HSR Health Services Research

DOI: 10.1111/1475-6773.12643
THE EVOLVING U.S. HEALTH WORKFORCE

Does the Regulatory Environment Affect Nurse Practitioners' Patterns of Practice or Quality of Care in Health Centers?

Ellen T. Kurtzman, Burt S. Barnow, Jean E. Johnson, Samuel J. Simmens, Donna Lind Infeld, and Fitzhugh Mullan

Objective. To examine the impact of state-granted nurse practitioner (NP) independence on patient-level quality, service utilization, and referrals.

Data Sources/Study Setting. The National Ambulatory Medical Care Survey's community health center (HC) subsample (2006–2011). Primary analyses included approximately 6,500 patient visits to 350 NPs in 220 HCs.

Study Design. Propensity score matching and multivariate regression analysis were used to estimate the impact of state-granted NP independence on each outcome, separately. Estimates were adjusted for sampling weights and NAMCS's complex design.

Data Collection/Extraction Methods. Every "NP-patient visit unit" was isolated using practitioner and patient visit codes and, using geographic identifiers, assigned to its state-year and that state-year's level of NP independence based on scope of practice policies. Nine outcomes were specified using ICD-9 codes, standardized drug classification codes, and NAMCS survey items.

Principal Findings. After matching, no statistically significant differences in quality were detected by states' independence status, although NP visits in states with prescriptive independence received more educational services (aIRR 1.66; 95 percent CI 1.09–2.53; $p = .02$) and medications (aIRR 1.26; 95 percent CI 1.04–1.53; $p = .02$), and NP visits in states with practice independence had a higher odds of receiving physician referrals (AOR 1.88; 95 percent CI 1.10–3.22; $p = .02$) than those in restricted states.

Conclusions. Findings do not support a quality–scope of practice relationship.

Key Words. Nurse practitioner, community health center, scope of practice, quality of care, state policy

The majority of Americans receive routine health care from primary care practitioners who typically practice in outpatient or community settings (Starfield et al. 1994; Green et al. 2001). While the demand for primary care

is expected to increase—a by-product of the growing elderly population and insurance expansion under the Affordable Care Act (ACA)—a shortage of primary care physicians (PCMDs) threatens access to high-quality care (Hofer, Abraham, and Moscovice 2011; Kirch, Henderson, and Dill 2012; Petterson et al. 2012). At the same time, the number of nurse practitioners (NPs)—nurses who have advanced clinical education (master's or doctoral degrees) beyond their professional registered nurse preparation and are certified by a national certifying body in an area of specialty (APRN Consensus Work Group & the National Council of State Boards of Nursing APRN Advisory Committee 2008)—is growing steadily (U.S. Department of Health & Human Services [DHHS], Health Resources and Services Administration [HRSA] 2013). Between 1995 and 2005, the per capita supply of NPs rose an average of 9 percent annually while the per capita supply of PCMDs rose considerably more slowly—an average of 1 percent annually (*Addressing Healthcare Workforce Issues for the Future: Hearing before the United States Senate Committee on Health, Education, Labor, and Pensions* 2008). Projections through 2025 suggest that 6,000–7,000 NPs will be added to the workforce each year and total nearly 250,000 by the end of that period (Auerbach 2012).

The majority of NPs practice in primary care settings and have been recognized to capably substitute for as much as 75–90 percent of the tasks typically performed by PCMDs (U.S. Congress, Office of Technology Assessment [OTA] 1986; DHHS, Agency for Healthcare Research and Quality [AHRQ] 2011; HRSA 2013). At the same time, a growing body of evidence has found NP- and PCMD-delivered primary care to be equivalent on most outcomes.[1] Because of their overlapping roles, similar outcomes, and growing availability, NPs are seen as one solution to meeting the nation's growing demand for primary care (Institute of Medicine 2011); however, state nurse practice acts—policies that establish NPs' legal recognition and authority to practice (sometimes referred to as "scope of practice")—have historically required NPs to be supervised by physicians,

---

Address correspondence to Ellen T. Kurtzman, Ph.D., M.P.H., R.N., F.A.A.N., School of Nursing, The George Washington University, 1919 Pennsylvania Avenue, NW Ste. 500, Washington, DC; e-mail: etk@gwu.edu. Jean E. Johnson, Ph.D., R.N., F.A.A.N., is with School of Nursing, The George Washington University, Washington, DC. Burt S. Barnow, Ph.D., and Donna Lind Infeld, Ph.D., are with Trachtenberg School of Public Policy and Public Administration, The George Washington University, Washington, DC. Samuel J. Simmens, Ph.D., is with Milken Institute School of Public Health, The George Washington University, Washington, DC. Fitzhugh Mullan, M.D., is with Milken Institute School of Public Health and School of Medicine & Health Sciences, The George Washington University, Washington, DC.

thus preventing the optimal use of and full access to the skills of this workforce (Health Affairs 2013).

Economic theory explains the relationship between the quality of NP care and states' restrictions of these practitioners, which are ostensibly designed to protect the public and improve quality. Specifically, in markets that suffer from information asymmetries, such as the health care market where consumers have limited information about quality and difficulty discerning performance differences among practitioners, producers are inclined to supply poor quality (Akerlof 1970). In such markets, occupational regulations are used to counteract the effects of quality uncertainty and provide signals to consumers regarding practitioners' competence. Based on this theory, unrestricted NP markets would be likely to produce lower quality than restricted markets; however, there has been little evidence exploring this phenomenon. A recent systematic review of published studies examining the impact of NP restrictions on health care delivery in the United States identified 15 studies through January 31, 2015. While the authors found that NP autonomy was associated with an increase in the number of NPs and expanded health care utilization, none of the included studies examined quality of care as the primary outcome (Xue et al. 2016). This study is intended to fill this gap.

Specifically, we made direct comparisons between NP-delivered care in states with and without NP restrictions. To determine whether NP restrictions protect the public, we examined the impact of restricted scope of practice on the quality of NP-delivered care. To determine whether such policies reduce access to services that are frequently delivered by these practitioners or alter their referral patterns, we compared patients' utilization of NP-delivered physical examinations, patient education and counseling services, imaging services, medications, and physician referrals by states' NP independence status. Finally, to explore whether detected effects may result from alternative explanations, we ran parallel tests comparing these same outcomes among patients seen by only PCMDs and physician assistants (PAs), separately. Results from these analyses served as a "placebo"—that is, if PCMD- and PA-delivered care varied by states' NP scope of practice, differences were less likely attributable to a policy effect and more likely the result of one or more alternative phenomena.

The study was set in community health centers (HCs)—an important setting in which to situate this work given their growing role in the U.S. health system, their continued expansion under the ACA (Ku et al. 2010; