used early-term inductions (defined as any induction at 37 or 38 weeks) as a proxy for EEDs, a measure that is likely an overestimate as it includes medically necessary inductions.

Using ACOG's suggested medical indications for early-term deliveries (American College of Obstetricians and Gynecologists, 2013b) and in consultation with a clinician, I define medical indication based on the available measures in the birth certificates across study years. Mothers with any history of diabetes (pre-pregnancy or gestational), eclampsia, hypertension (chronic or pregnancy-related), prior C-section, multiple gestation, or chromioamniotis are considered to have a medical indication. I also consider infants that are small for their gestational age (defined as having a sex-specific birth weight less than the 10th percentile for gestational age at birth) as criteria for a medically indicated induction or C-section. ACOG lists “fetal congenital malformations” as an example of a medically indicated condition. I define fetal malformations using measures available in the birth certificates (anencephaly, meningomyeocele/spina bifida, cyanotic congenital heart disease, congenital diaphragmatic hernia, omphalocele, gastroschisis, limb reduction defect, down syndrome, suspected chromosomal disorder, and hypospadias).

Medicaid Policy Categories: As described previously, Medicaid policy categories are classified into five categories: 1) full EED policy, 2) partial EED policy, 3) payment reform, 4) combination, and 5) no policy.

Early Elective Delivery: Figure 4 illustrates the hierarchy of definitions used to define elective birth and type of delivery. I define an EED as any C-section or induced vaginal birth without medical indication that occurs at 37 or 38 weeks gestation. C-sections and inductions are mutually exclusive. Since many inductions result in C-sections, I only count C-sections with no record of induction in all measures.

Early Elective Induction: I define these as induced vaginal births occurring at 37 or 38 weeks gestation with no record of medical indication.

Early Elective C-section: These are defined as cesarean deliveries at 37 or 38 weeks gestation with no record of induction and no medical indication.

Full-term Elective Induction: I define these as induced vaginal births at 39 or 40 weeks gestation with no medical indication.

Full-term Elective C-section: I define these as cesarean deliveries at 39 or 40 weeks gestations with no record of induction and no medical indication.

Assisted Ventilation: Responses are categorized as yes, no, and unknown. If the birth certificates indicate that an infant either required assisted ventilation immediately following delivery or for more than six hours then they are categorized as having received assisted ventilation.

Surfactant: Defined as yes, no, and unknown. This measure indicates whether the newborn was given surfactant replacement therapy.

Covariates: All models include individual-level covariates to account for maternal characteristics that may impact the dependent variables. Maternal race, ethnicity, education, age, and marital status are all correlated with likelihood of having an early-term birth (Kozhimannil et al., 2014). Mothers are classified into three race categories: white, black, or other. Maternal ethnicity is classified as Hispanic or unknown. Maternal education measures a mother's highest educational attainment measured in years: 0-8; 9-11; 12; 13-15; 16 or more years; or education unknown. Maternal age is reported in years. Marriage is a dichotomous measure of married or unknown. I also include a state-level control for whether there was a collaborative EED reduction campaign in a state during a given quarter (identified campaigns are listed in Appendix Table C3).

Education, assisted ventilation, and surfactant include "unknown" categories because of issues around states adopting the 2003 birth certificate revision, resulting in the updated versions of these measures not being available in all states and years during the study period. States that did not report a consistent measure in certain years and subsequently had missing data are considered "unknown."

Results

Table 1 reports unadjusted means for all variables by Medicaid EED policy category. Generally, mothers in states with partial EED policies in place are slightly older, more likely to be married, and more likely to have completed 16 or more years of schooling than those in the other four categories. A higher proportion of mothers in states with full EED policies in place are black and of Hispanic ethnicity as well. States with no policies in place have 24% unknown education data, versus ≤ 6% in other policy categories. States with full EED policies had the highest number of mothers with predicted Medicaid coverage (54%), those with no policies had 50%, states with payment reform and combination policies had 47% and 46% respectively, and those with partial EED policies had the least (41%).

Proportions of early-term elective delivery (including both C-sections and inductions) are similar across policy categories. No policy and full EED policy states have the most EEDs (7% each) and partial and combination categories have the least at 5%. These numbers are generally consistent with prior literature and state based estimates (Dahlen et al., 2017; Fowler et al., 2014). No policy and full EED policy states also have slightly higher proportions of early- and full-term elective inductions than the other three policy categories. The number of early-term elective C-sections are very similar across all policy categories, while the number of full-term elective C-sections is slightly higher in no policy and payment reform states.

Across all states, ≤ 3% of newborns required ventilation, and < 1% required surfactant replacement therapy. For both measures, 23% of data for these outcomes was unknown in no barrier states versus ≤ 5% in other policy categories. While missing data for these outcomes should not bias results, it indicates that this is a limited sample that excludes states with certain characteristics.

Table 2 reports logistic regression results as marginal effects for delivery method among births with predicted Medicaid coverage. States with full EED policies in place are associated with a 0.6 percentage point decrease ($P<0.05$) in early elective deliveries over the study period compared to states with no policies in place. This decline in EEDs represents a change from 6.6% of Medicaid paid births to 6%, a 9% decrease. To put this change in context, there are approximately 3.4 million singleton term births in the U.S. each year. If roughly half of these are paid for by Medicaid and 6.6% are early elective deliveries, then a 9% decrease is equivalent to approximately 10,000 fewer early elective deliveries each year among the Medicaid population.

Table 2 shows this decrease in EEDs in full-policy states is driven by a 0.5 percentage point reduction in early elective inductions (representing a change from 3.6% of Medicaid paid births to 3.1%) compared to states with no policies in place ($P<0.01$). Partial EED policy states are also associated with a 0.3 percentage point increase in the probability of early-term elective induction ($P<0.05$), representing a change from 3.6% of Medicaid paid births to 3.9%, compared to states with no policies in place.

There are no significant effects in any policy categories for full-term elective inductions or early-term elective C-sections. Full-term elective C-sections are associated with a 0.5 percentage point increase in states with full EED policies compared to states with no policies in place ($P<0.05$). This increase in full-term elective C-section represents a change from 6.3% of Medicaid paid births to 6.7%.

Logistic regression results reported as marginal effects for birth outcomes among the Medicaid predicted sample are reported in Table 3. Here, states with partial reform policies are associated with a 0.5 percentage point decrease in the likelihood of required ventilation for newborns compared to states with no policies in place ($P<0.01$). This increase represents a change from 2.7% of Medicaid paid births to 2.2% with required ventilation. There were no significant effects for required surfactant replacement therapy in any policy category.

Sensitivity Analysis

Logistic regression was also run on the overall sample of all births for comparability to prior studies and to see how the Medicaid population may be driving trends in the overall population. Results from logistic regression on the overall sample are reported in Tables 4-5. Here, there is no decrease in EEDs in full EED policy states. In partial policy states there is a 0.3 percentage point increase in EEDs ($P<0.001$), driven by a 0.2 percentage point increase in early elective inductions ($P<0.05$), compared to those states with no policies. In full EED policy states there is a 0.4 percentage point decline in early elective inductions ($P<0.01$) and a 0.6 percentage point increase in full-term C-sections ($P<0.001$) compared to states with no policies. There are no significant effects for payment reform or combination policy categories.

