

## Manuscript Details

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<b>Title</b>	Substance Use Disorder Treatment Admissions and State-Level Prenatal Substance Use Policies: Evidence from a National Treatment Database
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### Abstract

State policies pertaining to prenatal substance use have important implications for health outcomes of pregnant women and their infants. However, little is known about the impact of the various types of state-level prenatal substance use policies (i.e., treatment and supportive services; criminal justice initiatives; and health care provider reporting requirements) on substance use disorder treatment admissions. Using data from the 2002–2014 Treatment Episode Data Set - Admissions, we exploited state-level variation in the implementation of different types of policies to assess their impact on pregnant women's admission to substance use disorder treatment. The study found that state-level prenatal substance use policies focused only on the criminal justice sector were negatively associated with the proportion of women of reproductive age who were pregnant upon admission to treatment. Additionally, the implementation of policies that engaged all three sectors was positively associated with the proportion of women of reproductive age who were pregnant upon admission to treatment. These results were consistent across age groups and for both non-Hispanic white women and women of other racial/ethnic groups. The findings imply that states with cross-sector policy engagement around prenatal substance use and policies that take a multifaceted, comprehensive approach are more likely to see an increase in admissions to substance use disorder treatment during pregnancy.

**Keywords** Pregnancy; Substance Related Disorder; Substance Abuse Treatment Admissions; State Policies

**Taxonomy** Medicine, Special Population

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## Submission Files Included in this PDF

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## Research Data Related to this Submission

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Dear Dr. Spada:

We are pleased to submit our manuscript entitled “Substance Use Disorder Treatment Admission and State-level Prenatal Substance Use Policies: Evidence from a National Treatment Database” for publication consideration by *Addictive Behaviors*.

The study we describe includes secondary analysis of Treatment Episode Data Set - Admissions (TEDS-A) data to investigate the impact of state-level prenatal substance use policies and substance use disorder treatment admissions among pregnant women. We believe it will be of interest to your readers.

This is an original manuscript of approximately 3,300 words (with one figures and two tables), is not previously published, and is not under consideration elsewhere.

The authors have no conflicts of interest to report.

We appreciate your consideration and look forward to hearing from you.

Sincerely,



Katy B. Kozhimannil, Ph.D., M.P.A.  
Associate Professor

Division of Health Policy and Management, University of Minnesota School of Public Health

Date: November 9, 2018

Subject: Manuscript # ADDICTBEH\_2018\_813

Dear Dr. Dijkstra,

Please accept our thanks for the very thoughtful and helpful review of our manuscript entitled “Substance Use Disorder Treatment Admission and State-Level Prenatal Substance Use Policies: Evidence From A National Treatment Database” submitted to *Addictive Behaviors*. We have revised the manuscript substantially in light of these comments, and believe that this has led to considerable improvement in it. We have addressed all of the concerns that were raised by the referee and made all of the suggested changes.

With this letter we are submitting the revised version of our manuscript (attached), and below you will find a list of changes to the manuscript that were made in response to the reviewers’ comments. We appreciate the opportunity to have our work considered for possible publication in *Addictive Behaviors* and hope that you are pleased with what we have produced.

Sincerely,

Katy B. Kozhimannil, William N. Dowd, Mir M. Ali, Priscilla Novak, Jie Chen

## Reviewer 1

1. This is a sophisticated analytic approach to an important topic - in a sense pairing 2 somewhat problematic data sources: 1) Guttmacher tabulations of state response to substance use in pregnancy and 2) TEDS-A - to make something far more useful than either of the 2 are alone. Grounding the analysis in state-years is smart. And logit (as far as I can tell) makes sense as a method. Limitations of the primary outcome (proportion of pregnant treatment admissions), such as differences in SUD and pregnancy rates between states and time is addressed.

I have some clarifying questions and small comment(s).

Guttmacher does not include data from all states. My understanding has not been that the non-inclusion of certain states (such as NJ) in their reports indicates that the state has no policy related to substance use in pregnancy, rather that (for reasons I don't know) those data are not reported. Were states for which no Guttmacher data available included in analysis? The figure indicates that these states were analyzed as "no policy".

**Response:** In the process of building our prenatal substance use policies database we have had multiple corresponded with the Guttmacher institute and used their 'Substance Use During Pregnancy: State Laws and Policies' report going back all the way to 2002. The Guttmacher institute also shared their policy database files with us, which we used to verify the database that we have constructed for our analysis. From our understanding, a non-inclusion state means that the state does not have a policy. As shown in our paper (Table 1 and Figure 1), prenatal substance use policies varied within states from year to year; so, if for example, NJ went from having no policy in place to having some policy in place our data base would have captured that.

2. A limitation of TEDS - unit of analysis is treatment admission not individual - is noted. It is possible that multiple treatment admissions are possible within the same pregnancy (not within the same individual in subsequent pregnancies). Given that proportion pregnant in treatment is an outcome, states with more robust systems of care, that utilize ASAM levels of care, and step the individual down as treatment progresses, would have a greater count of treatment admissions in pregnancy. Did the authors look at this within a single level of care? Outpatient for example?

**Response:** This is a very interesting point and something that we have thought about quite a bit while conducting the analysis. The fact that states with more robust systems of care might see a greater count of treatment admissions is what prompted us to include state-level fixed effects in our model. State-level fixed effects allows us to account for the fact that besides having prenatal substance use policies, state could have other policies in place (such as Medicaid expansion, prescription drugs monitoring program, ASAM levels of care etc.) that is not possible for us to explicitly control for in the model. However, in any state with more treatment admissions per person, it is likely that this pattern holds true for both pregnant and non-pregnant women, so we do not expect that this type of difference across states would have a substantial impact on estimates. Our findings indicate that even after accounting for unobserved state level policy heterogeneity, prenatal substance use polices have an impact on pregnant treatment admissions. In addition, as we note in our paper, the TEDS-A database is at the treatment admission levels and captures all substance use related treatment in facilities that have received public funding;

thus, to make our study as nationally representative as possible we did not limit it to one specific type of treatment admission.

3. Finally - I am not sure what the numbers inside of the states in Figure 1 represent. And although I think the articles reads well as is, I would have expected the state data (Figure 1) to be in the results not the methods section.

**Response:** We appreciate the reviewer's point about our Figure 1 being part of the results section. Figure 1 demonstrates to the readers that there was enough variation within states and between states over the study period of our analysis to justify our empirical method. Thus, we thought it would be best to use Figure 1 to motivate the reasons (and validity) of our models rather than use it as a finding.

## Reviewer 2

This is a well-written, thoughtful paper exploring an important public health issue and policy question. I appreciated having the opportunity to review. I do have some concerns about how the findings are framed and the implications for states considering the types of policies that they should adopt to support the health and well-being of women with substance use disorders and their children. However, I think that this is very addressable with some revisions to the discussion section.

1. I have some concerns about how this study's findings' implications are communicated in the discussion section. Criminal justice policies include laws criminalizing prenatal substance use or considering prenatal substance use to be child abuse. These policies criminalize a medical condition, substance use disorder. The authors do not satisfactorily explain the opposing findings – that criminal justice policies have a harmful effect (likely by dissuading women from entering treatment) when implemented alone but appear to have a positive effect on the proportion of women in treatment who are pregnant when implemented in combination with other policies. The authors don't explain why this latter finding makes sense. What is it about combining criminal justice policies with other policies that leads to a greater proportion of women in treatment who are pregnant? One potential explanation might be the role of mandated treatment (mandated through the criminal justice system) in an environment in which more treatment options are available for pregnant women (i.e., supportive policies) and more pregnant women are being identified by their providers as having SUD (i.e., reporting requirements). However, there are real questions about the effects of mandated treatment, particularly when the treatment options available are of poor quality. Requiring more pregnant women to enter treatment programs when the treatment is poor quality and doesn't include medication, for OUD for instance, may do more harm than good.

I think the key question is mentioned in passing on page 17 and should be emphasized more in the discussion section: “Another avenue for future research may include examination of how these policies affect treatment completion and maintenance of recovery (Mutter, Ali, Smith, & Strashny, 2015).” The key question for evaluating the public health impact of these policies is not whether pregnant women with substance use disorder enter treatment but whether they remain engaged in treatment and what their longer-term recovery trajectories look like. This is a more challenging question to answer and I understand is beyond the scope of this study. However, I think that it could be helpful for the authors to elaborate on this point a bit more and to be more cautious in their recommendation that states adopt a “multi-faceted approach” that includes criminal justice policies.

**Response:** We thank the reviewer from this comment and for the suggested text in the discussion section. We agree, and feel that these suggestions help improve the way that we present the findings and implications. Based on this comment we have now included the following in the discussion section of the revised manuscript:

*However, policies that focus on multiple aspects of the treatment spectrum, from provider requirements to support services along with the criminal justice system, are more likely to see an increase in treatment use. This could be potentially due to the fact that mandated treatment*

*(mandated through the criminal justice system) in an environment in which more treatment options are available for pregnant women (i.e., supportive policies) and more pregnant women are being identified by their providers as having SUD (i.e., reporting requirements). However, it should be noted that simply requiring more pregnant women to enter treatment programs when the treatment is of poor quality (e.g. treatment option does not include medication for opioid use disorder), may not be optimal; thus quality of care is an important issue for states to consider.*

*It is important to note that the public health impact of these policies is not just whether pregnant women with SUD enter treatment but whether they remain engaged in treatment and what their longer-term recovery trajectories look like.*

2. In the methods section, the authors describe their approach to handling missing data for the pregnancy status variable in TEDS. This approach makes sense when the state simply didn't report pregnancy status when the woman wasn't pregnant. However, is that the case for all state-years? If not, I worry a bit about potential measurement bias. Although this approach to keeping unclear pregnancy status observations in the denominator produces a conservative estimate of the proportion of women who are pregnant, it doesn't necessarily produce a conservative estimate of the effects of the policies. Authors might consider whether there are opportunities to impute values for this variable (as a sensitivity analysis perhaps) or include an indicator variable for state-year observations in which missing data is an issue for the pregnancy status variable.

**Response:** We agree with the reviewer's point that while the impact of our approach on the proportion is conservative, our handling of missing data has an unknown impact on the policy estimates. We struggled with how to address this problem and considered imputation, but we didn't feel as though we could reasonably distinguish between "true" missings and missings that represent "not pregnant" using imputation. In order to test the sensitivity of our results to the assumption we made, we have conducted a sensitivity analysis in which we took a different approach to dealing with missing data. In the sensitivity analysis, we treated all missing observations as missing (i.e., excluded them from the analysis) and excluded state-years in which the percentage of treatment admissions for childbearing age women that were missing on the pregnancy variable exceeded 10% (there were 87 such state years). We excluded one additional state-year, because after excluding the 87 state-years with greater than 10% missing, one state (New Mexico) had only one year in the data and could not be included given our model specification. When we re-ran the main analysis (Table 2), the main findings persisted (i.e., criminal justice only was still negative and significant, and "all three policies" was still positive and significant relative to "none." One difference is that the category "criminal justice system and provider requirements" was still positive relative to "None" but became significant. We have added a description of this new sensitivity analysis to the manuscript in the methods and results sections, as follows:

*In addition, we tested our assumption that missing responses to the pregnancy question represented negative responses in a sensitivity analysis, where we excluded treatment episodes with missing data on pregnancy and dropped state-years with a missing rate greater than 10% (87 state-years). We also dropped one additional singleton state-year observation for New*

*Mexico, because singleton observations were incompatible with this specification (Correia, 2015). Results were robust to this sensitivity analysis.*

*We re-estimated the models using the alternative approach for missing data described above and found that the relationship between the proportion of pregnant admissions and no policies, criminal justice system only policies, and all three types of policies persisted, suggesting that these findings were not driven by our approach toward missing data.*

Minor issues:

3. Avoid term abuse. Consider replacing with misuse. It only appears twice, I believe, in reference to states charging pregnant women with child abuse but the term “substance abuser” has been empirically shown to increase stigma toward people with substance use disorder and its variant “substance abuse” should be avoided when possible.

**Response:** We thank the reviewer for this suggestion and have now replaced abuse with misuse in the revised version of the manuscript.

4. In Table 1, it is hard to keep track of all the notation and their meaning when looking at the table. I wonder if authors might consider excluding the lowercase letter notation for  $p$ -value $<0.01$  because anything  $<0.05$  is significant so that information alone seems sufficient. It would help to simplify the table and ease of interpretation.

**Response:** Per suggestion from the reviewer we have now excluded notification for  $p$ -value $<0.01$  from the table.

5. Perhaps a nit-picky point but in the last paragraph of the results section of the manuscript, are these really the number of pregnancies? Aren't these the proportion of women entering treatment who are pregnant?

**Response:** We have made the suggested change in the last paragraph of the results section.



**Substance Use Disorder Treatment Admissions and State-Level Prenatal Substance Use  
Policies: Evidence from a National Treatment Database**

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## **Substance Use Disorder Treatment Admissions and State-Level Prenatal Substance Use Policies: Evidence from A National Treatment Database**

### **Abstract**

State policies pertaining to prenatal substance use have important implications for health outcomes of pregnant women and their infants. However, little is known about the impact of the various types of state-level prenatal substance use policies (i.e., treatment and supportive services; criminal justice initiatives; and health care provider reporting requirements) on substance use disorder treatment admissions. Using data from the 2002–2014 Treatment Episode Data Set - Admissions, we exploited state-level variation in the implementation of different types of policies to assess their impact on pregnant women’s admission to substance use disorder treatment. The study found that state-level prenatal substance use policies focused only on the criminal justice sector were negatively associated with the proportion of women of reproductive age who were pregnant upon admission to treatment. Additionally, the implementation of policies that engaged all three sectors was positively associated with the proportion of women of reproductive age who were pregnant upon admission to treatment. These results were consistent across age groups and for both non-Hispanic white women and women of other racial/ethnic groups. The findings imply that states with cross-sector policy engagement around prenatal substance use and policies that take a multifaceted, comprehensive approach are more likely to see an increase in admissions to substance use disorder treatment during pregnancy.

**Key Words:** Pregnancy; Substance Related Disorder; Substance Abuse Treatment Admissions; State Policies.

## **1. Introduction**

Prenatal substance use is a significant risk factor for adverse pregnancy and birth outcomes (Norton, Zarkin, Calingaert, & Bradley, 1996). Women who use substances, including cocaine, marijuana, and alcohol during pregnancy are also more likely to experience adverse health outcomes (Terplan, Garrett, & Hartmann, 2009). Nearly 6 million women become pregnant each year in the United States (Curtin, Abma, Ventura, & Henshaw, 2013). The 2017 National Survey on Drug Use and Health indicated that approximately 8.5% of pregnant women aged 15-44 in the United States used an illicit substance in the past 30 days, and approximately 11.5% used alcohol; approximately 5.2% of pregnant women reported binge drinking during the prior month (Substance Abuse and Mental Health Services Administration, 2018). Prenatal substance use has been an important public health issue since fetal alcohol syndrome was recognized in 1973 (Popova, Lange, Probst, Gmel, & Rehm, 2017), and a surge in the use of crack cocaine among women of reproductive age in the 1980s brought the condition to national attention (Nadel, 1991). More recently, the opioid crisis has also disproportionately affected women of reproductive age (CDC, 2013; Kozhimannil, Graves, Levy, & Patrick, 2017), leading to an increase in rates of newborn opioid withdrawal (CDC, 2013; Patrick et al., 2015). The effects of the opioid epidemic on pregnant women and infants have refocused national attention on prenatal substance use policies in the United States.

To date, states have enacted policies of different types to address substance use among pregnant women and to protect infants from the harmful effects of such exposure. Currently, 19 states have established state-funded substance use treatment programs that are specifically targeted toward pregnant women, with 17 states and the District of Columbia providing pregnant women priority access to treatment programs and 10 states prohibiting treatment programs from

discriminating against them (Guttmacher Institute, 2017). Some states have enacted criminal justice–related policies (some of which have severe penalties) (Kennedy-Hendricks, McGinty, & Barry, 2016; Paltrow, Cohen, & Carey, 2000). Substance use/misuse during pregnancy is considered child abuse under civil child welfare statutes in 24 states and the District of Columbia. In addition, 18 states have enacted policies requiring health care providers to refer pregnant women to substance use disorder treatment and, in some cases, to child protective agencies; 7 states require providers to test for prenatal drug exposure if the provider suspects substance use (Jarlenski et al., 2017; Guttmacher Institute, 2017).

Research has shown that policies encouraging pregnant women to engage with health care providers to obtain substance use disorder treatment are associated with improved outcomes among this population (Lester, Andreozzi, & Appiah, 2004); however, mandatory reporting of drug use during pregnancy to child protective services may deter them from seeking treatment (Angelotta, Weiss, Angelotta, & Friedman, 2016). In fact, the American Congress of Obstetricians and Gynecologists (ACOG), the American Medical Association (AMA), and the American Psychiatric Association (APA) all suggest that reporting requirements may discourage women from receiving important prenatal care or substance use disorder treatment, thereby increasing potential neonatal harm (ACOG, 2012; AMA, 1990; APA, 1992).

