Scope of Practice and Opioid Prescribing Behavior of Nurse Practitioners Serving Medicare Beneficiaries

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Abstract

Providing comprehensive access to health care while keeping costs low and quality high has been the elusive goal of the healthcare system and policymakers. One potential policy solution is to increase access to health care by expanding the scope of practice (SOP) and prescriptive authority of nurse practitioners (NP). While this may increase access, some researchers argue that the expansion of SOP can compromise the quality and safety of rendered medical services. In this paper, we investigate quality and safety outcomes for NPs who have prescribed opioids for Medicare Part D beneficiaries. To do this, we use the Medicare Part D prescriptive-drug program records of both the practitioner's location and their corresponding written prescriptions and observe differences across states with different types of practice and prescription authority using a difference-in-difference framework. We find that SOP and prescriptive authority expansion do not compromise quality and safety in terms of potential abuse or misuse of prescriptive authority for nurse practitioners who are allowed to work to the full extent of their training. We conclude that expanding the scope of practice is a potential policy tool to increase access to health care.

Keywords: SOP, nurse practitioners, regulation, mobility
JEL Classification: J44, I18, H75

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1 Introduction

Providing comprehensive health care access, while simultaneously keeping costs low and quality high, has been the elusive goal of policymakers. One potential policy for increasing access to primary care is to expand the scope of practice and prescriptive authority of nurse practitioners in order to alleviate the primary care shortage (Mann, 2020; Markowitz and Adams, 2020). These nurse practitioners are a type of advanced registered nurse practitioner, with graduate degrees in advanced practice nursing. While they do not undergo a medical residency, they do have extensive clinical training and have become a popular choice of additional primary care provider for a number of states to resolve shortages in access to primary care since they provide a similar level of quality care to phsyicians in routine medical cases (Laurant et al., 2005; Lenz et al., 2004; Mundinger et al., 2000; Swan et al., 2015). The range of job tasks and required supervision differ by state, and are popularly referred to as the practitioners scope of practice. These job tasks may include items such as order laboratory and diagnostic testing, diagnosing and developing treatment plans for patients, prescribe various schedules of medications, or referring patients to specialists.

Broadening the scope of practice for nurse practitioners indicates allowing them to prescribe medication and operate to the full extent of their training and education to execute many primary care roles. The potential benefits of scope of practice expansions include reduced wait times for routine visits, reduced health care costs, and lower administrative costs for some physician practices, and the expansion of access to health care in rural markets (Fairman et al., 2011; Pittman and Williams, 2012; Traczynski and Udalova, 2018; Hughes et al., 2021). While some benefits have been researched in the literature, arguments against expanding scope of practice for nurse practitioners focus on the unknown potential effects on quality and safety of health care services if nurse practitioners are allowed to operate unsupervised by a physician (Mason, 2014). One of the main concern are about potential increases in the prescriptions of opioids, which have the potential for abuse and dependence (Schirle and McCabe, 2016).

In recent years, the United States drug overdose death rate more than tripled from 6.1 percent at the turn of the century to 20.7 in 2018 (Hedegaard et al., 2020) with especially large increases in the mortality of middle-aged white individuals (Case and Deaton, 2015), which has lead to concerns about potential over-prescribing of opioid medication. Opioid dependence is growing among both the young and old (Currie, 2018; Scholl et al., 2018), and increased opioid prescribing rates are associate with opioid-related dependencies, long-term use, overdose, loss of life, and worse socioeconomic conditions and poorer health outcomes (Ruhm, 2019; Barnett et al., 2017).

The previous studies of nurse practitioner scope of practice and opioid prescriptions have found mixed

results. For example, Muench et al. (2019) find that beneficiaries managed by nurse practitioners were less likely to receive an opioid and were more likely to instead receive a high daily opioid use of morphine compared with physicians. In contrast, Ladd et al. (2017) finds that nurse practitioners' status is not a predictor of prescribing practices. These practice restrictions were associated with lower rates of nurse practitioners with waivers to prescribe buprenorphine Spetz et al. (2019). While, Grecu and Spector (2019) finds that expanded prescriptive authority for nurse practitioners is associated with a decrease in opioid-related mortality. Our methodology aims to provide a salient interpretation of nurse practitioner prescribing behavior through resolving issues in previous papers by exploiting differences in both the job tasks and duties as well as the prescriptive authority of the nurse practitioners, which previous studies treat as a single variable.

This paper analyzes how nurse practitioners' scope of practice and prescriptive authority relates to the access, cost, and quality of health care and directly addresses the relationship between scope of practice expansions and the prescription of opioids. We interact state-level variations in scope of practice and the prescriptive authority to prescribe Schedule II drugs to identify the effects of expanding the scope of practice for nurse practitioners and if it jeopardizes patient's safety, access to health care, and cost. To accomplish this, we use the Medicare Provider Utilization and Payment Data, Part D Prescriber Summary Table annual data and develop individual-level repeated cross-sectional panel data that tracks nurse practitioner's location. Our identification strategy exploits the variations within the different types of scope of practice and prescriptive authority. We then provides plausibly causal estimates of the impacts of expanding the scope of practice on various prescribing behavior for general opioids, long-acting opioid drugs, and non-habit forming pharmaceutical drugs as controls, such as generic drugs, brand drugs, antibiotics. We further analyze the nurse practitioners average prescription drug costs, claims counts, and beneficiaries counts.

Our results show that states with prescriptive authority that expand the scope of practice to nurse practitioners' neither affected opioid prescribing behavior nor any other type of non-habit-forming pharmaceutical medications. In addition, we find statistically identical costs, claims counts, and beneficiaries counts, which provide evidence that expanding the scope of practice for nurse practitioners, which removes the physician supervision requirement, does not jeopardize patient's safety, access to health care, and cost. This research makes several important contributions to the literature. First, we provide one of the first studies that differentiates between prescriptive authority and other scope of practice laws, more accurately reflecting how they are written in state laws. We also utilize individual nurse practitioner data rather than aggregate to the state or county level, as has been the norm in the literature (Grecu and Spector, 2019; Ladd et al., 2017; Lozada et al., 2020; Kandrack et al., 2019). We develop a unique methodological approach that resolves a common issue in the liteature where our time period does

not have vacation in timing of law adoption, limiting researchers to impose parallel trend assumption for state-level comparison to identify plausibly causal estimation. Finally, within prescriptive authority states, we provide a potential solution to identify the causal relationship between nurse practitioner's scope of practice and various prescribing behavior.

Section 2 details two data source, the Medicare Provider Utilization, and Payment Data and the McMichael and Markowitz (2020) uniform classification of nurse practitioner scope of practice laws and Schedule II prescriptive authorities laws, including our strategy to operationalize Restrictive, Reduced prescriptive, Reduced Scope of Practice, and Full Autonomy regimes. Section 3 explains our identification strategy where we venture to discover nurse practitioners who are plausibly similar within observable and unobservable dimensions. These nurse practitioners only vary in their mobility decision which sorts into the treatment and comparison group. Then, we explain the difference-in-difference framework. Section 4 exhibits results and section 5 concludes our study with policy implications.