For infant health outcomes, states with full EED policies are associated with a 0.6 percentage point decrease in ventilation ($P<0.05$) and states with partial EED policies are associated with a 0.3 percentage point decrease in ventilation ($P<0.01$).

Discussion

These results show that Medicaid policies completely denying reimbursement for non-medically indicated early-term elective deliveries are associated with a 9% decrease in EEDs among Medicaid births. These results are comparable to earlier estimates by Dahlen et al. (2017), where they found a 10-14% decrease in Texas, a state with a much higher EED rate than the national average. The decrease found here in the EED rate appears to be driven by a reduction in early-term elective inductions, however it is offset by an increase in full-term elective C-sections, likely due to physicians shifting use of procedures to the full-term period among the

Medicaid population to make up for any loss of income in the early-term period. This increased utilization of elective C-sections in the full-term period may explain why there are no statistically significant changes observed in required ventilation among Medicaid births in full-policy EED states. In addition, there may be no change in required ventilation because while effects represent a statistically significant reduction in EEDs, these deliveries make up a small percentage of Medicaid births and the decrease may not be large enough to affect infant health outcomes in a meaningful way.

The small, but significant increase in early-term elective inductions among Medicaid births in in partial policy states may be due to physicians performing more procedures in response to the lower reimbursement. Interestingly, partial policy states are the only category that sees any change in infant health over the study period, indicating that the use of certain procedures may be too low among the Medicaid population, as Alexander (2015) has argued with C-sections. The lack of effects in payment reform and combination policy states may indicate that Medicaid EED policies have less effect among the Medicaid population in states that have already eliminated the Medicaid fee schedule differential to address overall C-section rates.

Results using the full sample of all births show similar trends among early-term elective inductions and full-term C-sections in full and partial EED policy states, however, there is a statistically significant decline in ventilation for infants in full EED policy states that is not present among the Medicaid births. These results highlight the importantance of isolating effects specific to the Medicaid covered population. In addition, all effects here appear to be driven by Medicaid reimbursement policies, as coefficients for collaborative campaigns are not statistically significant in any models, including those using the full sample of all births.

Strengths and Limitations

While this research represents an important contribution to the growing literature on EEDs, there are several limitations. The largest concerns the missing data on infant health measures. While regression results are unbiased estimates for the known observations, the observations represent a limited sample that excludes states with certain characteristics. This missing data limits the generalizability of results to all births.

In addition, when examining state level Medicaid policies, structural endogeneity is a potential concern, as states may have changed laws in response to concerns about EED rates. While there has been little research on the motivation for changing these state Medicaid policies, there has been a concerted national push from non-profits such as the March of Dimes and Leapfrog Group, as well as federal agencies such as the Department of Health and Human Services and the Center for Medicare and Medicaid Services that indicates these policies may part of a growing national trend, rather than isolated regional initiatives (Centers for Medicare & Medicaid Services, 2012).

Despite these limitations, this research is an important contribution to the literature with new estimates on policy effects by overall and Medicaid births, as well as measures of non-medically indicated early-term births. As more state governments, health care practitioners, and members of the public gain awareness of the risks inherent to elective delivery before 39 weeks, these findings will be useful as new states implement variations of Medicaid policies to address EEDs. The results of this paper suggest that Medicaid programs denying reimbursement for EEDs may result in unintended consequences, including more elective full-term C-section births and no changes in infant health.