In addition, potential health risks accompany criminal justice–focused policy efforts around prenatal substance use. Fear of criminal prosecution and loss of child custody have caused pregnant women who use substances to avoid prenatal care (Roberts & Pies, 2011). Because of their impact on the individual’s decision to receive timely care during pregnancy, policy measures that raise the possibility of criminal charges based on pregnancy and substance use have been connected to reduced birth weight and increased probability of preterm birth

(Coyer, 2017). In fact, among infants exposed to prenatal illicit drug use, higher levels of prenatal care were associated with reduced risk for low birth weight (El-Mohandes et al., 2003). Research has also shown that policies focused on criminal justice reduce the probability that pregnant women with an opioid use disorder will use medication-assisted treatment, which is the current recommended treatment (Angelotta et al., 2016; Saia et al., 2016). Furthermore, the most common strategy reported for avoiding detection of substance use during pregnancy was avoidance of care or isolation from friends or family members out of fear of being reported to authorities (Stone, 2015).

Although the literature on pregnancy-related substance use policies is growing, very little is known about the impact of different types of state-level policies on receipt of substance use disorder treatment among pregnant women. This study uses national data to examine the impact of state-level policies related to prenatal substance use across multiple policy types: 1) policies related to treatment and supportive services, 2) policies focused on criminal justice initiatives, and 3) reporting requirements for health care providers – on substance use disorder treatment among pregnant women. Specifically, this study looked at variation in the timing of these prenatal substance use policies, across all U.S. states from 2002 to 2014, to investigate their impact on substance use disorder treatment admissions among pregnant women of reproductive age (i.e., 15–44 years old). In addition, the study also examined the impact of these policies across different age groups and by race/ethnicity.

## **2. Methods**

### *2.1 Data and study population*

The primary source of data for this analysis is the public-use Treatment Episode Data Set - Admissions (TEDS-A). TEDS-A captures the characteristics of patients admitted to substance

use treatment facilities that report to individual state administrative data systems (Substance Abuse and Mental Health Services Administration, 2014). We combined TEDS-A data from 2002 to 2014 from the 50 states, which comprised 636 state-years. Three states (Alabama, Arkansas, and South Carolina) did not report TEDS-A data for one year, and four states (Alaska, Mississippi, Pennsylvania, and West Virginia) did not report for two or more years, for a total of 14 state-years excluded. Our data set contained over 6 million treatment admissions of women of reproductive age, almost 300,000 of which reported being pregnant at the time of admission.

## 2.2 Measures

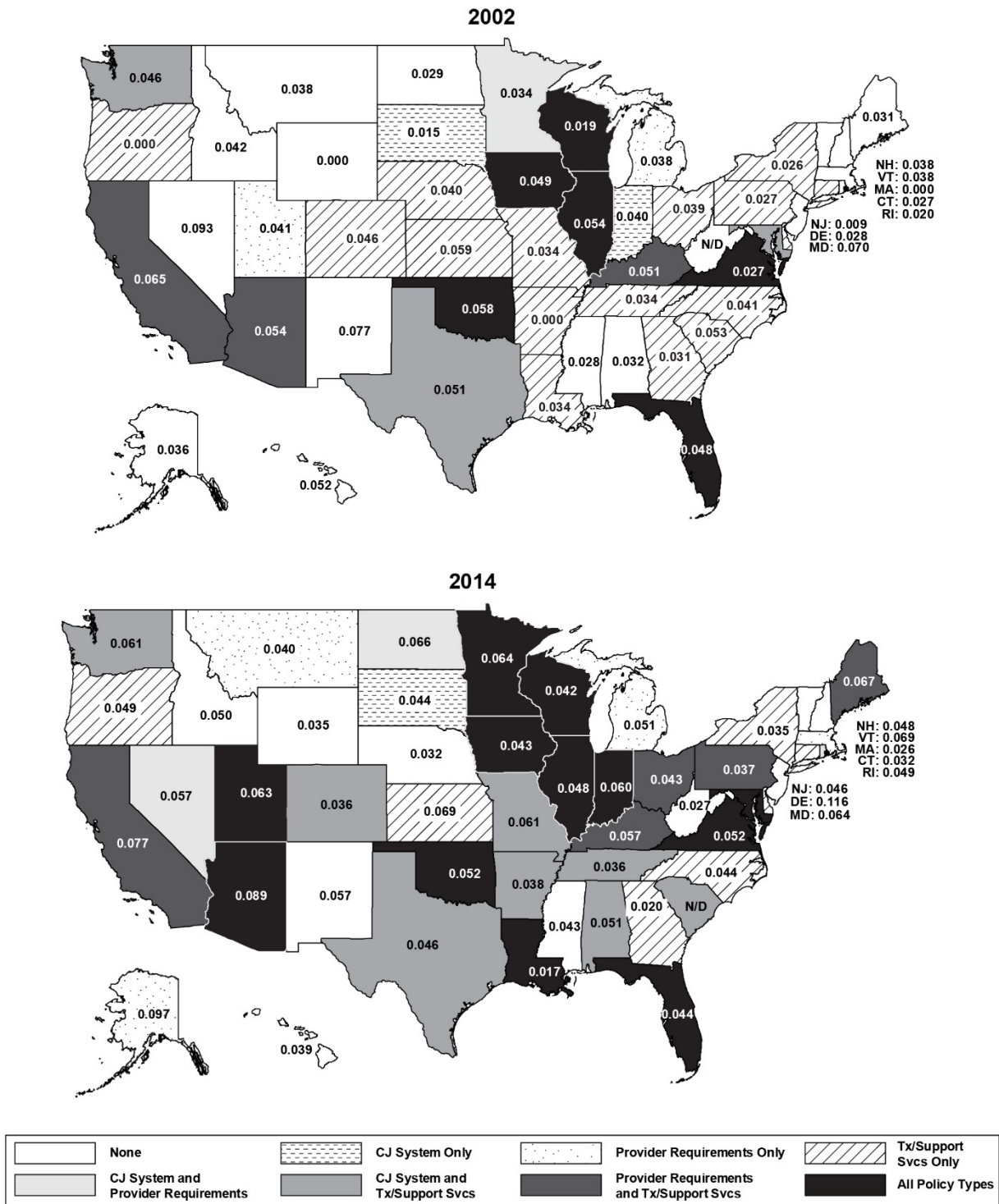
The outcome variable is the *proportion of pregnant admissions*. For each state-year, we defined the proportion of pregnant admissions as the number of women of reproductive age admitted to treatment who reported being pregnant divided by the sum of all women of reproductive age admitted to treatment. Records from which the pregnancy variable was missing were included in the denominator of the proportion. The average rate of missing pregnancy status for all state-years was 5.4%; however, instances of missing pregnancy status were concentrated in particular state-years. For example, in one of the state-years, women's admissions records were either marked as pregnant or the variable was not completed (i.e., data were missing). As such, we did not exclude records with missing data. Although this conservative approach decreases the calculated proportion of pregnant admissions in some state-years, it prevents us from artificially increasing the proportion of pregnant admissions in state-years with missing pregnancy records. We calculated the overall proportion of pregnant admissions as well as proportions of demographic subgroups defined by age (15–24 years old and 25–44 years old) and race/ethnicity (non-Hispanic white and all other racial/ethnic groups).

The independent variables of interest for this analysis were state policies toward prenatal substance use. Information on state policies over time was obtained from the Guttmacher Institute (2017). Current state policy information is updated monthly and is publicly available online; historical data were provided separately by the Guttmacher Institute. We organized seven distinct policy responses to substance use, from the Guttmacher data, into three types. States are identified as having policies oriented toward *treatment and support services* if they have established treatment programs specifically for pregnant women, given pregnant women priority access to treatment, or explicitly protected them from discrimination in existing treatment programs. States with policies oriented toward the *criminal justice system* are identified as those that either have a law explicitly criminalizing prenatal substance misuse or those that consider prenatal substance misuse to be child abuse under child welfare laws. Finally, states with policies that have *provider reporting requirements* are identified as those in which health care providers are required to report suspected prenatal substance use or test when prenatal exposure is suspected.

Some states have only one type of policy. Others have multiple policy types, and the policy approach used by some states has changed over time. From the three policy types (i.e., treatment and support services, criminal justice system, and provider reporting requirements) we developed an eight-level categorical variable representing all possible combinations of policy stances in a state in a given year, from having none of the policies in place to having all three types of policies in place. Figure 1 displays a map showing the policy stance of each state at the beginning (2002) and end (2014) of the period analyzed and indicates the proportion of women of reproductive age admitted to treatment who reported being pregnant at admission for the year depicted. As the maps in Figure 1 show, numerous states changed their policy stances between

2002 and 2014. The map demonstrates considerable variation in policy measures, with many states initially adopting policies or adding additional policy types. Of the 16 states with no policies in place in 2002, 7 states added at least one policy type and 3 states added multiple policy types by 2014. Of the 34 states with at least one policy type in place in 2002, 14 states added additional policies by 2014.





*Figure 1: Distribution of States into Policy Categories*

### 2.3 Analysis

We estimated fractional logit models of the proportion of pregnant admissions on the eight-level categorical indicator of state policy with standard errors clustered at the state level. Fractional logit models are used when the values of the dependent variables fall between 0 and 1 and help prevent some of the shortcomings of linear models or modeling the log-odds of fractional dependent variables (Papke & Wooldridge, 1996).

To account for differences among states and across time that would influence our results, such as differences in fertility rates or treatment needs among women who are pregnant (specifically) or of reproductive age (generally), we also controlled for state and year fixed effects as well as state-specific time trends. In our models, “none” was used as the reference category for the state policy indicator. Additionally, we conducted F-tests to examine the significance of differences between levels of policy.

We estimated the models for all women of reproductive age as well as analyses that were stratified by age and race/ethnicity subgroups defined a priori. Finally, for the small number of state-years ( $n = 12$  out of 636) in which no women reported being pregnant at the time of admission, we re-ran the analysis with these state-years excluded and confirmed that their presence did not meaningfully change the results. In addition, we relaxed tested our assumption that missing responses to the pregnancy question represented negative responses in a sensitivity analysis, where we excluded treatment episodes with missing data on pregnancy and dropped state-years with a missing rate greater than 10% (87 state-years). We also dropped one additional singleton state-year observation for New Mexico, because singleton observations ~~we~~are incompatible with ~~our~~ this specification (Correia, 2015). Results were robust to this sensitivity analysis.

### 3. Results

Data from the 636 state-years included in the analysis were distributed into policy categories as shown in Table 1. The table also presents the unadjusted average proportion of pregnant admissions across state-years in each policy category. On average, states with policies oriented toward the criminal justice system only or toward treatment and support services only had the lowest proportions of pregnant admissions, while states with multiple types of policies had the highest proportions.

*Table 1: Distribution of States into Policy Categories*

Category	State-Years	Average Proportion Pregnant	States
None	142	0.043	AK, AL, HI,* ID,* MA, ME, MS,* MT, ND, NE, NH,* NJ,* NM,* NV, VT,* WV,* WY*
Criminal Justice System Only	29	0.041	AL, IN, SD*
Provider Reporting Requirements Only	54	0.047	AK, MA, MI,* MT, RI, UT
Treatment and Support Services Only	151	0.041	AR, CO, CT,* DE,* GA,* KS,* LA, MO, NC,* NE, NY,* OH, OR,* PA, SC, TN
Criminal Justice System and Provider Reporting Requirements	28	0.060	MN, ND, NV, RI
Criminal Justice System and Treatment and Support Services	70	0.050	AL, AR, CO, IN, LA, MD, MO, SC, TN, TX,* WA*
Provider Reporting Requirements and Treatment and Support Services	55	0.057	AZ, CA,* KY,* ME, OH, PA, UT
All Three Policies	107	0.051	AZ, FL,* IA,* IL,* IN, LA, MD, MN, OK,* UT, VA,* WI*
Total	636	0.047	-

\* Denotes state data included in category for entire analysis period.

Table 2 presents marginal effects from fractional logit models. The results indicate that, compared to states with no applicable policies, states with only criminal justice system-oriented

policies have a lower proportion of pregnant admissions. On average, the proportion of pregnant admissions is one percentage point lower in states with policies oriented toward the criminal justice system only, relative to states with no policies in place to address prenatal substance use. To place this result in context, the median state-year showed 6,452 admissions by women of reproductive age, 291 of whom reported being pregnant. A one-percentage-point decrease represents a decline of nearly 65 pregnant admissions. In addition, the differences between policies oriented toward the criminal justice system only and all other policy types were significant ( $P < .05$ ).

Table 2: Fractional Logit Model Results

	Overall	Age: 15–24	Age: 25–44	White	Other
<b>Policy Stance in State-Year</b>					
None (reference category)					
Criminal Justice System Only	-0.010 <sup>a,c</sup> <del>€</del> (0.004)	-0.013 <sup>c</sup> <del>€</del> (0.007)	-0.008 <sup>a,c</sup> <del>€</del> (0.003)	-0.008 <sup>a,c</sup> <del>€</del> (0.004)	-0.015 <sup>a,c</sup> <del>€</del> (0.006)
Provider Reporting Requirements Only	0.005 <sup>b</sup> <del>B</del> (0.005)	0.009 <sup>b</sup> (0.009)	0.003 <sup>b</sup> <del>B</del> (0.004)	0.007 <sup>b</sup> (0.007)	0.002 <sup>b</sup> (0.006)
Treatment and Support Services Only	0.001 <sup>b,c</sup> (0.004)	0.003 <sup>c</sup> (0.008)	0 <sup>b,c</sup> <del>€</del> (0.004)	0.002 <sup>c</sup> (0.004)	0.001 <sup>b,c</sup> (0.007)
Criminal Justice System and Provider Reporting Requirements	0.003 <sup>b</sup> (0.004)	-0.003 <sup>c</sup> (0.007)	0.004 <sup>b</sup> <del>B</del> (0.003)	0.001 <sup>b,c</sup> <del>€</del> (0.003)	0.006 <sup>b</sup> (0.010)
Criminal Justice System and Treatment and Support Services	0 <sup>b,c</sup> <del>€</del> (0.005)	-0.002 <sup>c</sup> <del>€</del> (0.008)	0.001 <sup>b,c</sup> <del>B,€</del> (0.004)	0.002 <sup>b,c</sup> <del>B,€</del> (0.005)	-0.003 <sup>b,c</sup> <del>€</del> (0.007)
Provider Reporting Requirements and Treatment and Support Services	0.003 <sup>b,c</sup> <del>B,€</del> (0.004)	0.005 <sup>b,c</sup> <del>€</del> (0.009)	0.002 <sup>b,c</sup> <del>B,€</del> (0.003)	0.004 <sup>b</sup> <del>B,c</del> (0.004)	-0.001 <sup>b,c</sup> <del>€</del> (0.006)
Criminal Justice System, Provider Reporting Requirements, and Treatment and Support Services	0.013 <sup>a,b</sup> <del>A,B</del> (0.004)	0.017 <sup>a,b</sup> <del>B</del> (0.008)	0.011 <sup>a,b</sup> <del>A,B</del> (0.004)	0.012 <sup>a,b</sup> <del>A,B</del> (0.004)	0.017 <sup>a,b</sup> <del>B</del> (0.008)
<b>Observations</b>	636	636	636	636	636

Marginal effects from fractional logit models on the proportion of reproductive-age admissions who are pregnant. Clustered standard errors in parentheses.

Models include state and time (year) fixed effects, as well as state-specific time (year) trends.

<sup>a</sup> Significantly different from none at the 5% level.

<sup>A</sup> ~~Significantly different from none at the 1% level.~~

<sup>b</sup> Significantly different from criminal justice system only at the 5% level.

<sup>B</sup> ~~Significantly different from criminal justice system only at the 1% level.~~

<sup>c</sup> Significantly different from criminal justice system, provider reporting requirements, and treatment and support services at the 5% level.

<sup>€</sup> ~~Significantly different from criminal justice system, provider reporting requirements, and treatment and support services at the 1% level.~~

On the other hand, relative to having no applicable policies in place, states with all three types of policies had a higher proportion of pregnant admissions. On average, the proportion of pregnant admissions was 1.3 percentage points greater in states with all three types of policies, relative to states with no policies in place to address prenatal substance use ( $P < .01$ ). This difference represents an increase of 84 additional pregnant women in treatment for the median state-year. Next, we compared the overall marginal effect for states with all three types of policies in place with the overall marginal effect for states with policies oriented toward the criminal justice system only. We found a significant difference of 2.3 percentage points ( $P < .01$ ), which represents an increase of 148 additional pregnant women in treatment for the median state-year.

Overall, these results hold across the four demographic subgroups shown in Table 2. For all subgroups, except the age group of 15–24 years old, the ~~number-proportion of women who are of~~ pregnant ~~upon~~ admissions in states that had only criminal justice system policies remained significantly different from the ~~number-in~~ states with no policies. For all subgroups, the ~~number-proportion~~ of pregnant admissions in states with all three policy types remained significantly different from the ~~number-in~~ states with only criminal justice system policies as well as states with no policies. We re-estimated the models using the alternative approach for missing data described above and found that the relationship between the proportion of pregnant admissions and no policies, criminal justice system only policies, and all three types of policies persisted, suggesting that ~~these our~~ findings ~~we~~ are not driven by our approach toward missing data.

#### **4. Discussion**

This study examined state-level variation in the implementation of prenatal substance use policies, across three types, to investigate their impact on substance use disorder treatment admissions among pregnant women of reproductive age. The study finds significant negative association between the enactment of state policies focused solely on criminal justice and the proportion of pregnant admissions. In addition, the results also suggest that implementation of state policies across all three sectors (treatment and support services, criminal justice system, and provider reporting requirements) were positively associated with the proportion of pregnant admissions. These results hold for pregnant women across both age groups examined (15–24 years and 25–44 years) and for both non-Hispanic white women and women of all other racial/ethnic groups. These findings imply that states that are more policy engaged around prenatal substance use and adopt policies that take a multifaceted, comprehensive approach may see an increase in the use of substance use disorder treatment by pregnant women.

Pregnant women with substance use disorder are at increased risk for adverse health and social outcomes, including prolonged hospitalization (Whiteman et al., 2014), illness (Bauer et al., 2002), exposure to violence (Velez et al., 2006), and maternal death during delivery (Maeda, Bateman, Clancy, Creanga, & Leffert, 2014). In addition to these adverse health consequences of substance use for pregnant women, research has shown poorer birth outcomes and health conditions for infants exposed to prenatal drug use (Noonan, Reichman, Corman, & Dave, 2007). Although treatment for substance use disorder after delivery may improve maternal health and child outcomes (e.g., reduce the likelihood of subsequent drug use), research shows that substance use disorder treatment is likely to be most effective when pregnant women who engage in alcohol or substance use are targeted earlier for enrollment into treatment (Howell, Heiser, & Harrington, 1999).

Pregnancy is a critical time in women’s reproductive life course and in her addiction trajectory when there may be increased motivation to cease substance use and seek recovery (Terplan et al., 2009). More than 50% of pregnant women who need substance use disorder treatment receive it only during the postpartum period (Wolfe, Guydish, Santos, Delucchi, & Gleghorn, 2007). Thus, there is a need for programs that effectively screen, receive, treat, and retain pregnant women in treatment for substance use disorder. State-level policies might play a role in addressing the treatment needs of this population. The results from this study indicate that if states were to adopt policies to address prenatal substance use with a focus only on the criminal justice system, then pregnant women are likely to represent a smaller share of treatment admissions relative to other women of reproductive age. Policies focusing on provider reporting requirements only or treatment and support services only are not likely to affect rates of treatment use. However, policies that focus on multiple aspects of the treatment spectrum, from provider requirements to support services along with the criminal justice system, are more likely to see an increase in treatment use. This could be potentially due to the fact that mandated treatment (mandated through the criminal justice system) in an environment in which more treatment options are available for pregnant women (i.e., supportive policies) and more pregnant women are being identified by their providers as having SUD (i.e., reporting requirements). However, it should be noted that simply requiring more pregnant women to enter treatment programs when the treatment is of poor quality (e.g. treatment option does not include medication for opioid use disorder), may not be optimal, and has potential for harm; thus quality of care is an important issue for states to consider.

Despite its strong quasi-experimental design, this study has several limitations that are worth noting. First, the TEDS-A data are at the treatment admission level, thus it is possible that



multiple treatment admissions might have been included for the same individual. Second, details of the implementation or enforcement of policies are likely to vary from state to state, and these variations might have an impact on substance use disorder treatment admissions. For example, states might have policies that consider substance ~~misuse~~ ~~abuse~~ during pregnancy a form of child abuse but choose not to enforce or prosecute individuals under that statutory provision (Miranda, Dixon, & Reyes, 2015). Third, many policies related to general substance use were implemented at the state level during the study period that were not specific to pregnant women (e.g., parity laws, Medicaid expansion), which might have influenced the results of the analysis (Maclean & Saloner, 2017; McKenna, 2017). While the inclusion of state-level fixed effects and linear time trends moderate this issue to a large extent, explicitly controlling for other policies related to substance use might be an important robustness check for inclusion in future studies. Fourth, the study is limited only to treatment admissions reported to TEDS and does not include women who receive treatment from providers who do not report to TEDS, such as primary care providers, office-based providers, facilities operated by federal agencies, or other providers not receiving public funding. TEDS requirements vary by state—some states require reporting eligible facilities to report all admissions, while others require reporting only on patients who receive public funding. Our use of proportions as the dependent variable reduces the impact of this limitation.

Understanding the impact of prenatal substance use policies on a nationally representative sample of pregnant women with substance use disorder, regardless of whether they have received treatment or not, is an important avenue for future studies to consider. Additionally, future studies may wish to consider how these policies influence women's receipt of mental health services, as research has shown that individuals with substance use disorder are

likely to seek treatment in mental health settings, regardless of their mental health status (Ali, Teich, & Mutter, 2015). Another avenue for future research may include examination of how these policies affect treatment completion and maintenance of recovery (Mutter, Ali, Smith, & Strashny, 2015). It is important to note that the public health impact of these policies is not just whether pregnant women with SUD enter treatment but whether they remain engaged in treatment and what their as well as their longer-term recovery trajectories. ~~look like.~~

To attain the best possible health outcomes for pregnant women and their children, a singular focus on one sector or policy type might not be optimal. However, policy initiatives that engage a range of relevant stakeholders – from health care providers to treatment facilities to law enforcement – appear to be a more effective approach. An additional approach for states to consider along with the type of policies explored in this analysis is providing services in addition to primary treatment for substance use that address the broader psychosocial needs of both the woman and the child. In fact, studies show that women who received child care support during treatment were more likely to abstain from future substance use (Terplan et al., 2009), and the most effective substance use disorder treatment programs for pregnant women also address their social and mental health needs (Howell et al., 1999). In other words, a multilevel policy approach that engages all sectors of the health and social service system, and which addresses various aspects of the continuum of care, including prevention of misuse initiation, is warranted. This analysis provides further evidence that a multifaceted approach might be an effective policy mechanism for addressing substance use during pregnancy.

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This analysis examined the relationship between state level prenatal substance use policies and substance use disorder treatment admissions among pregnant women from 2002-2014.

States that have enacted policies focused only on criminal justice experienced a decline in substance use treatment admissions among pregnant women.

States that adopt a multifaceted, comprehensive policy approach – including treatment and support, clinician reporting requirements and criminal justice – experienced an increase in substance use treatment admissions among pregnant women.

**Substance Use Disorder Treatment Admissions and State-Level Prenatal Substance Use  
Policies: Evidence from a National Treatment Database**

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## **Substance Use Disorder Treatment Admissions and State-Level Prenatal Substance Use Policies: Evidence from A National Treatment Database**

### **Abstract**

State policies pertaining to prenatal substance use have important implications for health outcomes of pregnant women and their infants. However, little is known about the impact of the various types of state-level prenatal substance use policies (i.e., treatment and supportive services; criminal justice initiatives; and health care provider reporting requirements) on substance use disorder treatment admissions. Using data from the 2002–2014 Treatment Episode Data Set - Admissions, we exploited state-level variation in the implementation of different types of policies to assess their impact on pregnant women’s admission to substance use disorder treatment. The study found that state-level prenatal substance use policies focused only on the criminal justice sector were negatively associated with the proportion of women of reproductive age who were pregnant upon admission to treatment. Additionally, the implementation of policies that engaged all three sectors was positively associated with the proportion of women of reproductive age who were pregnant upon admission to treatment. These results were consistent across age groups and for both non-Hispanic white women and women of other racial/ethnic groups. The findings imply that states with cross-sector policy engagement around prenatal substance use and policies that take a multifaceted, comprehensive approach are more likely to see an increase in admissions to substance use disorder treatment during pregnancy.