2 Data

To understand the relationship between scope of practice legislation and subsequent prescribing patterns by nurse practitioners, we need information on each individuals practitioner over time. Data on nurse practitioners' prescribing patterns was obtained through the 2013-2018 National Provider Identifiers from the Medicare Provider Utilization and Payment Data, Part D Prescriber Summary Table files available through the Centers for Medicare & Medicaid Services. In addition, individual National Provider Identifier (NPI) data was cross-listed with the annual NPI registry to identify practitioner attributes such as practice specialization, to ensure we were correctly identifying groups affected by scope of pratice expansions. As a result, the analysis includes the subset of all nurse practitioners who serve Medicare beneficiaries that participate in the Part D prescription-drug program, which includes approximately two-thirds of all Medicare beneficiaries.

Legislative information for each state's scope of practice and prescriptive authority laws were obtained from McMichael and Markowitz (2020). This comprehensive historical legislative data differs from the American Association of Nurse Practitioners' definitions in that it includes the exact month of the policy change and considers when a supervision or collaboration policy is non-binding due to a simple signature requirement or admission requirements. This detailed data was collected by a team of lawyers and economists and verified by outside parties at multiple stages.

Table 1, under the columns labeled "Rx," describes the policy set during our 2013-2018 time period. When a state has a designation of $Rx = 1$, it had full prescriptive authority through the entire sample period. In our definition, full prescriptive authority means that a nurse practitioner can prescribe Schedule

Table 1: Scope of Practice Status Between 2013 and 2018

State	**Rx**	**SOP**	**State**	**Rx**	**SOP**
(1)	(2)	(3)	(4)	(5)	(6)
Alabama	2013	0	Nevada	1	2013
Alaska	1	1	New Hampshire	1	1
Arizona	1	1	New Jersey	1	0
Colorado	1	1	New Mexico	1	1
Connecticut	2014	2014	New York	2015	2015
Delaware	2015	2015	North Dakota	1	1
District of Columbia	1	1	Oregon	1	1
Florida	2017	0	Rhode Island	1	1
Hawaii	1	1	South Carolina	1	0
Idaho	1	1	South Dakota	2017	2017
Iowa	1	1	Texas	1	0
Kentucky	1	0	Utah	2016	2016
Maine	1	1	Vermont	1	1
Maryland	1	1	Virginia	1	0
Minnesota	2015	2015	Washington	1	1
Mississippi	1	0	West Virginia	0	2016
Montana	1	1	Wyoming	1	1
Nebraska	2015	2015			

Notes: To preserve space, we suppress $SOP = 0$ and $Rx = 0$ for Arkansas, California, Illinois, Indiana, Kansas, Louisiana, Massachusetts, Michigan, Missouri, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, and Wisconsin.

II, III, and IV medications without physician oversight or signatures. Restricted prescriptive authority or $Rx = 0$ means that the nurse practitioners were unable to prescribe Schedule II medications through our entire sample period. In most states, the law also does not allow for independent Schedule III or IV prescriptions. A year designation means that the nurse practitioner could not prescribe medication until and during this date and then received full prescriptive authority in the following years.

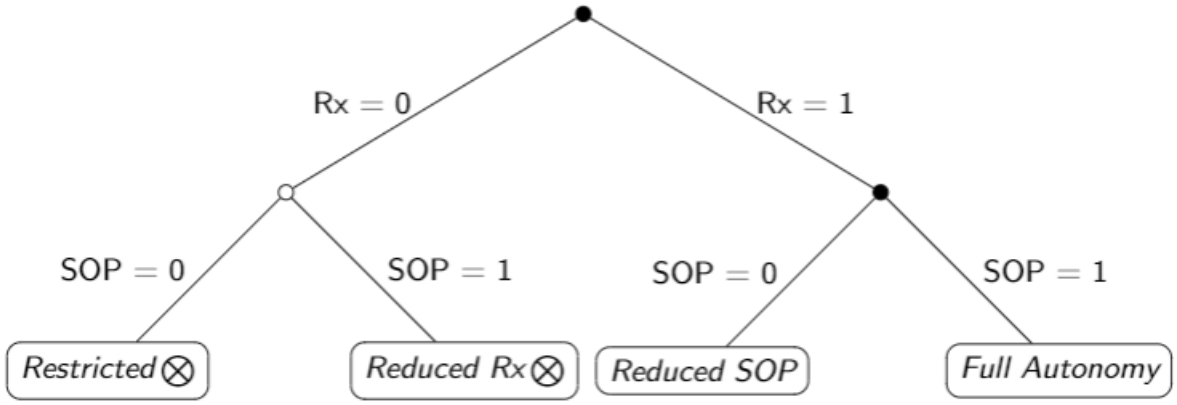
The second set of dates within 1, labeled "SOP," presents the scope of practice laws within these states during our sample period. Scope of practice differs from prescriptive authority in that scope of practice it instead measures if a nurse practitioner can operate independently to the full scope of their training in providing various aspects of primary care, such as ordering testing, diagnosing patients, and developing treatment plans. Most previous studies have treated this as a singular variable, even though they are different policies and laws. We attempt to improve the literature by incorporating the newly develop definitions and differences of McMichael and Markowitz (2020). Presented in Table 1, a value of 1 for SOP, i.e., $SOP = 1$, means that a nurse practitioner has full authority to practice without supervision through the entire period. A value of 0 for SOP, i.e., $SOP = 0$, means that one or more of the aspects of primary care require physician supervision, commonly referred to as reduced or restricted scope of practice through the entire sample period. A year designation implies that a nurse practitioner had reduced or restricted SOP up to and during this date and then received a full scope of practice legal

expansion in the following years.

3 Identification strategy and method

For ease of notation and discussion, we operationalize $Rx = 0$ & $SOP = 0$ as a Restrictive regime where the practitioner can neither prescribe medication or perform job duties independently, $Rx = 0$ & $SOP = 1$ as Reduced Rx regime since they have reduced prescriptive authority but maintain autonomy in all other job duties, $Rx = 1$ & $SOP = 0$ as Reduced SOP where the nurse practitioner can prescribe medication but cannot perform all job functions without supervision or collaboration with a physician, and $Rx = 1$ & $SOP = 1$ as Full Autonomy where the nurse practitioner can both prescriptive medication and has autonomy over all job tasks. Figure 1 presents a tree diagram to visualize our four groups.

Figure 1: Relevant groups



Notes:

The purpose of our research is to identify how the scope of practice, coupled with prescriptive authority, affects opioid prescribing behavior among nurse practitioners. Hence, in our base methodology, we exclude Restrictive and Reduced Rx states, as these states do not have Schedule II prescriptive authority, and only consider Reduced SOP or Full Autonomy states. This limitation of states presents the first crucial issue within the current literature, in that when considering the 2013-2018 available sample of scope of practice laws, there were no changes in policy for states with prescriptive authority, as shown in table 2. This lack of variation of timing in the adoption of Full Autonomy for states among Reduced SOP states has limited causal estimates in previous papers. This only allows a simple difference of means comparisons of prescribing behaviors between Full Autonomy to Reduce SOP states, and the comparison of averages may yield biased estimates.