Figure 1. State Medicaid Policies, 2009

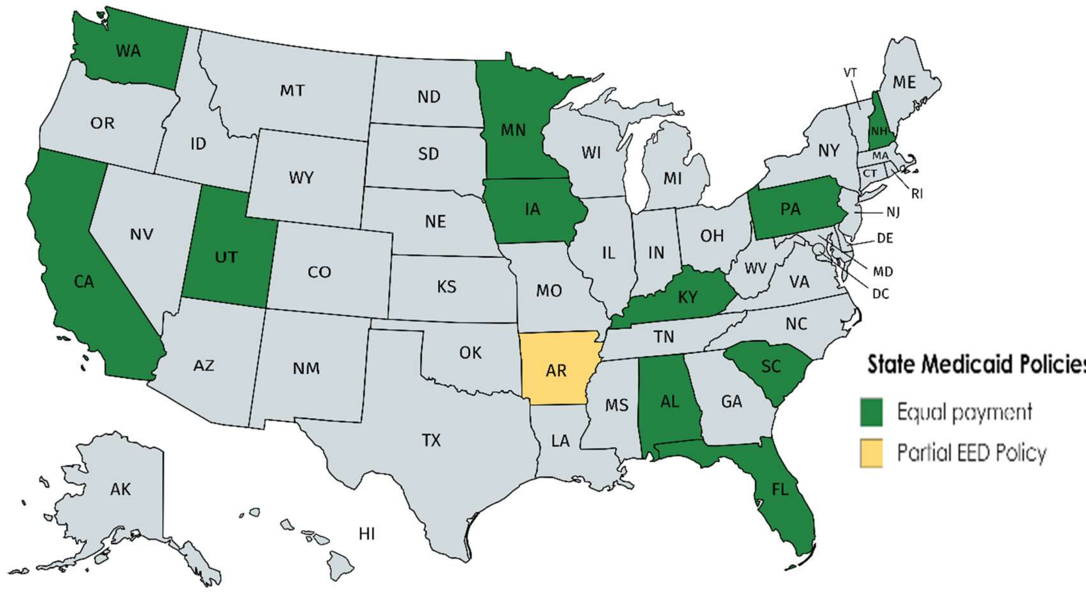


Figure 2. State Medicaid Policies, 2016

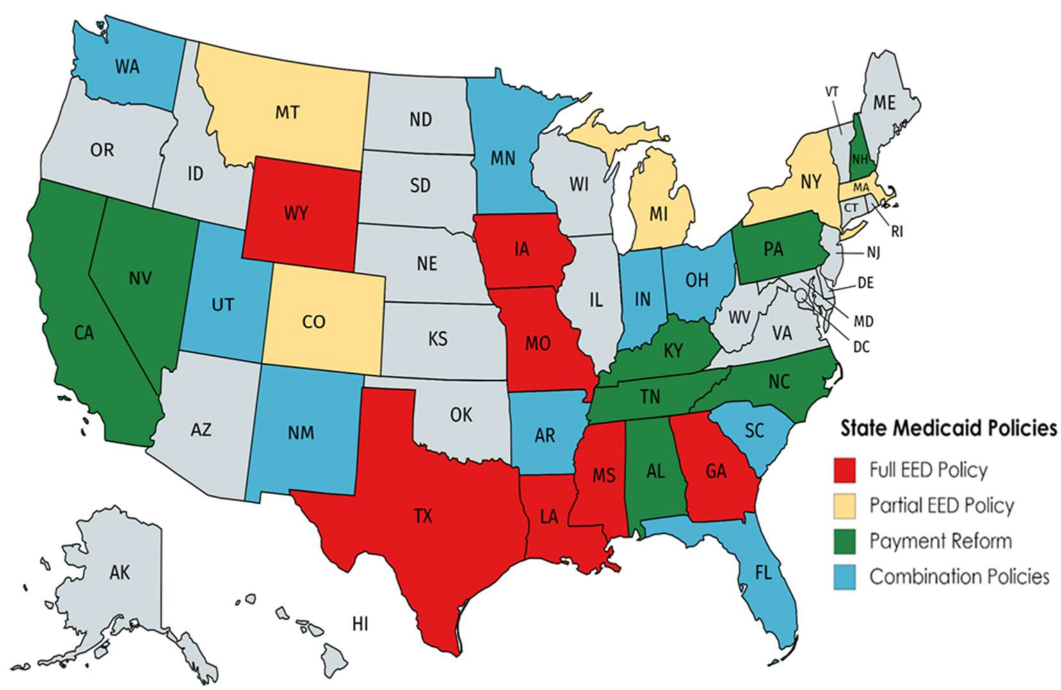
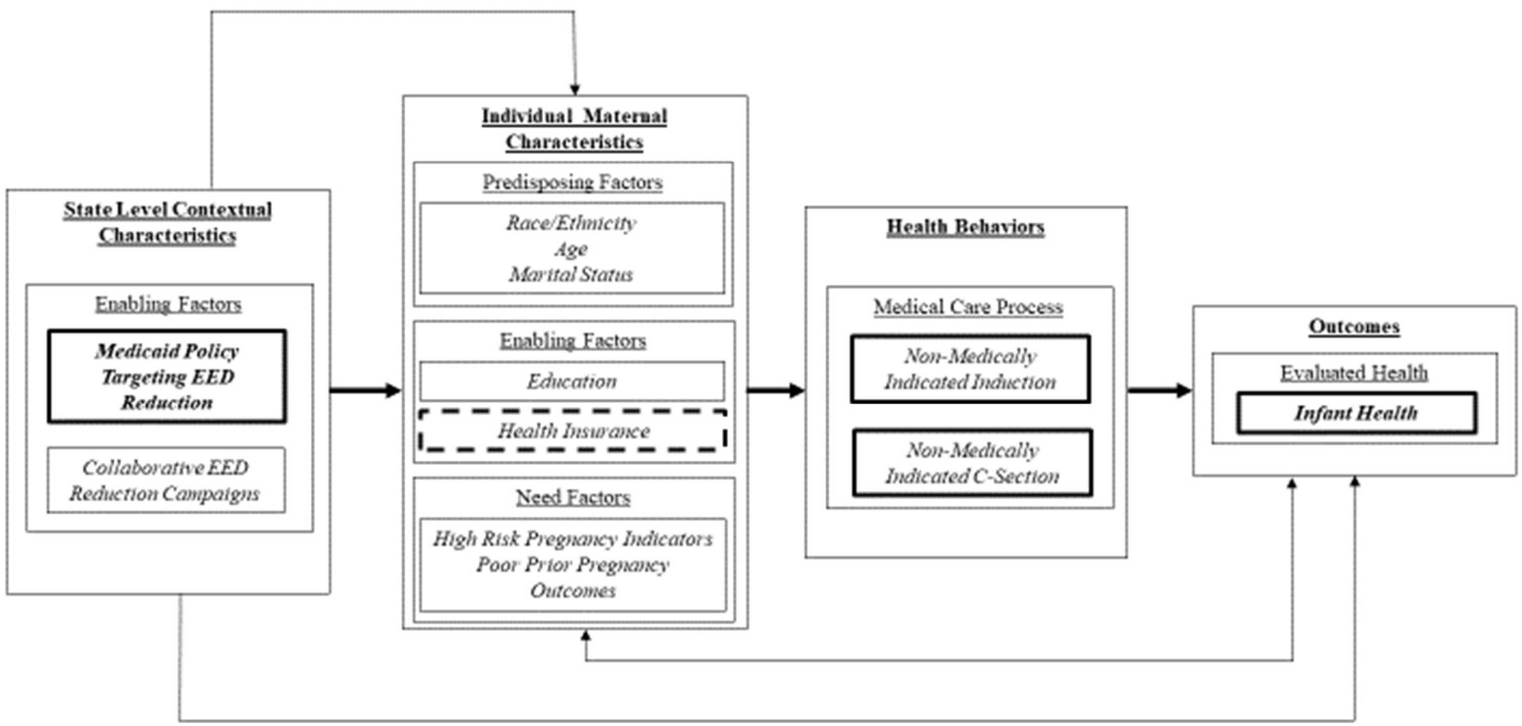


Figure 3. Conceptual Framework



Note: Author's adaptation of Anderson's Behavioral Model of Access to Health Care (2007).