**Key Words:** Pregnancy; Substance Related Disorder; Substance Abuse Treatment Admissions; State Policies.



## **1. Introduction**

Prenatal substance use is a significant risk factor for adverse pregnancy and birth outcomes (Norton, Zarkin, Calingaert, & Bradley, 1996). Women who use substances, including cocaine, marijuana, and alcohol during pregnancy are also more likely to experience adverse health outcomes (Terplan, Garrett, & Hartmann, 2009). Nearly 6 million women become pregnant each year in the United States (Curtin, Abma, Ventura, & Henshaw, 2013). The 2017 National Survey on Drug Use and Health indicated that approximately 8.5% of pregnant women aged 15-44 in the United States used an illicit substance in the past 30 days, and approximately 11.5% used alcohol; approximately 5.2% of pregnant women reported binge drinking during the prior month (Substance Abuse and Mental Health Services Administration, 2018). Prenatal substance use has been an important public health issue since fetal alcohol syndrome was recognized in 1973 (Popova, Lange, Probst, Gmel, & Rehm, 2017), and a surge in the use of crack cocaine among women of reproductive age in the 1980s brought the condition to national attention (Nadel, 1991). More recently, the opioid crisis has also disproportionately affected women of reproductive age (CDC, 2013; Kozhimannil, Graves, Levy, & Patrick, 2017), leading to an increase in rates of newborn opioid withdrawal (CDC, 2013; Patrick et al., 2015). The effects of the opioid epidemic on pregnant women and infants have refocused national attention on prenatal substance use policies in the United States.

To date, states have enacted policies of different types to address substance use among pregnant women and to protect infants from the harmful effects of such exposure. Currently, 19 states have established state-funded substance use treatment programs that are specifically targeted toward pregnant women, with 17 states and the District of Columbia providing pregnant women priority access to treatment programs and 10 states prohibiting treatment programs from

discriminating against them (Guttmacher Institute, 2017). Some states have enacted criminal justice–related policies (some of which have severe penalties) (Kennedy-Hendricks, McGinty, & Barry, 2016; Paltrow, Cohen, & Carey, 2000). Substance use/misuse during pregnancy is considered child abuse under civil child welfare statutes in 24 states and the District of Columbia. In addition, 18 states have enacted policies requiring health care providers to refer pregnant women to substance use disorder treatment and, in some cases, to child protective agencies; 7 states require providers to test for prenatal drug exposure if the provider suspects substance use (Jarlenski et al., 2017; Guttmacher Institute, 2017).

Research has shown that policies encouraging pregnant women to engage with health care providers to obtain substance use disorder treatment are associated with improved outcomes among this population (Lester, Andreozzi, & Appiah, 2004); however, mandatory reporting of drug use during pregnancy to child protective services may deter them from seeking treatment (Angelotta, Weiss, Angelotta, & Friedman, 2016). In fact, the American Congress of Obstetricians and Gynecologists (ACOG), the American Medical Association (AMA), and the American Psychiatric Association (APA) all suggest that reporting requirements may discourage women from receiving important prenatal care or substance use disorder treatment, thereby increasing potential neonatal harm (ACOG, 2012; AMA, 1990; APA, 1992).

In addition, potential health risks accompany criminal justice–focused policy efforts around prenatal substance use. Fear of criminal prosecution and loss of child custody have caused pregnant women who use substances to avoid prenatal care (Roberts & Pies, 2011). Because of their impact on the individual’s decision to receive timely care during pregnancy, policy measures that raise the possibility of criminal charges based on pregnancy and substance use have been connected to reduced birth weight and increased probability of preterm birth

(Coyer, 2017). In fact, among infants exposed to prenatal illicit drug use, higher levels of prenatal care were associated with reduced risk for low birth weight (El-Mohandes et al., 2003). Research has also shown that policies focused on criminal justice reduce the probability that pregnant women with an opioid use disorder will use medication-assisted treatment, which is the current recommended treatment (Angelotta et al., 2016; Saia et al., 2016). Furthermore, the most common strategy reported for avoiding detection of substance use during pregnancy was avoidance of care or isolation from friends or family members out of fear of being reported to authorities (Stone, 2015).

Although the literature on pregnancy-related substance use policies is growing, very little is known about the impact of different types of state-level policies on receipt of substance use disorder treatment among pregnant women. This study uses national data to examine the impact of state-level policies related to prenatal substance use across multiple policy types: 1) policies related to treatment and supportive services, 2) policies focused on criminal justice initiatives, and 3) reporting requirements for health care providers – on substance use disorder treatment among pregnant women. Specifically, this study looked at variation in the timing of these prenatal substance use policies, across all U.S. states from 2002 to 2014, to investigate their impact on substance use disorder treatment admissions among pregnant women of reproductive age (i.e., 15–44 years old). In addition, the study also examined the impact of these policies across different age groups and by race/ethnicity.

## **2. Methods**

### *2.1 Data and study population*

The primary source of data for this analysis is the public-use Treatment Episode Data Set - Admissions (TEDS-A). TEDS-A captures the characteristics of patients admitted to substance

use treatment facilities that report to individual state administrative data systems (Substance Abuse and Mental Health Services Administration, 2014). We combined TEDS-A data from 2002 to 2014 from the 50 states, which comprised 636 state-years. Three states (Alabama, Arkansas, and South Carolina) did not report TEDS-A data for one year, and four states (Alaska, Mississippi, Pennsylvania, and West Virginia) did not report for two or more years, for a total of 14 state-years excluded. Our data set contained over 6 million treatment admissions of women of reproductive age, almost 300,000 of which reported being pregnant at the time of admission.