Our methodology addresses this limitation and introduce a new component, state by state mobility patterns, to provide a plausibly causal answer to our research question on how the scope of practice

Table 2: No variation in timing of adoption of Full Autonomy among reduced SOP states

State	2013	2014	2015	2016	2017	2018
Alaska	F	F	F	F	F	F
Arizona	F	F	F	F	F	F
Colorado	F	F	F	F	F	F
District of Columbia	F	F	F	F	F	F
Hawaii	F	F	F	F	F	F
Iowa	F	F	F	F	F	F
Idaho	F	F	F	F	F	F
Maryland	F	F	F	F	F	F
Maine	F	F	F	F	F	F
Montana	F	F	F	F	F	F
North Dakota	F	F	F	F	F	F
New Hampshire	F	F	F	F	F	F
New Mexico	F	F	F	F	F	F
Nevada	F	F	F	F	F	F
Oregon	F	F	F	F	F	F
Rhode Island	F	F	F	F	F	F
Vermont	F	F	F	F	F	F
Washington	F	F	F	F	F	F
Wyoming	F	F	F	F	F	F
Alabama	R	R	R	R	R	R
Kentucky	R	R	R	R	R	R
Mississippi	R	R	R	R	R	R
New Jersey	R	R	R	R	R	R
South Carolina	R	R	R	R	R	R
Texas	R	R	R	R	R	R
Virginia	R	R	R	R	R	R

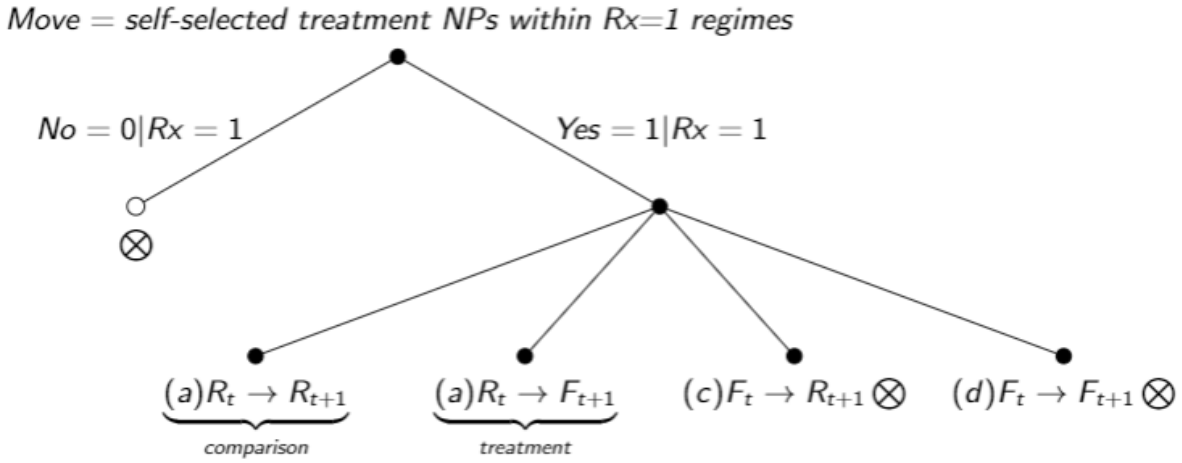
Notes: We define $Rx = 1$ & $SOP = 0$ as Reduced SOP (R), and $Rx = 1$ & $SOP = 1$ as Full Autonomy SOP (F) regime for nurse practitioners.

affects opioid prescribing behavior among nurse practitioners. Therefore, our variation will not be at the state policy level, but instead for individual practitioners who move within and to states with various legal environments. Figure 2 exhibits our strategy graphically in how we exploit the nurse practitioner's mobility within Reduced SOP and Full Autonomy states. We consider nurse practitioners in two periods, t and $t+1$, for each pair of adjacent years.

In period t, a nurse practitioner, indexed as i, can move to a different state in the next period, $t+1$, or remain in the same state in $t+1$. Within Reduced SOP and Full Autonomy states, we exclude the nurse practitioners who have not moved or changed states. Nurse practitioners can move in four possible ways: from Reduced SOP to Reduced SOP ($R_t \to R_{t+1}$), from Reduced SOP to Full Autonomy ($R_t \to F_{t+1}$), from Full Autonomy to Reduced SOP ($F_t \to R_{t+1}$), and Full Autonomy to Full Autonomy ($F_t \to F_{t+1}$).

Within these four groups, comparing opioid prescribing behaviors of nurse practitioners who moved from Reduced SOP to Reduced SOP ($R_t \to R_{t+1}$) provides a relevant comparison group to the nurse practitioners who moved from Reduced SOP to Full Autonomy ($R_t \to F_{t+1}$). Hence we assign treatment

Figure 2: Relevant groups



Notes: We define $Rx = 1$ & $SOP = 0$ as Reduced SOP (R), and $Rx = 1$ & $SOP = 1$ as Full Autonomy (F) regime for nurse practitioners.

status as $treat = 1$ for nurse practitioners who moved from Reduced SOP to Full Autonomy ($R_t \rightarrow F_{t+1}$), and comparison status as $treat = 0$ for nurse practitioners who moved from Reduced SOP to Reduced SOP ($R_t \rightarrow R_{t+1}$). The time t allows to pre-treatment period as $post = 0$ and $t + 1$ as post-treatment $post = 1$. With this identification strategy, we implement a standard difference-in-difference framework.

$$y = \alpha + \beta treat + \gamma post + \delta treat \times post + \epsilon \tag{1}$$

where y represents the dependent variable in logarithmic transformation as $y = ln(Y + 1)$. We use several relevant variables to proxy nurse practitioners prescribing behavior. Since we are only using mobility between two time periods, additional corrections for multi-period difference-in-differences are not required. The coefficient α, β, γ, and δ are expressed as:

$$\alpha = E[y|treat = 0, post = 0]$$

$$\beta = (E[y|treat = 1, post = 0] - E[y|treat = 0, post = 0])$$

$$\gamma = (E[y|treat = 0, post = 1] - E[y|treat = 0, post = 0])$$

$$\begin{aligned}\delta = &(E[y|treat = 1, post = 1] - E[y|treat = 0, post = 1]) \\ &- (E[y|treat = 1, post = 0] - E[y|treat = 0, post = 0])\end{aligned}$$

The coefficient α provides the averages prescribing behavior nurse practitioners within the comparison group in their pre-mobility period when they are in Reduced SOP states, which provides an estimate of baseline prescribing behavior. The coefficient β compares pre-mobility average prescribing behavior in the

treatment group to a comparison group. The estimate of γ provides insight into how nurse practitioners in the comparison groups changed their prescribing behavior after moving to another Reduced SOP state.

Finally, the coefficient of interest within the difference-in-difference framework is δ. The coefficient δ provides a plausibly causal effect of the Full Autonomy practice on prescribing behavior of nurse practitioners. Under the parallel trend assumption that the prescribing behavior of nurse practitioners within the treatment group would remain unchanged, were these nurse practitioners in the comparison group in counterfactual. Using this assumption, δ is identifiable as the difference in average prescribing behavior of nurse practitioners within the treatment group, before and after they move between Reduced SOP and Full Autonomy states, relative to the average prescribing behavior of nurse practitioners within the control group before and after they move between Reduced SOP and another Reduced SOP states. Since the dependent variable is in logarithmic transformation, the coefficient δ can be explained as a geometric mean comparison in percentage as $e^{\delta} - 1$.

Nurse practitioners are not likely to move just to prescribe certain medications and instead move for autonomy in their job tasks, and data shows that most nurse practitioners move instead for personal of family reasons (Dywili et al., 2011). The mobility of nurse practitioners is plausibly as good as randomly assigned to their prescribing behavior, given that nurse practitioners are moving within the state with Schedule II prescriptive authority. However, the decision to move may not be exogenous, hence to potentially allow us to adequately compare various prescribing behavior of nurse practitioners, we consider two groups: the treatment group, which includes nurse practitioners who moved from one Reduced SOP state to a Full Autonomy state, and the comparison group, which includes nurse practitioners who moved from one Reduced SOP to a different Reduced SOP state. We argue that these two groups, on average, are plausibly similar within observable and unobservable dimensions, except the treatment group sort themselves to move to Full Autonomy states while the comparison group sorts themselves to move to another Reduced SOP state.