Figure 4. Definitions and Sample Size by Delivery Type

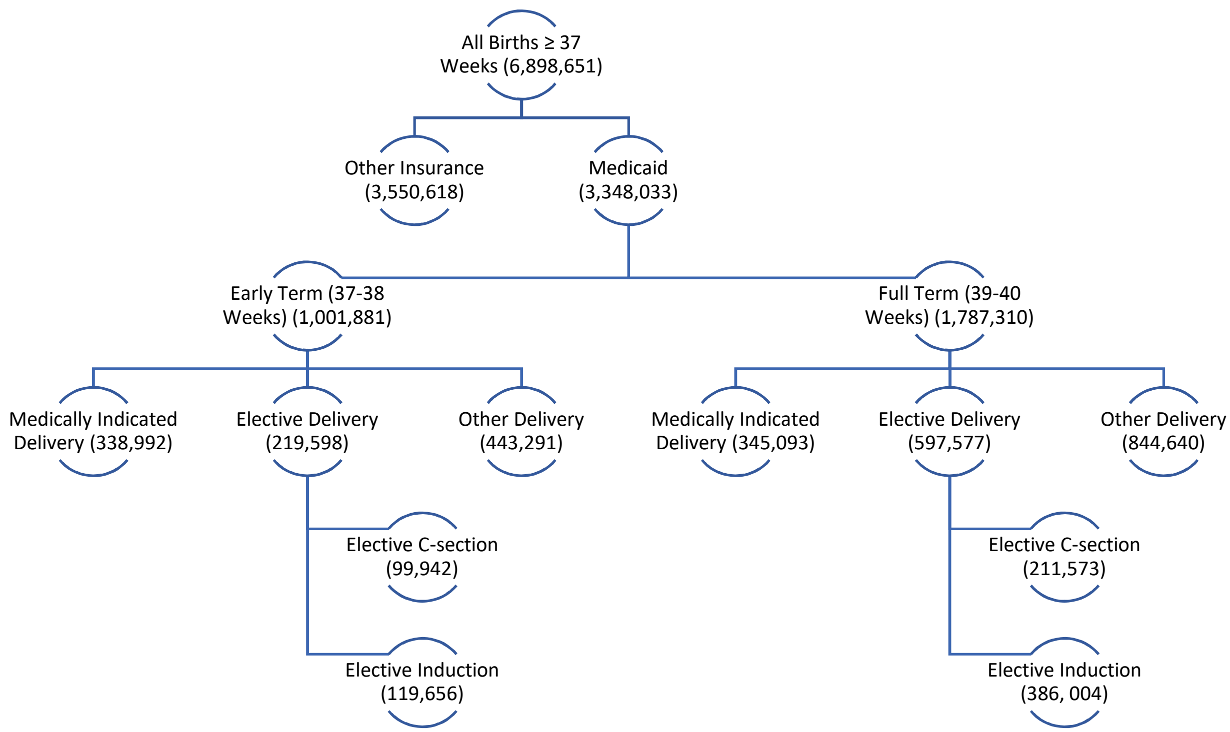


Table 1. Means and Proportions by Medicaid Policy Category, 2009–2016

	No Policy	EED Policy	Partial EED Policy	Payment Reform	Combination
Maternal Characteristics					
Age (years)	27.9	27.5	29.0	28.2	28.2
Married	0.60	0.58	0.64	0.60	0.62
Race					
White	0.76	0.77	0.76	0.76	0.78
Black	0.16	0.17	0.15	0.13	0.13
Other	0.08	0.05	0.09	0.10	0.09
Hispanic Ethnicity	0.19	0.35	0.20	0.30	0.14
Education					
0-8 Years	0.03	0.04	0.03	0.04	0.03
9-11 Years	0.10	0.14	0.10	0.12	0.10
12 Years	0.19	0.27	0.20	0.25	0.23
13-15 Years	0.22	0.29	0.26	0.27	0.31
>16 Years	0.23	0.26	0.35	0.27	0.30
Unknown	0.24	0.00	0.06	0.06	0.03
Predicted Medicaid	0.50	0.54	0.41	0.47	0.46
Dependent Variables					
Early-Term Elective Delivery	0.07	0.07	0.05	0.06	0.05
Early-Term Elective Induction	0.04	0.04	0.03	0.03	0.03
Full-Term Elective Induction	0.12	0.13	0.10	0.10	0.11
Early-Term Elective C-section	0.03	0.03	0.03	0.03	0.02
Full-Term Elective C-section	0.07	0.06	0.06	0.07	0.05
Assisted Ventilation					
Required	0.02	0.03	0.02	0.02	0.03
Unknown	0.23	0.00	0.05	0.04	0.03
Surfactant					
Required	0.006	0.001	0.006	0.006	0.008
Unknown	0.23	0.00	0.05	0.04	0.03

Note: Proportions reported unless otherwise indicated. N = 6,879,415 based on a 25% sample of all births 37 weeks and over.

Table 2. Marginal effects of Medicaid Policies on Early Elective Deliveries and Birth Procedures for Births Likely Paid by Medicaid, 2009-2016

	EED Policies	**Partial EED Policies**	**Payment Reform Policies**	**Combined Policies**
Early Elective Delivery	**-0.006***	0.002	0.002	0.001
Early-Term Elective Induction	**-0.005****	**0.003***	0.001	0.001
Full-Term Elective Induction	0.004	-0.000	0.003	0.002
Early-Term Elective C-section	-0.000	-0.000	0.001	-0.000
Full-Term Elective C-section	**0.005***	-0.001	-0.000	-0.002

Note: *N* = 3,327,000 based on a 25% sample of all births 37 weeks and over. All results are estimated using logistic regression and all models include state and year-by-quarter fixed effects and clustered standard errors. Boldface indicates statistical significance *p<0.05, **p<0.01, ***p<0.001).

Table 3. Marginal effects of Medicaid Policies on Infant Health Outcomes for Births Likely Paid by Medicaid, 2009-2016

	EED Policies	**Partial EED Policies**	**Payment Reform Policies**	**Combined Policies**
Requires Ventilation	-0.005	**-0.005****	-0.004	-0.0001
Surfactent Administered	-0.000	-0.000	-0.000	-0.000

Note: *N* = 2,891,308 based on a 25% sample of all births 37 weeks and over. All results are estimated using logistic regression and all models include state and year-by-quarter fixed effects and clustered standard errors. Boldface indicates statistical significance *p<0.05, **p<0.01, ***p<0.001).

Table 4. Marginal effects of Medicaid Policies on Early Elective Deliveries for All Births, 2009-2016

	EED Policies	**Partial EED Policies**	**Payment Reform Policies**	**Combined Policies**
Early Elective Delivery	-0.004	**0.003*** **	0.002	0.000
Early-Term Elective Induction	**-0.004** **	**0.002***	0.001	0.000
Full-Term Elective Induction	0.004	-0.003	0.005	0.001
Early-Term Elective C-section	0.001	0.001	0.001	-0.000
Full-Term Elective C-section	**0.006*** **	-0.003	0.001	-0.002

Note: *N* = 6,814,931 based on a 25% sample of all births 37 weeks and over. All results are estimated using logistic regression and all models include state and year-by-quarter fixed effects and clustered standard errors. Boldface indicates statistical significance *p<0.05, **p<0.01, ***p<0.001).

Table 5. Marginal effects of Medicaid Policies on Infant Health Outcomes for All Births, 2009-2016

	EED Policies	**Partial EED Policies**	**Payment Reform Policies**	**Combined Policies**
Requires Ventilation	**-0.006***	**-0.003** **	-0.005	-0.001
Surfactent Administered	-0.000	-0.000	-0.000	-0.000

Note: *N* = 5,989,874 based on a 25% sample of all births 37 weeks and over. All results are estimated using logistic regression and all models include state and year-by-quarter fixed effects and clustered standard errors. Boldface indicates statistical significance *p<0.05, **p<0.01, ***p<0.001).

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Appendix A: Chapter 1 Supplementary Materials

Appendix Table A1. Excluded States

State	Reason For Exclusion
Alabama	No PRAMS data
Arizona	No PRAMS data
California	No PRAMS data
Connecticut	No PRAMS data
District of Columbia	No PRAMS data
Florida	No PRAMS data
Idaho	No PRAMS data
Indiana	No PRAMS data
Iowa	Only one year of PRAMS data available in study period
Kansas	No PRAMS data
Kentucky	No PRAMS data
Louisiana	No PRAMS data
Mississippi	No years of PRAMS data available in post-period
Montana	No PRAMS data
Nevada	No PRAMS data
New Hampshire	Only one year of PRAMS data in study period
New Mexico	No years of PRAMS data available in pre-period
North Carolina	Only one year of PRAMS data in study period
North Dakota	No PRAMS data
South Carolina	No PRAMS data
South Dakota	No PRAMS data
Texas	Only one year of PRAMS data in study period
Virginia	No PRAMS data
Washington	No PRAMS data

Appendix Table A2: Parallel Trend Tests, P-Value of Interaction of Age-Based Treatment Group (Model 1) and Year-by-Quarter (2008-2009)

	F-Test	**2008Q2**	**2008Q3**	**2008Q4**	**2009Q1**	**2009Q2**	**2009Q3**	**2009Q4**
Insurance Type								
Private	0.873	0.469	0.885	0.723	0.828	0.899	0.464	0.707
Public		0.815	0.816	0.425	0.650	0.954	0.468	0.743
Uninsured		REF	REF	REF	REF	REF	REF	REF
ESI/Dependent Coverage	0.348	0.094	0.170	0.104	0.441	0.739	0.173	0.284
Unintended Birth	0.370	0.175	0.770	0.235	0.212	0.108	0.454	0.601
First Trimester Prenatal Care	0.953	0.532	0.735	0.794	0.972	0.909	0.995	0.807
Smoking During Pregnancy	0.038	0.945	0.421	0.748	0.146	0.077	0.201	0.081
Took Prenatal Vitamins	0.648	0.829	0.601	0.671	0.236	0.892	0.418	0.792