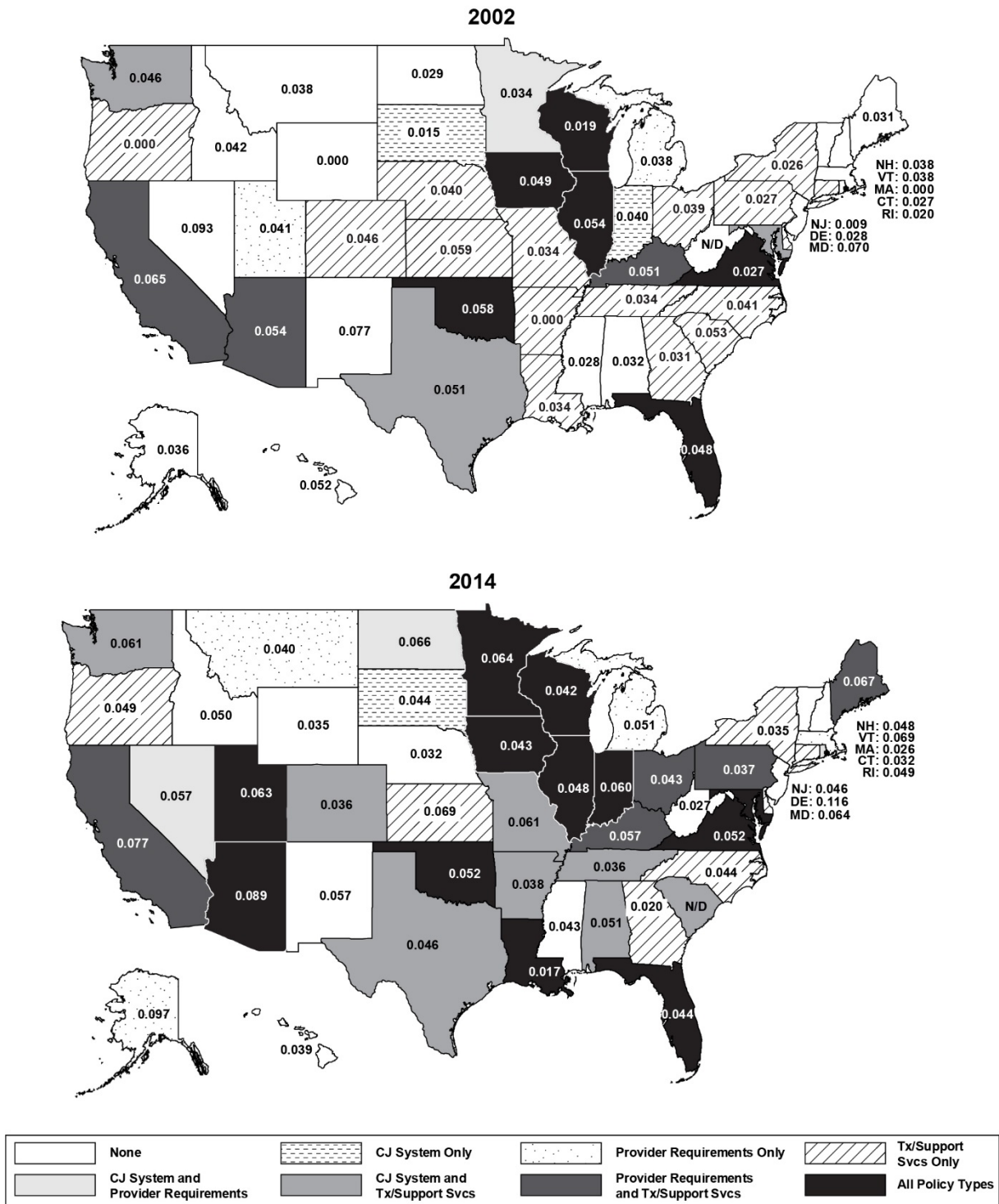
## 2.2 Measures

The outcome variable is the *proportion of pregnant admissions*. For each state-year, we defined the proportion of pregnant admissions as the number of women of reproductive age admitted to treatment who reported being pregnant divided by the sum of all women of reproductive age admitted to treatment. Records from which the pregnancy variable was missing were included in the denominator of the proportion. The average rate of missing pregnancy status for all state-years was 5.4%; however, instances of missing pregnancy status were concentrated in particular state-years. For example, in one of the state-years, women's admissions records were either marked as pregnant or the variable was not completed (i.e., data were missing). As such, we did not exclude records with missing data. Although this conservative approach decreases the calculated proportion of pregnant admissions in some state-years, it prevents us from artificially increasing the proportion of pregnant admissions in state-years with missing pregnancy records. We calculated the overall proportion of pregnant admissions as well as proportions of demographic subgroups defined by age (15–24 years old and 25–44 years old) and race/ethnicity (non-Hispanic white and all other racial/ethnic groups).

The independent variables of interest for this analysis were state policies toward prenatal substance use. Information on state policies over time was obtained from the Guttmacher Institute (2017). Current state policy information is updated monthly and is publicly available online; historical data were provided separately by the Guttmacher Institute. We organized seven distinct policy responses to substance use, from the Guttmacher data, into three types. States are identified as having policies oriented toward *treatment and support services* if they have established treatment programs specifically for pregnant women, given pregnant women priority access to treatment, or explicitly protected them from discrimination in existing treatment programs. States with policies oriented toward the *criminal justice system* are identified as those that either have a law explicitly criminalizing prenatal substance misuse or those that consider prenatal substance misuse to be child abuse under child welfare laws. Finally, states with policies that have *provider reporting requirements* are identified as those in which health care providers are required to report suspected prenatal substance use or test when prenatal exposure is suspected.

Some states have only one type of policy. Others have multiple policy types, and the policy approach used by some states has changed over time. From the three policy types (i.e., treatment and support services, criminal justice system, and provider reporting requirements) we developed an eight-level categorical variable representing all possible combinations of policy stances in a state in a given year, from having none of the policies in place to having all three types of policies in place. Figure 1 displays a map showing the policy stance of each state at the beginning (2002) and end (2014) of the period analyzed and indicates the proportion of women of reproductive age admitted to treatment who reported being pregnant at admission for the year depicted. As the maps in Figure 1 show, numerous states changed their policy stances between

2002 and 2014. The map demonstrates considerable variation in policy measures, with many states initially adopting policies or adding additional policy types. Of the 16 states with no policies in place in 2002, 7 states added at least one policy type and 3 states added multiple policy types by 2014. Of the 34 states with at least one policy type in place in 2002, 14 states added additional policies by 2014.



*Figure 1: Distribution of States into Policy Categories*

### 2.3 Analysis

We estimated fractional logit models of the proportion of pregnant admissions on the eight-level categorical indicator of state policy with standard errors clustered at the state level. Fractional logit models are used when the values of the dependent variables fall between 0 and 1 and help prevent some of the shortcomings of linear models or modeling the log-odds of fractional dependent variables (Papke & Wooldridge, 1996).

To account for differences among states and across time that would influence our results, such as differences in fertility rates or treatment needs among women who are pregnant (specifically) or of reproductive age (generally), we also controlled for state and year fixed effects as well as state-specific time trends. In our models, “none” was used as the reference category for the state policy indicator. Additionally, we conducted F-tests to examine the significance of differences between levels of policy.

We estimated the models for all women of reproductive age as well as analyses that were stratified by age and race/ethnicity subgroups defined a priori. Finally, for the small number of state-years ( $n = 12$  out of 636) in which no women reported being pregnant at the time of admission, we re-ran the analysis with these state-years excluded and confirmed that their presence did not meaningfully change the results. In addition, we tested our assumption that missing responses to the pregnancy question represented negative responses in a sensitivity analysis, where we excluded treatment episodes with missing data on pregnancy and dropped state-years with a missing rate greater than 10% (87 state-years). We also dropped one additional singleton state-year observation for New Mexico, because singleton observations were incompatible with this specification (Correia, 2015). Results were robust to this sensitivity analysis.



### 3. Results

Data from the 636 state-years included in the analysis were distributed into policy categories as shown in Table 1. The table also presents the unadjusted average proportion of pregnant admissions across state-years in each policy category. On average, states with policies oriented toward the criminal justice system only or toward treatment and support services only had the lowest proportions of pregnant admissions, while states with multiple types of policies had the highest proportions.

*Table 1: Distribution of States into Policy Categories*

Category	State-Years	Average Proportion Pregnant	States
None	142	0.043	AK, AL, HI,* ID,* MA, ME, MS,* MT, ND, NE, NH,* NJ,* NM,* NV, VT,* WV,* WY*
Criminal Justice System Only	29	0.041	AL, IN, SD*
Provider Reporting Requirements Only	54	0.047	AK, MA, MI,* MT, RI, UT
Treatment and Support Services Only	151	0.041	AR, CO, CT,* DE,* GA,* KS,* LA, MO, NC,* NE, NY,* OH, OR,* PA, SC, TN
Criminal Justice System and Provider Reporting Requirements	28	0.060	MN, ND, NV, RI
Criminal Justice System and Treatment and Support Services	70	0.050	AL, AR, CO, IN, LA, MD, MO, SC, TN, TX,* WA*
Provider Reporting Requirements and Treatment and Support Services	55	0.057	AZ, CA,* KY,* ME, OH, PA, UT
All Three Policies	107	0.051	AZ, FL,* IA,* IL,* IN, LA, MD, MN, OK,* UT, VA,* WI*
Total	636	0.047	-

\* Denotes state data included in category for entire analysis period.

Table 2 presents marginal effects from fractional logit models. The results indicate that, compared to states with no applicable policies, states with only criminal justice system-oriented

policies have a lower proportion of pregnant admissions. On average, the proportion of pregnant admissions is one percentage point lower in states with policies oriented toward the criminal justice system only, relative to states with no policies in place to address prenatal substance use. To place this result in context, the median state-year showed 6,452 admissions by women of reproductive age, 291 of whom reported being pregnant. A one-percentage-point decrease represents a decline of nearly 65 pregnant admissions. In addition, the differences between policies oriented toward the criminal justice system only and all other policy types were significant ( $P < .05$ ).

Table 2: Fractional Logit Model Results

	Overall	Age: 15–24	Age: 25–44	White	Other
<b>Policy Stance in State-Year</b>					
None (reference category)					
Criminal Justice System Only	-0.010 <sup>a,c</sup> (0.004)	-0.013 <sup>c</sup> (0.007)	-0.008 <sup>a,c</sup> (0.003)	-0.008 <sup>a,c</sup> (0.004)	-0.015 <sup>a,c</sup> (0.006)
Provider Reporting Requirements Only	0.005 <sup>b</sup> (0.005)	0.009 <sup>b</sup> (0.009)	0.003 <sup>b</sup> (0.004)	0.007 <sup>b</sup> (0.007)	0.002 <sup>b</sup> (0.006)
Treatment and Support Services Only	0.001 <sup>b,c</sup> (0.004)	0.003 <sup>c</sup> (0.008)	0 <sup>b,c</sup> (0.004)	0.002 <sup>c</sup> (0.004)	0.001 <sup>b,c</sup> (0.007)
Criminal Justice System and Provider Reporting Requirements	0.003 <sup>b</sup> (0.004)	-0.003 <sup>c</sup> (0.007)	0.004 <sup>b</sup> (0.003)	0.001 <sup>b,c</sup> (0.003)	0.006 <sup>b</sup> (0.010)
Criminal Justice System and Treatment and Support Services	0 <sup>b,c</sup> (0.005)	-0.002 <sup>c</sup> (0.008)	0.001 <sup>b,c</sup> (0.004)	0.002 <sup>b,c</sup> (0.005)	-0.003 <sup>b,c</sup> (0.007)
Provider Reporting Requirements and Treatment and Support Services	0.003 <sup>b,c</sup> (0.004)	0.005 <sup>b,c</sup> (0.009)	0.002 <sup>b,c</sup> (0.003)	0.004 <sup>b,c</sup> (0.004)	-0.001 <sup>b,c</sup> (0.006)
Criminal Justice System, Provider Reporting Requirements, and Treatment and Support Services	0.013 <sup>a,b</sup> (0.004)	0.017 <sup>a,b</sup> (0.008)	0.011 <sup>a,b</sup> (0.004)	0.012 <sup>a,b</sup> (0.004)	0.017 <sup>a,b</sup> (0.008)
<b>Observations</b>	636	636	636	636	636

Marginal effects from fractional logit models on the proportion of reproductive-age admissions who are pregnant. Clustered standard errors in parentheses.