4 Results

Our analysis depends on two specific subsamples. First is the Reduced SOP, where nurse practitioners have opioid prescriptive authority but not the full scope of practice. Second is Full Autonomy, where nurse practitioners have both prescriptive authority and practice autonomy. However, there is no variation of timing in the scope of practice law adoption (see Table 2), resulting in a lack of proper natural experimental setting, which restricts adequate comparison of various prescribing behavior of nurse practitioners from these two subgroups. To circumvent this issue, we exploit the timing variation of nurses who moved within and across these two regimes.

We implement a difference-in-difference method to estimate the effect of Full Autonomy expansion on various opioid and non-opioid-related prescribing behavior. Since we generate repeated cross-sectional panel data, we include cross-sectional year fixed-effects and nurse practitioner's specialty fixed-effects. And, we report robust to heteroskedasticity standard errors. Furthermore, standard errors are also clustered at the nurse practitioner's specialty level to allow for any arbitrary intra-correlation process within their specialty (Bertrand et al., 2004).

Table 3: Impacts of Full Autonomy on Nurse Practitioner's opioid prescribing behavior

	Opioids				
	Claim counts	Drug cost	Day supply	Bene count	Prescriber rate
	(1)	(2)	(3)	(4)	(5)
treat × *post*	0.112	0.203	0.219	0.039	0.064
	(0.314)	(0.517)	(0.508)	(0.257)	(0.186)
treat	−0.319	−0.444	−0.472	−0.181	−0.087
	(0.224)	(0.370)	(0.363)	(0.185)	(0.132)
post	−0.075	−0.132	−0.133	−0.044	−0.050
	(0.270)	(0.441)	(0.433)	(0.220)	(0.158)
Year FE	Yes	Yes	Yes	Yes	Yes
Specialty FE	Yes	Yes	Yes	Yes	Yes
Cluster SE	Specialty	Specialty	Specialty	Specialty	Specialty
HC SE	Yes	Yes	Yes	Yes	Yes
Observations	844	844	844	844	844
R^2	0.080	0.073	0.072	0.068	0.061
Adjusted R^2	0.057	0.050	0.048	0.045	0.038
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 3 investigates the impact of Full Autonomy on nurse practitioner opioid prescribing behavior in our difference-in-difference framework. When analyzing this set of nurse practitioners, we find no discernible difference in the number of claims, cost of prescribed medication, number of days supplied, the number of beneficiaries serviced, or the prescription rate between nurse practitioners with scope of practice autonomy and those who do not have autonomy over job tasks. This methodology improves the previous work by isolating a treatment group that only varies in the scope of practice and physician oversight, but both can prescribe Schedule II medications. The lack of effect implies that we do not find evidence supporting the argument that unsupervised nurse practitioners would endanger the quality and safety of over-prescribing opioid medications.

Likewise, in table 4, we repeat our methodology with a focus on long-acting opioid prescribing behavior. Utilizing a difference-in-difference framework for nurse practitioners who moved between Reduced SOP and Reduced SOP or Full Autonomy, we find no evidence of differences in nurse practitioner be-

Table 4: Impacts of Full Autonomy on Nurse Practitioner's long-acting opioid prescribing behavior

	Long-acting opioids				
	Claim counts	Drug cost	Day supply	Bene count	Prescriber rate
	(1)	(2)	(3)	(4)	(5)
treat × *post*	−0.026	−0.084	−0.050	0.009	−0.005
	(0.161)	(0.347)	(0.281)	(0.094)	(0.120)
treat	−0.029	−0.054	−0.041	0.019	0.002
	(0.113)	(0.244)	(0.196)	(0.065)	(0.087)
post	0.015	0.049	0.044	0.012	0.0003
	(0.137)	(0.298)	(0.240)	(0.076)	(0.100)
Year FE	Yes	Yes	Yes	Yes	Yes
Specialty FE	Yes	Yes	Yes	Yes	Yes
Cluster SE	Specialty	Specialty	Specialty	Specialty	Specialty
HC SE	Yes	Yes	Yes	Yes	Yes
Observations	844	844	844	844	844
R^2	0.084	0.072	0.068	0.068	0.069
Adjusted R^2	0.060	0.049	0.044	0.044	0.046
Note:					*p<0.1; **p<0.05; ***p<0.01

havior within the number of claims, drug costs, days supplied, beneficiary count, or prescription rate of long-acting opioids when a nurse practitioner is not under physician supervision.

Using a subset of non-Schedule II drugs, such as antibiotics, we additionally test if having Full Autonomy impacts nurse practitioner prescribing behavior for non-opioids in table 5. The purpose for investigating this relationship is to understand if this lack of behavioral differences only happens with closely monitored opioid medications, or if it is common across many of the non-habit forming medication nurse practitioners may prescribe. The set of nurse practitioners in the Full Autonomy state without direct physician supervision after their mobility decision does not differ from the control group in their claim count, drug cost, or beneficiary count for an antibiotic medication. They also do not differ in the number of claims or the drug costs for either branded and generic medications, showing no inherent difference in prioritizing one type of medication. Interestingly, we find individuals that move to Full Autonomy states already had weakly significantly reduced claims and beneficiary counts for antibiotics and generic drugs before the mobility change.

Finally, table 6 aggregates all prescriptions regardless of Schedule or generic classification. The aggregate measure includes opioids, long-acting opioids, antibiotics, and other medications to understand any changes in the aggregate nurse practitioner behavior. There is no evidence of differences in prescribing rates for nurse practitioners that moved to Full Autonomy states without physician supervision relative to those nurse practitioners who move and remain in Reduced SOP states. This result implies that

Table 5: Impacts of Full Autonomy on Nurse Practitioner's prescribing behavior

	Prescribing behavior for other medications						
	Antibiotic drugs			Brand drugs		Generic drugs	
	Claim counts	Drug cost	Bene count	Claim counts	Drug cost	Claim counts	Drug cost
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
treat × *post*	−0.164	−0.232	−0.122	−0.286	−0.443	0.072	0.217
	(0.288)	(0.473)	(0.278)	(0.372)	(0.776)	(0.379)	(0.547)
treat	−0.363*	−0.500	−0.368*	−0.073	−0.054	−0.527*	−0.645
	(0.209)	(0.348)	(0.200)	(0.267)	(0.556)	(0.273)	(0.394)
post	0.092	0.048	0.036	0.351	0.748	0.122	0.119
	(0.246)	(0.398)	(0.237)	(0.316)	(0.649)	(0.316)	(0.452)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialty FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty
HC SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	844	844	844	844	844	844	844
R^2	0.160	0.163	0.148	0.050	0.050	0.065	0.053
Adjusted R^2	0.139	0.142	0.126	0.025	0.026	0.042	0.028
Note:							*p<0.1; **p<0.05; ***p<0.01

allowing nurse practitioners to practice independently does not affect the claims count, 30-day fill count, drug cost, days supplied, or the beneficiary count.