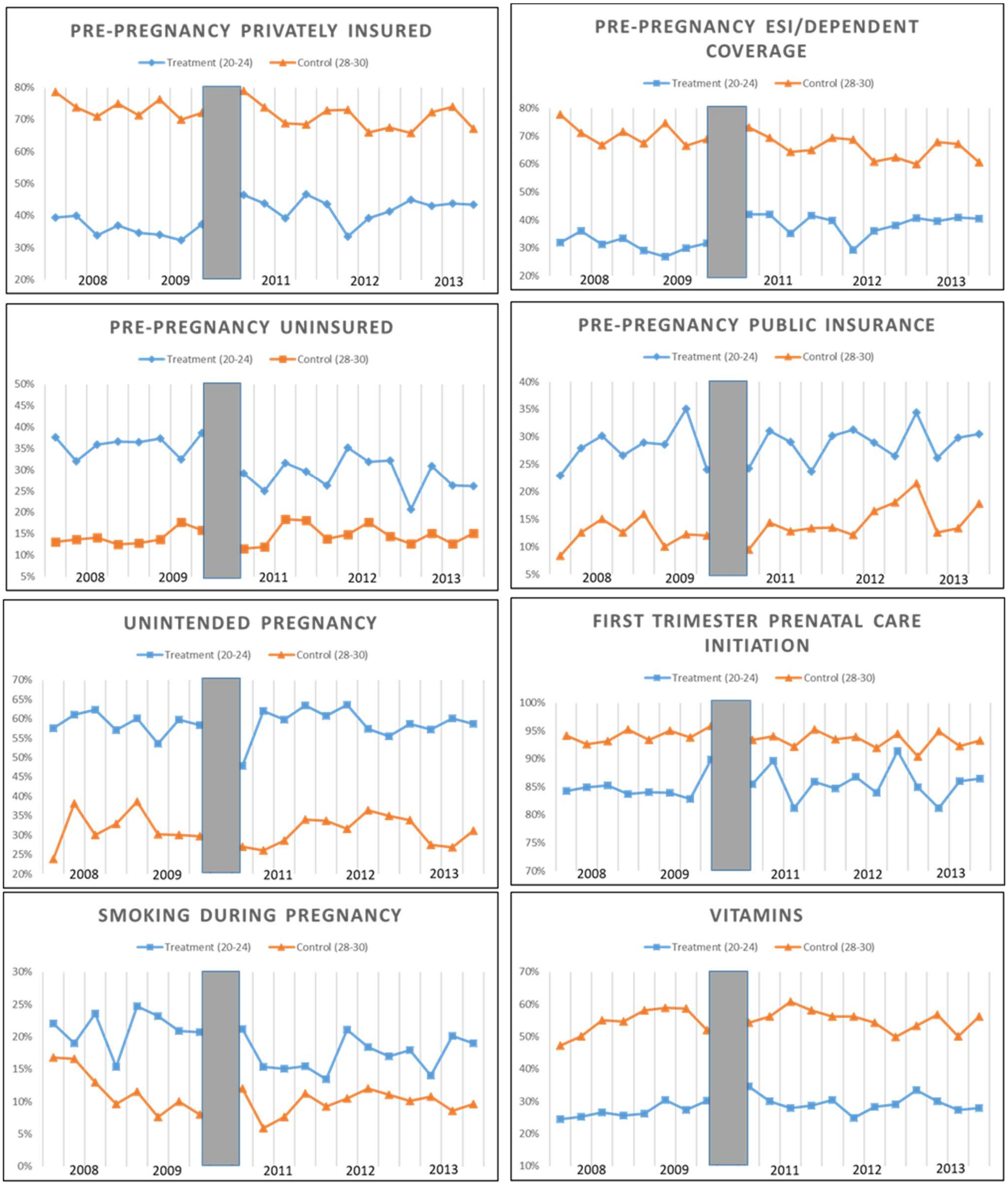
Appendix Table A3: Parallel Trend Tests, P-Value of Interaction of State-Based Treatment Group (Model 2) and Year-by-Quarter (2008-2009)

	F-Test	**2008Q2**	**2008Q3**	**2008Q4**	**2009Q1**	**2009Q2**	**2009Q3**	**2009Q4**
Insurance Type								
Private	0.906	0.950	0.806	0.530	0.934	0.745	0.549	0.765
Public		0.754	0.992	0.587	0.568	0.773	0.953	0.714
Uninsured		REF	REF	REF	REF	REF	REF	REF
ESI/Dependent Coverage	0.598	0.213	0.174	0.655	0.413	0.441	0.149	0.230
Unintended Birth	0.226	0.335	0.630	0.278	0.392	0.534	0.848	0.751
First Trimester Prenatal Care	0.702	0.491	0.649	0.300	0.369	0.785	0.708	0.812
Smoking During Pregnancy	0.951	0.791	0.684	0.436	0.859	0.794	0.951	0.833
Took Prenatal Vitamins	0.347	0.377	0.773	0.628	0.466	0.543	0.801	0.827

Appendix Table A4: Parallel Trend Tests, P-Value of Interaction of State-Based Treatment Group (Model 3) and Year-by-Quarter (2008-2009)

	F-Test	**2008Q2**	**2008Q3**	**2008Q4**	**2009Q1**	**2009Q2**	**2009Q3**	**2009Q4**
Insurance Type								
Private	0.919	0.946	0.809	0.527	0.864	0.871	0.549	0.745
Public		0.756	1.000	0.563	0.577	0.729	0.889	0.815
Uninsured		REF	REF	REF	REF	REF	REF	REF
ESI/Dependent Coverage	0.615	0.210	0.171	0.651	0.346	0.435	0.137	0.284
Unintended Birth	0.276	0.339	0.642	0.294	0.730	0.477	0.658	0.597
First Trimester Prenatal Care	0.802	0.495	0.665	0.313	0.699	0.806	0.446	0.871
Smoking During Pregnancy	0.840	0.790	0.682	0.426	0.906	0.832	0.863	0.544
Took Prenatal Vitamins	0.277	0.383	0.772	0.637	0.446	0.554	0.676	0.641

Appendix Figure A1. Unadjusted Weighted Means Pre- and Post-ACA Dependent Coverage Provision for Age-Based Treatment and Control Groups (Model 1)



Appendix Figure A2. Unadjusted Weighted Means Pre- and Post-ACA Dependent Coverage Provision for State-Based Treatment and Control Groups (Model 2)

Appendix Figure A3. Unadjusted Weighted Means Pre- and Post-ACA Dependent Coverage Provision for Alternate State-Based Treatment and Control Groups (Model 3)

Appendix B: Chapter 2 Supplementary Materials

Appendix Table B1. Categorization of Underlying Cause of Death by NCHS Selected Causes of Death Recodes

95-98 Recode	**Description with ICD-9 Codes**	**99-15 Recode**	**Description with ICD-10 Codes**
PRETERM INFANT DEATH			
220	Gastritis, duodenitis, and non-infective enteritis and colitis (535,555-558)	064	Gastritis, duodenitis, and noninfective enteritis and colitis (K29,K50-K55)
220	Gastritis, duodenitis, and non-infective enteritis and colitis (535,555-558)	115	Necrotizing enterocolitis of newborn (P77)
400	Newborn affected by maternal complications of pregnancy (761)	075 076 077	Newborn affected by incompetent cervix (P01.0) Newborn affected by premature rupture of membranes (P01.1) Newborn affected by multiple pregnancy (P01.5)
410	Newborn affected by complications of placenta, cord, and membranes (762)	080 081 082	Newborn affected by complications involving placenta (P02.0-P02.3) Newborn affected by complications involving cord (P02.4-P02.6) Newborn affected by chorioamnionitis (P02.7)
440	Disorders relating to short gestation and unspecified low birthweight (765)	089 090	Extremely low birthweight or extreme immaturity (P07.0,P07.2) Other low birthweight or preterm (P07.1,P07.3)
460	Birth trauma (767)	092	Birth trauma (P10-P15)
500	Respiratory distress syndrome (769)	096	Respiratory distress of newborn (P22)
510	Other respiratory conditions of the newborn (770)	102	Chronic respiratory disease originating in the perinatal period (P27)
510	Other respiratory conditions of the newborn (770)	103	Atelectasis (P28.0-P28.1)
520	Infections specific to the perinatal period (771)	106	Bacterial sepsis of newborn (P36)
530	Neonatal hemorrhage (772)	110	Neonatal hemorrhage (P50-P52,P54)
PERINATAL INFANT DEATH			
Certain conditions originating in the perinatal period (760-779)		Certain conditions originating in the perinatal period (P00-P96)	
		Newborn affected by maternal factors and by complications of pregnancy, labor and delivery (P00-P04)	

390	Newborn affected by maternal conditions which may be unrelated to present pregnancy (760)	072	Newborn affected by maternal hypertensive disorders (P00.0)
400	Newborn affected by maternal complications of pregnancy (761)	073	Newborn affected by other maternal conditions which may be unrelated to present pregnancy (P00.1-P00.9)
410	Newborn affected by complications of placenta, cord, and membranes (762)	075	Newborn affected by incompetent cervix (P01.0)
		076	Newborn affected by premature rupture of membranes (P01.1)
420	Newborn affected by other complications of labor and delivery (763)	077	Newborn affected by multiple pregnancy (P01.5)
		078	Newborn affected by other maternal complications of pregnancy (P01.2-P01.4,P01.6-P01.9)
		080	Newborn affected by complications involving placenta (P02.0-P02.3)
		081	Newborn affected by complications involving cord (P02.4-P02.6)
		082	Newborn affected by chorioamnionitis (P02.7)
		083	Newborn affected by other and unspecified abnormalities of membranes (P02.8-P02.9)
		084	Newborn affected by other complications of labor and delivery (P03)
		085	Newborn affected by noxious influences transmitted via placenta or breast milk (P04)
		Disorders related to length of gestation and fetal malnutrition (P05-P08)	
430	Slow fetal growth and fetal malnutrition (764)	087	Slow fetal growth and fetal malnutrition (P05)
440	Disorders relating to short gestation and unspecified low birthweight (767)	089	Extremely low birthweight or extreme immaturity (P07.0,P07.2)
450	Disorders relating to long gestation and high birthweight (766)	090	Other low birthweight or preterm (P07.1,P07.3)
		091	Disorders related to long gestation and high birthweight (P08)
460	Birth trauma (767)	092	Birth trauma (P10-P15)
Intrauterine hypoxia and birth asphyxia (768)		Intrauterine hypoxia and birth asphyxia (P20-P21)	
480	Fetal distress in liveborn infant (768.2-768.4)	094	Intrauterine hypoxia (P20)
490	Birth asphyxia (768.5-768.9)	095	Birth asphyxia (P21)
500	Respiratory distress syndrome (769)	096	Respiratory distress of newborn (P22)
		Other respiratory conditions originating in the perinatal period (P23-P28)	
510	Other respiratory conditions of the newborn (770)	098	Congenital pneumonia (P23)
		099	Neonatal aspiration syndromes (P24)

		100	Interstitial emphysema and related conditions originating in the perinatal period (P25)
		101	Pulmonary hemorrhage originating in the perinatal period (P26)
		102	Chronic respiratory disease originating in the perinatal period (P27)
		103	Atelectasis (P28.0-P28.1)
		104	All other respiratory conditions originating in the perinatal period (P28.2-P28.9)
		Infections specific to the perinatal period (P35-P39)	
520	Infections specific to the perinatal period (771)	106	Bacterial sepsis of newborn (P36)
		107	Omphalitis of newborn with or without mild hemorrhage (P38)
		108	All other infections specific to the perinatal period (P35,P37,P39)
		Hemorrhagic and hematological disorders of newborn (P50-P61)	
530	Neonatal hemorrhage (772)	110	Neonatal hemorrhage (P50-P52,P54)
540	Hemolytic disease of newborn, due to isoimmunization, and other perinatal jandice (773-774)	111	Hemorrhagic disease of newborn (P53)
		112	Hemolytic disease of newborn due to isoimmunization and other perinatal jaundice (P55-P59)
560	Hemorrhagic disease of newborn (776.0)	113	Hematological disorders (P60-P61)
550	Syndrome of infant of a diabetic mother and neonatal diabetes mellitus (775.0-775.1)	114	Syndrome of infant of a diabetic mother and neonatal diabetes mellitus (P70.0-P70.2)
220	Gastritis, duodenitis, and noninfective enteritis and colitis (535,555-558	115	Necrotizing enterocolitis of newborn (P77)
570	All other and ill-defined conditions originating in the perinatal period (775.2-775.9,776,1-779)	116	Hydrops fetalis not due to hemolytic disease (P83.2)
		117	Other perinatal conditions (P29,P70.3-P70.9,P71-P76,P78-P81,P83.0-P83.1,P83.3-P83.9,P90-P96)
SLEEP RELATED CAUSES OF DEATH			
590	Sudden Infant Death Syndrome (798.0)	135	Sudden Infant Death Syndrome (R95)
600	Symptoms, signs, and all other ill-defined conditions (780-797, 798.1-799)	136	Other symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R53,R55-R94,R96-R99)
630	Accidental mechanical suffocation (E913)	146	Accidental suffocation and strangulation in bed (W75)
ACCIDENTAL CAUSES OF DEATH			

620	Inhalation and ingestion of food or other object causing obstruction of respiratory tract or suffocation (E911-E912)	143	Falls (W00-W19)
		144	Accidental discharge of firearms (W32-W34)
		145	Accidental drowning and submersion (W65-W74)
640	Other accidental causes and adverse effects (E8OO-E91O,E914-E949)	147	Other accidental suffocation and strangulation (W76-W77,W81-W84)
		148	Accidental inhalation and ingestion of food or other objects causing obstruction of respiratory tract (W78-W80)
		149	Accidents caused by exposure to smoke, fire and flames (X00-X09)
		150	Accidental poisoning and exposure to noxious substances (X40-X49)
		151	Other and unspecified accidents (W20-W31,W35-W64,W85-W99,X10-X39,X50-X59)
OTHER CAUSES OF DEATH			
10	Certain Intestinal Infections (008-009)	2	Certain intestinal infectious diseases (A00-A08)
20	Whooping cough (033)	3	Diarrhea and gastroenteritis of infectious origin (A09)
30	Meningococcal infection (036)	4	Tuberculosis (A16-A19)
40	Septicemia (038)	5	Tetanus (A33,A35)
50	Viral diseases (045-079)	6	Diphtheria (A36)
60	Congenital syphilis (090)	7	Whooping cough (A37)
70	Remainder of infectious and parasitic diseases (001-007,010-032,034-035,037,039-041,042-044,080-088)	8	Meningococcal infection (A39)
		9	Septicemia (A40-A41)
		10	Congenital syphilis (A50)
80	Malignant neoplasms including neoplasms of lymphatic and hematopoietic tissues (140-203)	11	Gonococcal infection (A54)
		13	Acute poliomyelitis (A80)
90	Benign neoplasms, carcinoma in situ, and neoplasms of uncertain behavior and of unspecified nature (210-239)	14	Varicella (chickenpox) (B01)
		15	Measles (B05)
		16	Human immunodeficiency virus (HIV) disease (B20-B24)
100	Diseases of thymus gland (254)	17	Mumps (B26)
110	Cystic fibrosis (277.0)	18	Other and unspecified viral diseases (A81-B00,B02-B04,B06-B19,B25,B27-B34)
120	Diseases of blood and blood-forming organs (280-289)	19	Candidiasis (B37)
130	Meningitis (320-322)	20	Malaria (B50-B54)
140	Other diseases of nervous system and sense organs (323-389)	21	Pneumocystosis (B59)
		22	
150	Acute upper respiratory infections (460-465)		

160	Bronchitis and bronchiolitis (466,490-491)
180	Pneumonia (480-486)
190	Influenza (487)
200	Remainder of diseases of respiratory system (470-470,492-519)
210	Hernia of abdominal cavity and intestinal obstruction without mention of hernia (550-553,560)
230	Remainder of diseases of digestive system (520-534,536-543,562-579)
250	Anencephalus and similar anomalies (740)
260	Spina bifida (741)
270	Congenital hydrocephalus (742.3)
280	Other congenital anomalies of central nervous system and eye (742.0-742.2,742.4-742.9,743)
290	Congenital anomalies of heart (745-746)
300	Other congenital anomalies of circulatory system (747)
310	Congenital anomalies of respiratory system (748)
320	Congenital anomalies of digestive system (749-751)
330	Congenital anomalies of genitourinary system (752-753)
340	Congenital anomalies of musculoskeletal system (754-756)
350	Down's syndrome (758.0)
360	Other chromosomal anomalies (758.1-758.9)
370	All other and unspecified congenital anomalies (744,757,75S)
660	Child battering and other maltreatment (E967)
670	Other homicide (E960-E966,E968-E969)
680	All other causes (Residual)

25	All other and unspecified infectious and parasitic diseases (A20-A32,A38,A42-A49,A51-A53,A55-A79,B35-B36,B38-B49,B55-B58,B60-B99)
26	Hodgkin's disease and non-Hodgkin's lymphomas (C81-C85)
27	Leukemia (C91-C95)
28	Other and unspecified malignant neoplasms (C00-C80,C88,C90,C96-C97)
30	In situ neoplasms, benign neoplasms and neoplasms of uncertain or unknown behavior (D00-D48)
31	Anemias (D50-D64)
32	Hemorrhagic conditions and other diseases of blood and blood-forming organs (D65-D76)
34	Certain disorders involving the immune mechanism (D80-D89)
35	Short stature, not elsewhere classified (E34.3)
36	Nutritional deficiencies (E40-E64)
37	Cystic fibrosis (E84)
38	Volume depletion, disorders of fluid, electrolyte and acid-base balance (E86-E87)
40	All other endocrine, nutritional and metabolic diseases (E00-E32,E34.0-E34.2,E34.4-E34.9,E65-E83,E85,E88)
41	Meningitis (G00,G03)
42	Infantile spinal muscular atrophy, type I (Werdnig-Hoffman) (G12.0)
43	Infantile cerebral palsy (G80)
44	Anoxic brain damage, not elsewhere classified (G93.1)
45	Other diseases of nervous system (G04,G06-G11,G12.1-G12.9,G20-G72,G81-G92,G93.0,G93.2-G93.9,G95-G98)
47	Diseases of the ear and mastoid process (H60-H93)
48	Pulmonary heart disease and diseases of pulmonary circulation (I26-I28)
49	Pericarditis, endocarditis and myocarditis (I30,I33,I40)
50	Cardiomyopathy (I42)
51	Cardiac arrest (I46)
52	Cerebrovascular diseases (I60-I69)

54	All other diseases of circulatory system (I00-I25,I31,I34-I38,I44-I45,I47-I51,I70-I99)
56	Acute upper respiratory infections (J00-J06)
57	Influenza (J10-J11)
58	Pneumonia (J12-J18)
59	Acute bronchitis and acute bronchiolitis (J20-J21)
60	Bronchitis, chronic and unspecified (J40-J42)
61	Asthma (J45-J46)
62	Pneumonitis due to solids and liquids (J69)
65	Other and unspecified diseases of respiratory system (J22,J30-J39,J43-J44,J47-J68,J70-J98)
66	Hernia of abdominal cavity and intestinal obstruction without hernia (K40-K46,K56)
68	All other and unspecified diseases of digestive system (K00-K28,K30-K38,K57-K92)
69	Renal failure and other disorders of kidney (N17-N19,N25,N27)
119	Other and unspecified diseases of genitourinary system (N00-N15,N20-N23,N26,N28-N95)
120	Anencephaly and similar malformations (Q00)
121	Congenital hydrocephalus (Q03)
122	Spina bifida (Q05)
123	Other congenital malformations of nervous system (Q01-Q02,Q04,Q06-Q07)
124	Congenital malformations of heart (Q20-Q24)
125	Other congenital malformations of circulatory system (Q25-Q28)
126	Congenital malformations of respiratory system (Q30-Q34)
127	Congenital malformations of genitourinary system (Q50-Q64)
128	Congenital malformations of digestive system (Q35-Q45)
129	Congenital malformations and deformations of musculoskeletal system, limbs and integument (Q65-Q85)
130	Down's syndrome (Q90)
131	Edward's syndrome (Q91.0-Q91.3)
132	Patau's syndrome (Q91.4-Q91.7)

	133	Other congenital malformations and deformations (Q10-Q18,Q86-Q89)
	137	Other chromosomal abnormalities, not elsewhere classified (Q92-Q99)
		All other diseases (Residual) (F01-F99,H00-H57,L00-M99)
	141	Motor vehicle accidents(V02-V04,V09.0,V09.2,V12-V14,V19.0-V19.2,V19.4-V19.6,V20-V79,V80.3-V80.5,V81.0-V81.1,V82.0-V82.1,V83-V86, V87.0-V87.8,V88.0-V88.8,V89.0,V89.2)
	142	Other and unspecified transport accidents (V01,V05-V06,V09.1,V09.3-V09.9,V10-V11,V15-V18,V19.3, V19.8-V19.9,V80.0-V80.2,V80.6-V80.9,V81.2-V81.9,V82.2-V82.9, V87.9,V88.9,V89.1,V89.3,V89.9,V90-V99)
	153	Assault (homicide) by hanging, strangulation and suffocation (X91)
	154	Assault (homicide) by discharge of firearms (*U01.4,X93-X95)
	155	Neglect, abandonment and other maltreatment syndromes (Y06-Y07)
	156	Assault (homicide) by other and unspecified means (*U01.0-*U01.3,*U01.5-*U01.9,X85-X90,X92,X96-X99,Y00-Y05,Y08-Y09)
	157	Complications of medical and surgical care (Y40-Y84)
	158	Other external causes (X60-X84,Y10-Y36)

Notes: The International Classification of Diseases 9th Revision (ICD 9) codes are used to specify underlying cause of death for the years 1995-1998. From 1999-2015, cause of death is specified with the International Classification of Diseases 10th Revision (ICD 10) codes. NCHS has defined selected "recodes" to support analysis by the Selected Causes of Death groups. These causes of death groups for analysis of infant mortality data are the "61 Selected Causes of Death" for ICD-9 codes and the "130 Selected Causes" for ICD-10 codes.

Appendix C: Chapter 3 Supplementary Materials

Appendix Table C1. State Medicaid Policies, 2009-2016

State	EED Policy	Partial EED Policy	Payment Reform	Combination
AR		7/1/2009 Incentive Payment		7/1/2012 Perinatal Bundle
CO		1/1/2011-12/31/2015 Incentive Payment		
FL			Equal Payment	7/1/2016 EED Policy
GA	10/1/2013			
IA	7/1/2013		Ends 10/1/2010 Equal Payment	
IN	7/1/2014			2/1/2015 Equal Payment
LA	9/1/2014			
MA		7/1/2011 Incentive Payment		
MI		1/1/2013 Hard Stop Policy		
MN			10/1/2009 Equal Payment	1/1/2012 Hard Stop Policy
MO	9/30/2014			
MS	1/2/2015			
MT		10/1/2014 Reduce Payment		
NC			4/2011 Pregnancy Medical Home	
NM			4/1/2011 Equal Payment	11/1/2013 EED Policy
NV			6/1/2012 Equal Payment	
NY		7/1/2013 Reduce Payment		
OH			3/1/2015 Episodic Bundle	5/1/2015 EED Policy
SC			Equal Payment	1/1/2013 EED Policy
TN			7/11/2011 Equal Payment	
TX		9/1/2011 Hard Stop Policy		10/1/2011 EED Policy
UT			Equal Payment	7/1/2016 EED Policy
WA			Equal Payment	4/1/2010 Incentive
WY	1/1/2012			
States with payment reform (equal payment) policies, but no changes during the study period: AL, CA, KY, NH, PA				
States with no Medicaid EED policies: AK, AZ, CT, DE, HI, ID, IL, KS, MD, ME, NE, NJ, ND, OK, OR, RI, SD, VA, VT, WI, WV				

Source: Author's original research and Byanova (2016). All data on state Medicaid fee schedules came from Alexander (2015).

Appendix Table C2. Probability of Medicaid Paid Delivery Using the Pregnancy Risk Assessment Monitoring System (PRAMS), 2009-2010

	Medicaid Coverage at Delivery	
	Coefficient	***P***
Individual Level		
Age	-0.06	0.000
Race		
Black	0.69	0.000
Other	0.22	0.001
Unknown	0.12	0.478
Ethnicity		
Hispanic	-0.84	0.000
Unknown	-0.64	0.000
Married	-1.30	0.000
Education		
0-8 Years	-0.06	0.601
9-11 Years	0.20	0.007
12 Years	-0.58	0.000
13-15 Years	-2.01	0.000
>16 Years	-0.46	0.005
Smoking During Pregnancy		
Smoked	0.90	0.000
Unknown	-0.06	0.760
High Blood Pressure		
Yes	0.01	0.819
Unknown	-0.25	0.195
Diabetes		
Yes	0.23	0.001
Unknown	0.11	0.573
State Level		
Medicaid Eligibility (% FPL)	-0.00	0.070
Population (Women 15-44)	-0.00	0.000
Poverty Rate	0.08	0.000
Obesity Rate	0.01	0.104

Note: Author's analysis using the Pregnancy Risk Assessment Monitoring System (PRAMS). All effects are estimated with logistic regression using PRAMS survey weights. N = 3,767,871 (Unweighted 73,728)

Appendix Table C3. States with Collaborative Campaigns Targeting EEDs

State	Campaign	Date
AL	Alabama Perinatal Excellence Collaborative (APEC)	1/1/2012
AR	ARbestHealth	2/2012
CA	Patient Safety First . . . a California Partnership for Health (PSF) The California Maternal Quality Care Collaborative (CMQCC) Big 5 State Prematurity Initiative California Hospital Engagement Network (CalHEN)	1/2010 2010 9/2010-2/2012 3/2012
CO	Partnership for Patients (PfP)	4/2011
CT	March of Dimes Perinatal Quality Improvement Initiative	2011
DE	Delaware Healthy Mother and Infant Consortium (DHMIC)	2011
FL	Florida Perinatal Quality Collaborative (FPQC) Big 5 State Prematurity Initiative	6/2010 9/2010-2/2012
IL	Big 5 State Prematurity Initiative Midwest Business Group on Health (MBGH) Illinois Perinatal Quality Collaborative (ILPQC)	9/2010-2/2012 2011 2012
IN	Indiana Perinatal Quality Improvement Collaborative (IPQIC)	1/2013
KS	Kansas Healthcare Collaborative/Kansas HEN Kansas Perinatal Quality Collaborative (KPQC)	7/2012 9/2012
KY	Healthy Babies are Worth the Wait (HBWW)	2007
LA	Louisiana Birth Outcomes Initiative Statewide Adult Medicaid Quality Grant (Included MCOs and 34 Hospitals)	11/2010 12/2012–4/2015
MA	Massachusetts Perinatal Quality Collaborative (MPQC)	5/2011
MD	Maryland Patient Safety Center Perinatal Collaborative & Perinatal Learning Network The Maryland Perinatal System Standards	2009 7/2012
MI	Michigan Health & Hospital Association (MHA) Keystone OB Collaborative Healthy Babies Are Worth the Wait	2009 11/2012
MN	Minnesota Department of Human Services Perinatal Practices Advisory Group	2012
MS	Mississippi Perinatal Quality Collaborative	11/2014
MO	Midwest Health Initiative (MHI)	2014
NC	Perinatal Quality Collaborative of North Carolina (PQCNC) 39 Weeks Project	2009-2010
NY	Big 5 State Prematurity Initiative	9/2010-2/2012
OH	Ohio Perinatal Quality Collaborative (OPQC)	2008
OK	Every Week Counts Collaborative	4/2011
OR	March of Dimes 39 Weeks campaign Oregon Perinatal Collaborative	2011 2/2012
PA	Pennsylvania Hospital Engagement Networks Obstetric Adverse Events Collaborative	5/2013
SC	South Carolina Birth Outcomes Initiative (BOI)	3/2011
TN	Tennessee Healthy Babies are Worth the Wait	2013
TX	Big 5 State Prematurity Initiative	9/2010-2/2012
UT	Intermountain Healthcare Hospital System The Maternal and Infant Health Program	1/2001 2009
WA	Washington State Perinatal Collaborative	11/2010
WV	West Virginia Perinatal Partnership	2009

Source: Author's original research and Byanova (2016).