Models include state and time (year) fixed effects, as well as state-specific time (year) trends.

<sup>a</sup> Significantly different from none at the 5% level.

<sup>b</sup> Significantly different from criminal justice system only at the 5% level.

<sup>c</sup> Significantly different from criminal justice system, provider reporting requirements, and treatment and support services at the 5% level.

On the other hand, relative to having no applicable policies in place, states with all three types of policies had a higher proportion of pregnant admissions. On average, the proportion of pregnant admissions was 1.3 percentage points greater in states with all three types of policies, relative to states with no policies in place to address prenatal substance use ( $P < .01$ ). This difference represents an increase of 84 additional pregnant women in treatment for the median state-year. Next, we compared the overall marginal effect for states with all three types of policies in place with the overall marginal effect for states with policies oriented toward the criminal justice system only. We found a significant difference of 2.3 percentage points ( $P < .01$ ), which represents an increase of 148 additional pregnant women in treatment for the median state-year.

Overall, these results hold across the four demographic subgroups shown in Table 2. For all subgroups, except the age group of 15–24 years old, the proportion of women who are pregnant upon admissions in states that had only criminal justice system policies remained significantly different from the states with no policies. For all subgroups, the proportion of pregnant admissions in states with all three policy types remained significantly different from the states with only criminal justice system policies as well as states with no policies. We re-estimated the models using the alternative approach for missing data described above and found that the relationship between the proportion of pregnant admissions and no policies, criminal justice system only policies, and all three types of policies persisted, suggesting that these findings were not driven by our approach toward missing data.

#### **4. Discussion**

This study examined state-level variation in the implementation of prenatal substance use policies, across three types, to investigate their impact on substance use disorder treatment

admissions among pregnant women of reproductive age. The study finds significant negative association between the enactment of state policies focused solely on criminal justice and the proportion of pregnant admissions. In addition, the results also suggest that implementation of state policies across all three sectors (treatment and support services, criminal justice system, and provider reporting requirements) were positively associated with the proportion of pregnant admissions. These results hold for pregnant women across both age groups examined (15–24 years and 25–44 years) and for both non-Hispanic white women and women of all other racial/ethnic groups. These findings imply that states that are more policy engaged around prenatal substance use and adopt policies that take a multifaceted, comprehensive approach may see an increase in the use of substance use disorder treatment by pregnant women.

Pregnant women with substance use disorder are at increased risk for adverse health and social outcomes, including prolonged hospitalization (Whiteman et al., 2014), illness (Bauer et al., 2002), exposure to violence (Velez et al., 2006), and maternal death during delivery (Maeda, Bateman, Clancy, Creanga, & Leffert, 2014). In addition to these adverse health consequences of substance use for pregnant women, research has shown poorer birth outcomes and health conditions for infants exposed to prenatal drug use (Noonan, Reichman, Corman, & Dave, 2007). Although treatment for substance use disorder after delivery may improve maternal health and child outcomes (e.g., reduce the likelihood of subsequent drug use), research shows that substance use disorder treatment is likely to be most effective when pregnant women who engage in alcohol or substance use are targeted earlier for enrollment into treatment (Howell, Heiser, & Harrington, 1999).

Pregnancy is a critical time in women’s reproductive life course and in her addiction trajectory when there may be increased motivation to cease substance use and seek recovery

(Terplan et al., 2009). More than 50% of pregnant women who need substance use disorder treatment receive it only during the postpartum period (Wolfe, Guydish, Santos, Delucchi, & Gleghorn, 2007). Thus, there is a need for programs that effectively screen, receive, treat, and retain pregnant women in treatment for substance use disorder. State-level policies might play a role in addressing the treatment needs of this population. The results from this study indicate that if states were to adopt policies to address prenatal substance use with a focus only on the criminal justice system, then pregnant women are likely to represent a smaller share of treatment admissions relative to other women of reproductive age. Policies focusing on provider reporting requirements only or treatment and support services only are not likely to affect rates of treatment use. However, policies that focus on multiple aspects of the treatment spectrum, from provider requirements to support services along with the criminal justice system, are more likely to see an increase in treatment use. This could be potentially due to the fact that mandated treatment (mandated through the criminal justice system) in an environment in which more treatment options are available for pregnant women (i.e., supportive policies) and more pregnant women are being identified by their providers as having SUD (i.e., reporting requirements). However, it should be noted that simply requiring more pregnant women to enter treatment programs when the treatment is of poor quality (e.g. treatment option does not include medication for opioid use disorder), may not be optimal, and has potential for harm; thus quality of care is an important issue for states to consider.

Despite its strong quasi-experimental design, this study has several limitations that are worth noting. First, the TEDS-A data are at the treatment admission level, thus it is possible that multiple treatment admissions might have been included for the same individual. Second, details of the implementation or enforcement of policies are likely to vary from state to state, and these

variations might have an impact on substance use disorder treatment admissions. For example, states might have policies that consider substance misuse during pregnancy a form of child abuse but choose not to enforce or prosecute individuals under that statutory provision (Miranda, Dixon, & Reyes, 2015). Third, many policies related to general substance use were implemented at the state level during the study period that were not specific to pregnant women (e.g., parity laws, Medicaid expansion), which might have influenced the results of the analysis (Maclean & Saloner, 2017; McKenna, 2017). While the inclusion of state-level fixed effects and linear time trends moderate this issue to a large extent, explicitly controlling for other policies related to substance use might be an important robustness check for inclusion in future studies. Fourth, the study is limited only to treatment admissions reported to TEDS and does not include women who receive treatment from providers who do not report to TEDS, such as primary care providers, office-based providers, facilities operated by federal agencies, or other providers not receiving public funding. TEDS requirements vary by state—some states require reporting eligible facilities to report all admissions, while others require reporting only on patients who receive public funding. Our use of proportions as the dependent variable reduces the impact of this limitation.

Understanding the impact of prenatal substance use policies on a nationally representative sample of pregnant women with substance use disorder, regardless of whether they have received treatment or not, is an important avenue for future studies to consider. Additionally, future studies may wish to consider how these policies influence women's receipt of mental health services, as research has shown that individuals with substance use disorder are likely to seek treatment in mental health settings, regardless of their mental health status (Ali, Teich, & Mutter, 2015). Another avenue for future research may include examination of how

these policies affect treatment completion and maintenance of recovery (Mutter, Ali, Smith, & Strashny, 2015). It is important to note that the public health impact of these policies is not just whether pregnant women with SUD enter treatment but whether they remain engaged in treatment as well as their longer-term recovery trajectories.

To attain the best possible health outcomes for pregnant women and their children, a singular focus on one sector or policy type might not be optimal. However, policy initiatives that engage a range of relevant stakeholders – from health care providers to treatment facilities to law enforcement – appear to be a more effective approach. An additional approach for states to consider along with the type of policies explored in this analysis is providing services in addition to primary treatment for substance use that address the broader psychosocial needs of both the woman and the child. In fact, studies show that women who received child care support during treatment were more likely to abstain from future substance use (Terplan et al., 2009), and the most effective substance use disorder treatment programs for pregnant women also address their social and mental health needs (Howell et al., 1999). In other words, a multilevel policy approach that engages all sectors of the health and social service system, and which addresses various aspects of the continuum of care, including prevention of misuse initiation, is warranted. This analysis provides further evidence that a multifaceted approach might be an effective policy mechanism for addressing substance use during pregnancy.



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