Table 6: Impacts of Full Autonomy on Nurse Practitioner's aggregated prescribing behaviour

	Aggregated prescribing behaviour				
	Claim counts	30 day fill	Drug cost	Day supply	Bene count
	(1)	(2)	(3)	(4)	(5)
treat × *post*	−0.025	−0.015	0.033	0.004	0.091
	(0.230)	(0.241)	(0.290)	(0.272)	(0.272)
treat	−0.346**	−0.314*	−0.288	−0.316	−0.360*
	(0.166)	(0.174)	(0.212)	(0.195)	(0.195)
post	0.115	0.133	0.173	0.129	0.007
	(0.196)	(0.206)	(0.243)	(0.233)	(0.233)
Year FE	Yes	Yes	Yes	Yes	Yes
Specialty FE	Yes	Yes	Yes	Yes	Yes
Cluster SE	Specialty	Specialty	Specialty	Specialty	Specialty
HC SE	Yes	Yes	Yes	Yes	Yes
Observations	844	844	844	844	844
R^2	0.092	0.086	0.079	0.076	0.071
Adjusted R^2	0.069	0.063	0.055	0.052	0.047
Note:					*p<0.1; **p<0.05; ***p<0.01

4.1 Robustness checks

We use the term placebo treatment test to refer to a test that replicates the core analysis with a permuted treatment variable. Similarly, we use placebo population test to refer to a test that replicates the core analysis in a different population.

4.1.1 Placebo treatment effects

Our results, discussed above, indicate that there is a null treatment effect of moving from Reduced SOP to Full Autonomy on various prescribing behavior among nurse practitioners. The obvious question is if such null treatment effects are just statistical chance (invalid) or causally zero. We precisely know the status of each nurse practitioner and if they belong in the treatment group and the comparison group through our identification strategy. Yet, we do not know what would have happened under all possible treatment assignments and against all possible treatment assignments, and how unusual the estimated treatment effect is. To answer these questions, we randomly permute the treatment, i.e. the status of moving from Reduced SOP to Full Autonomy states. For this, we develop the placebo effect distribution, then we test how unusual or skewed the actual treatment effect is when compared against the mean of the placebo effect distribution.

We randomly permute treatment status and conduct the standard difference-in-difference for 1000 iterations. From each iterations, we collect and store the value of the randomly permuted treatment effect to elicit a distribution. Because we randomize the treatment assignment, we call these estimates the placebo effect. The distributions of placebo effects are exhibited in Figure 3. Then we custom test how many standard deviations the mean of placebo effect distribution is from the actual treatment effect. Actual treatment effects for various prescribing behavior is presented in appendix tables 3, 4, 5, and 6, which addresses opioids, long-acting opioids, non-opioid drugs, and aggregate prescriptions, respectively.

$$Z = \frac{\overline{\delta}_{placebo} - \delta}{\sigma_{\delta_{placebo}}}$$

Figure 3 depicts the placebo effect distribution for each of our categories. Where, $\overline{\delta}_{placebo}$ is the vector which comprise 1000 value of randomized treatment effect. It's respective standard deviation is $\sigma_{\delta_{placebo}}$. Given the placebo effect distribution is normally distributed by conventional criteria of the $\mid Z \mid > 3$, we can define that randomized inference p-value to be less than 1%. We provide the 5% quantile and 95% quantile values of placebo effect distribution since the distribution does not appear to be distributed randomly. If the actual treatment effect, presented in corresponding tables 3, 4, 5, and 6, are far apart from these two quantile values, then it corroborates and supports that the mean placebo treatment effect is statistically significantly far away from the actual treatment effect suggesting that the actual treatment

effects are plausibly causal and not a statistical chance.

4.1.2 Placebo population

While the previous placebo test supports that we are observing a true null result of the policy, additional tests of differing the population that is affected by the policy will also provide a different dimension of investigation into the treatment effect of scope of practice expansions. A placebo population test refers to a test that replicates the core analysis in a different population. We have 19 Full Autonomy or treatment states and 7 Reduced SOP or comparison state (see table 2). There could be $C(26, 19) = \frac{26!}{19!(26-19)!} = 657800$ possible ways for these 26 states to fall in either treatment or comparison group. If the Full Autonomy has a an actual null effect on various prescribing behavior, then any sequence of placebo population should yield a distribution centered around zero. For this purpose, we develop placebo population and run the standard difference-in-difference for 1000 iteration. From each iterations, we collect and store the value of the treatment effect from placebo population. As expected, the actual treatment effects is not statistically apart from the mean of the treatment effect from placebo population. We presented such distribution in figure 4. The distribution shows that when any of the states are randomly assigned in the treatment or control group, the treatment effect do not change suggesting that the expansion of Reduced SOP to Full Autonomy does not change the prescribing behavior of nurse practitioners.

4.1.3 Policy reversal

Our results, and subsequently the previous robustness tests, find no differences in prescribing behavior when we compare to nurse practitioners from the treatment group, those who move from Reduce SOP to another Full Autonomy state, to the nurse practitioners from the comparison group, those who move from one Reduce SOP to a different Reduce SOP state. This suggest that change from Reduce SOP to Full Autonomy doesn't jeopardize patient's safety, cost, and beneficiaries counts. In fact, it does not seem to have any affect in presribing patterns at all, which is the primary cited concern against expanding scope of practice and prescriptive authority rights to nurse practitioners. We additional believe it would be interesting to look at prescription behavioral changes for a policy reversal. Does prescribing behavior change for a nurse practitioner who moved from a Full Autonomy state to a Reduce SOP state?

For this question, we must investigate two different subsamples. First are the nurse practitioners who move from Full Autonomy to Reduced SOP. We define these as the treatment group. Second, we define comparison group as nurse practitioners who move from one Full Autonomy state to another Full autonomy state to find the counterfactual. Looking back to Figure 1, in this setting, group (c) is the treatment group and (d) is the comparison group. We then ran the standard difference-in-difference

models and recorded the estimates. These estimates are presented in Appendix **??** Table A1 and A2. The estimates are statistically insignificant, which can be interpreted that policy reversal is likely not to change the nurse practitioners' prescribing behavior.

4.1.4 Inclusion of several relevant covariates

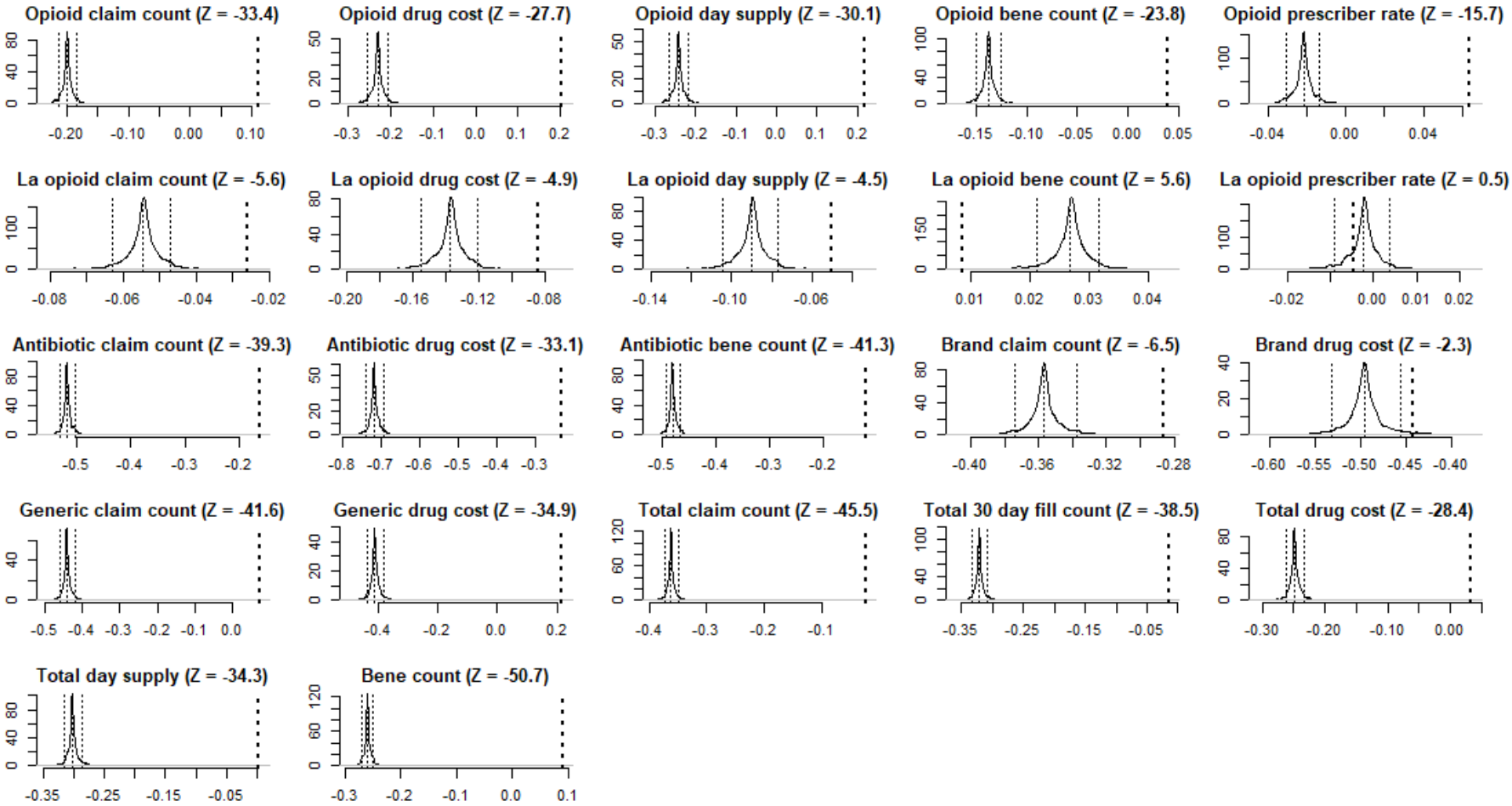
We modified equation 1 to incorporate several relevant covariates as the following such as the nurse practitioner gender, average age of beneficiaries, number of female beneficiaries, number of white beneficiaries, the number of beneficiaries who are dual qualified for Medicare and Medicaid, and the beneficiary Average Hierarchical Condition Category risk score. We then conduct the following difference-in-difference framework on each two-year cross-sectional pair.

$$y = \alpha + \beta treat + \gamma post + \delta treat \times post + \mathbf{X}_k \Gamma_k + \epsilon \tag{2}$$

Where $X_{ist,k}$ represents a matrix of k different vectors of the independent variables, mentioned above. Γ_k lists the respective coefficients.

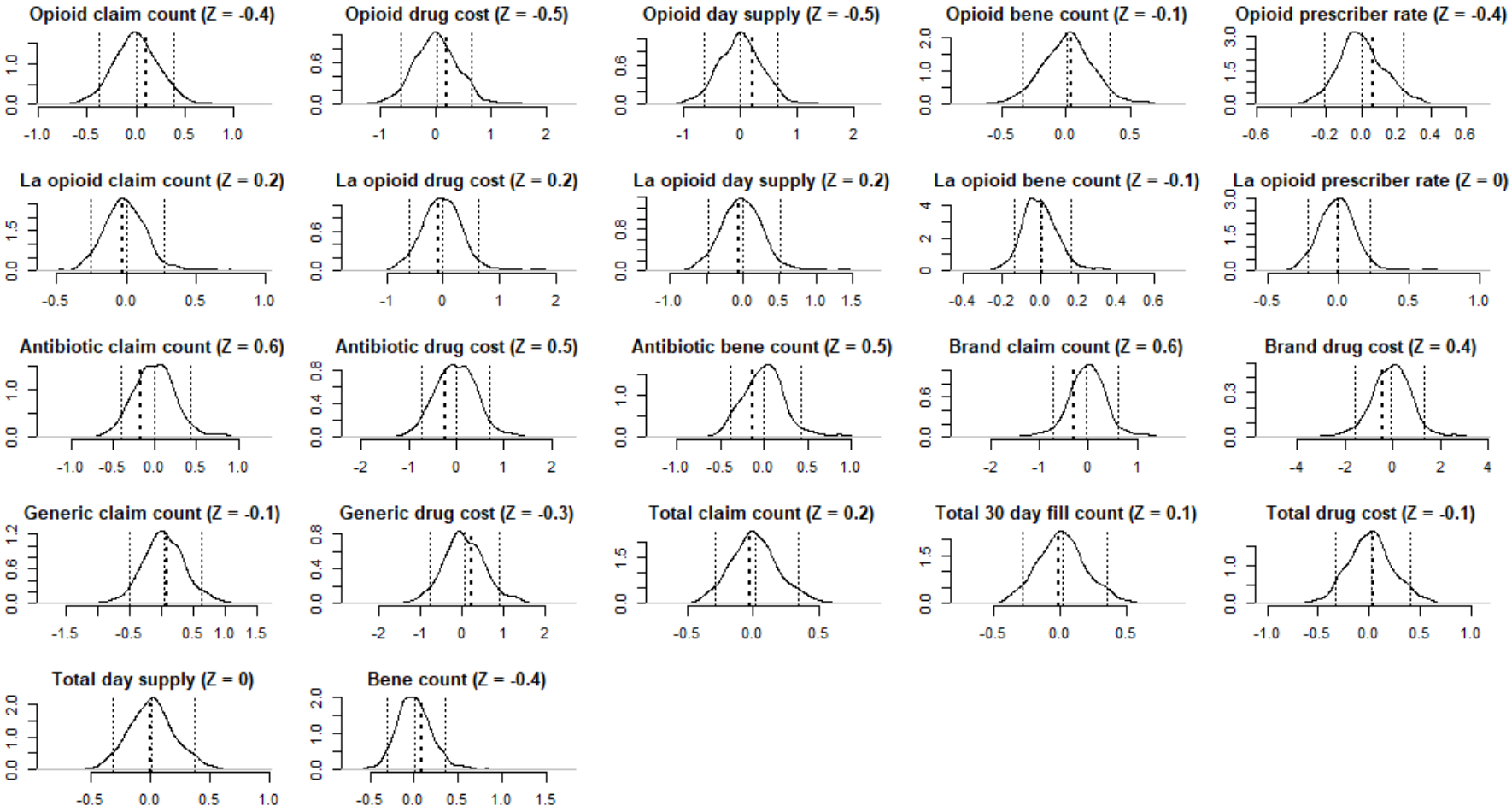
For a standard difference-in-difference, if it would have captured the proper comparison, the inclusion of covariates should not affect the estimates, as standard difference-in-difference captures any unobserved invariant heterogeneity. There is a risk in the standard difference-in-difference setting of the inclusion of covariates. If the treatment intervention changes the covariates, which we call time-varying covariates, the inclusion of such time-varying covariates can be problematic. Rather than in main results, we include several covariates within a standard difference-in-difference and report the impact of Full Autonomy on the nurse practitioner's prescribing behavior in Appendix **??** Table A3 and A4. These results remained robust to our main findings.

Figure 3: Placebo treatment effect distribution



Notes: We permute the 1000 possible sequences of states to sort themselves in treatment of comparison states and run the standard difference-in-difference regression and generate placebo effect distribution for δ as $\delta_{placebo}$. Enclosed in the parenthesis include the Z-stat. $Z = \frac{\overline{\delta}_{placebo} - \delta}{\sigma_{\delta_{placebo}}}$ which interprets how many standard deviation the mean of placebo effect distribution is from the δ. The three dotted lines are 5% quantile, mean, and 95% quantile. The bold dotted line is the value of δ.

Figure 4: Treatment effect distribution on placebo population or policy sequences



Notes: We randomize the treatment assignment and run the standard difference-in-difference regression and generate the treatment effect distribution from placebo population δ as $\delta_{placebo}$. Enclosed in the parenthesis include the Z-stat. $Z = \frac{\overline{\delta}_{placebo} - \delta}{\sigma_{\delta_{placebo}}}$ which interprets how many standard deviation the mean of placebo effect distribution is from the δ. The three dotted lines are 5% quantile, mean, and 95% quantile. The bold dotted line is the value of δ.

5 Conclusion

The United States is simultaneously experiencing both a primary care shortage and an opioid epidemic. One potential policy solution to increase access to primary health care is to allow nurse practitioners to operate independently using the full extent of their training in diagnosing, treating, and managing patient care. There are two relevant sets of laws affecting a nurse practitioners ability to act as a primary care provider, the first being the prescriptive authority of nurse practitioners within that state and the second being the scope of practice which describes which job tasks and functions a nurse practitioner may perform without supervision or collaboration requirements. One of the concerns with expanding access is that nurse practitioners may further the opioid epidemic by increasing the rate at which they prescribe opioids when working without supervision, or that they will prescribe only expensive branded medication.

Our study, when analyzing nurse practitioners that moved between Reduced SOP states with physician supervision for job tasks and Full Autonomy states, supports that nurse practitioner prescribing behavior with full job task autonomy did not change relative to supervised nurse practitioners. The nurse practitioners who move to Full Autonomy states have similar claim counts, drug costs, days supplied, beneficiary counts, and prescribing rates for opioids, long-acting opioids, antibiotics, generic and branded medications. To ensure that these are real null results and not driven by statistical anomalies, we confirmed this finding with several different robustness tests using placebo treatments and populations.

The observation that nurse practitioner prescribing behavior does not change has important policy implications. With the primary health care shortage, allowing nurse practitioners to work independently and to the full extent of their training increases access to primary care and reduces wait times. Though this is beneficial, there have been concerns from many policymakers and policy groups that allowing for Full Autonomy in the scope of practice and prescriptive authority of Schedule II drugs may endanger costs and safety. Our study fails to find evidence supporting this concern. While there are many additional points to consider, and no policy decision should be made off of one study, we believe our work can assure policymakers that expansions of the scope of practice and prescriptive authority of nurse practitioners can increase access without causing undue harm in drug costs or safety when considering the prescribing behavior of nurse practitioners who move to full autonomy states.

These results improve the current literature by addressing the scope of practice and prescription authority's dual policies and using individual nurse practitioner data. We also deal with an established issue in the literature where there were not state-level policy changes during the period in which there is available medicare beneficiary data by incorporating nurse practitioner mobility. This mechanism allows our study to isolate the effect of removing supervision in practice requirements and its subsequent effect

on nurse practitioner behavior without the noise generated by improper counterfactuals, allowing for estimates that have a closer causal interpretation than the existing literature. Despite this, this study is still subject to some limitations. For example, there were no policy changes for the specific Reduced SOP and Full Autonomy states, and using mobility is subject to limited sample size. These limitations are unable to be rectified until more years of data are available.

We would like to address a significant limitation with the Part D Prescriber Public Use Files that, as far as we can tell, were not accounted for in previous publications within the literature. Upon inspection of the data, there are positive opioid prescription rates for many nurse practitioners in states with no prescriptive authority. Contacting CMS, it was determined that these observations occur for one of three reasons. The first is that these specific nurse practitioners may also be physician assistants. Based on their taxonomy codes, we excluded nurse practitioners who are also physician assistants which is a correction we do not believe has been incoprorated in previous studies. The second is when a prescriber does not have an NPI, or the pharmacy cannot obtain the prescribers NPI, and a nurse practitioner's NPI may be substituted on pharmacy claim transactions if the payer allows it. The final reason why this positive prescription rate may exist is that there are occasions when CMS receives plans with non-standard data formats where the unusual circumstance may arrive like an emergency prescription at an out-of-network pharmacy or home infusion pharmacy submits the form which may contain alternate information on the nurse practitioner. Past and future research should consider this severe limitation before making causal claims using this data. We bypass this problem by not including any states that do not have prescriptive authority.

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Table A1: Impacts of policy reversal on opioid prescribing behavior

	Opioids prescribing behavior									
	Opioids					Long-acting opioids				
	Claim counts	Drug cost	Day supply	Bene count	Prescriber rate	Claim counts	Drug cost	Day supply	Bene count	Prescriber rate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
D	−0.239	−0.442	−0.406	−0.207	−0.079	−0.042	−0.012	−0.032	−0.034	−0.006
	(0.214)	(0.374)	(0.354)	(0.173)	(0.134)	(0.134)	(0.296)	(0.241)	(0.083)	(0.109)
treat	−0.186	−0.334	−0.283	−0.119	−0.047	−0.163	−0.410*	−0.333*	−0.051	−0.147*
	(0.162)	(0.282)	(0.266)	(0.129)	(0.099)	(0.103)	(0.223)	(0.183)	(0.064)	(0.082)
post	0.045	0.070	0.080	0.032	−0.019	−0.016	−0.045	−0.038	−0.004	−0.017
	(0.099)	(0.173)	(0.162)	(0.081)	(0.057)	(0.066)	(0.148)	(0.121)	(0.041)	(0.055)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialty FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty
HC SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177
R^2	0.121	0.123	0.126	0.100	0.119	0.046	0.045	0.048	0.033	0.051
Adjusted R^2	0.108	0.111	0.113	0.087	0.106	0.032	0.031	0.034	0.019	0.037

Note: *p<0.1; **p<0.05; ***p<0.01

Table A2: Impacts of policy reversal on other prescribing behaviors

	Various prescribing behavior											
	Other medications							Aggregated prescribing behavior				
	Antibiotic drugs			Brand drugs		Generic drugs						
	Claim counts	Drug cost	Bene count	Claim counts	Drug cost	Claim counts	Drug cost	Claim counts	30 day fill	Drug cost	Day supply	Bene count
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
D	0.004	−0.036	−0.044	0.055	0.154	−0.155	−0.192	−0.138	−0.151	−0.235	−0.200	−0.009
	(0.189)	(0.330)	(0.180)	(0.249)	(0.531)	(0.260)	(0.376)	(0.155)	(0.163)	(0.201)	(0.182)	(0.182)
treat	−0.303**	−0.415*	−0.215	−0.341*	−0.605	−0.337*	−0.458	−0.202*	−0.190	−0.186	−0.195	−0.174
	(0.139)	(0.246)	(0.133)	(0.187)	(0.395)	(0.197)	(0.284)	(0.116)	(0.121)	(0.148)	(0.136)	(0.136)
post	0.011	−0.044	0.055	0.176	0.444*	0.208*	0.332**	0.100	0.128*	0.182*	0.154*	0.040
	(0.083)	(0.142)	(0.081)	(0.121)	(0.253)	(0.115)	(0.164)	(0.072)	(0.075)	(0.094)	(0.083)	(0.083)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Specialty FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Cluster SE	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	
HC SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177
R^2	0.214	0.205	0.197	0.043	0.054	0.059	0.053	0.069	0.065	0.063	0.066	0.064
Adjusted R^2	0.202	0.193	0.186	0.029	0.041	0.046	0.039	0.055	0.052	0.049	0.052	0.050

Note: *p<0.1; **p<0.05; ***p<0.01

Table A3: Impacts of Full Autonomy on opioid prescribing behavior

	Opioids prescribing behavior									
	Opioids					Long-acting opioids				
	Claim counts	Drug cost	Day supply	Bene count	Prescriber rate	Claim counts	Drug cost	Day supply	Bene count	Prescriber rate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
D	−0.173	−0.430	−0.389	−0.163	−0.104	0.199	0.511	0.416	0.062	0.165
	(0.329)	(0.566)	(0.533)	(0.276)	(0.200)	(0.246)	(0.547)	(0.448)	(0.169)	(0.200)
treat	−0.043	−0.092	0.004	−0.015	0.074	−0.231	−0.582	−0.465	−0.035	−0.177
	(0.244)	(0.421)	(0.394)	(0.207)	(0.148)	(0.183)	(0.405)	(0.332)	(0.125)	(0.147)
post	−0.135	−0.175	−0.163	−0.118	−0.103	−0.190	−0.422	−0.363*	−0.065	−0.139
	(0.147)	(0.258)	(0.238)	(0.121)	(0.085)	(0.118)	(0.261)	(0.213)	(0.080)	(0.094)
NP gender: Male	−0.061	−0.373	−0.283	0.153	0.024	0.047	−0.033	−0.013	0.159	−0.028
	(0.192)	(0.328)	(0.306)	(0.156)	(0.119)	(0.161)	(0.336)	(0.278)	(0.122)	(0.122)
Average age of beneficiaries	0.041***	0.073***	0.070***	0.038***	0.006	0.039***	0.089***	0.075***	0.007	0.039***
	(0.015)	(0.026)	(0.024)	(0.013)	(0.009)	(0.012)	(0.026)	(0.021)	(0.008)	(0.009)
Beneficiary female count	0.004*	0.006	0.007*	0.005***	0.001	0.0001	0.003	0.001	0.0001	−0.0004
	(0.002)	(0.004)	(0.004)	(0.002)	(0.001)	(0.002)	(0.004)	(0.004)	(0.001)	(0.001)
Beneficiary race white count	−0.002	−0.003	−0.004	−0.001	−0.0004	0.001	0.00001	0.001	0.001	0.0004
	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)	(0.001)
Beneficiary dual count	0.011***	0.018***	0.018***	0.007***	0.002**	0.008***	0.017***	0.014***	0.004***	0.006***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.004)	(0.003)	(0.001)	(0.001)
Beneficiary average risk score	−0.266***	−0.409***	−0.493***	−0.162**	−0.044	0.046	0.101	0.082	0.080**	0.060
	(0.079)	(0.139)	(0.124)	(0.070)	(0.047)	(0.058)	(0.129)	(0.105)	(0.040)	(0.050)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specialty FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty
HC SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	897	897	897	897	897	897	897	897	897	897
R^2	0.274	0.257	0.277	0.273	0.160	0.155	0.159	0.157	0.132	0.140
Adjusted R^2	0.249	0.232	0.252	0.247	0.131	0.126	0.130	0.128	0.102	0.110

Note: *p<0.1; **p<0.05; ***p<0.01

Table A4: Impacts of Full Autonomy on other prescribing behaviors

	Various prescribing behavior											
	Other medications							Aggregated prescribing behavior				
	Antibiotic drugs			Brand drugs		Generic drugs						
	Claim counts	Drug cost	Bene count	Claim counts	Drug cost	Claim counts	Drug cost	Claim counts	30 day fill	Drug cost	Day supply	Bene count
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
D	−0.034	−0.239	−0.110	0.106	0.296	−0.042	−0.085	−0.082	−0.099	−0.111	−0.167	−0.013
	(0.254)	(0.436)	(0.242)	(0.396)	(0.828)	(0.221)	(0.326)	(0.117)	(0.135)	(0.193)	(0.173)	(0.173)
treat	−0.226	−0.222	−0.162	−0.243	−0.460	−0.199	−0.273	−0.039	−0.033	−0.103	−0.014	0.009
	(0.175)	(0.310)	(0.168)	(0.293)	(0.610)	(0.175)	(0.259)	(0.089)	(0.100)	(0.139)	(0.127)	(0.127)
post	−0.036	−0.141	0.040	0.137	0.458	0.092	0.176	0.059	0.079	0.203**	0.103	0.046
	(0.117)	(0.198)	(0.114)	(0.192)	(0.396)	(0.083)	(0.118)	(0.057)	(0.065)	(0.097)	(0.082)	(0.082)
NP gender: Male	0.233	0.299	0.269*	−0.188	−0.326	−0.194	−0.290	−0.156*	−0.227**	−0.350***	−0.291***	0.054
	(0.152)	(0.250)	(0.152)	(0.238)	(0.499)	(0.129)	(0.192)	(0.081)	(0.089)	(0.129)	(0.112)	(0.112)
Average age of beneficiaries	0.050***	0.082***	0.048***	−0.004	−0.043	0.039***	0.049***	0.018***	0.022***	0.008	0.025***	0.011
	(0.012)	(0.022)	(0.012)	(0.019)	(0.039)	(0.010)	(0.014)	(0.006)	(0.006)	(0.010)	(0.008)	(0.008)
Beneficiary female count	0.012***	0.015***	0.013***	0.008***	0.014***	0.003***	0.004***	0.003***	0.004***	0.003**	0.004***	0.004***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Beneficiary race white count	−0.004***	−0.006***	−0.005***	−0.003	−0.005	0.001	0.002*	0.001	0.001*	0.001*	0.001*	0.001*
	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Beneficiary dual count	−0.00002	0.001	−0.001	0.011***	0.015***	0.010***	0.010***	0.008***	0.007***	0.006***	0.008***	0.002***
	(0.002)	(0.003)	(0.001)	(0.002)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Beneficiary average risk score	−0.209***	−0.197**	−0.231***	0.184**	0.571***	0.046*	0.184***	0.043**	0.026	0.469***	0.060**	0.025
	(0.057)	(0.093)	(0.053)	(0.090)	(0.198)	(0.028)	(0.049)	(0.022)	(0.024)	(0.041)	(0.028)	(0.028)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Specialty FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Cluster SE	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	Specialty	
HC SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	897	897	897	897	897	897	897	897	897	897	897	897
R^2	0.384	0.344	0.382	0.181	0.152	0.439	0.359	0.546	0.499	0.373	0.433	0.818
Adjusted R^2	0.362	0.321	0.361	0.153	0.122	0.419	0.337	0.530	0.482	0.351	0.413	0.811

Note: *p<0.1; **p<0.05; ***p<0.01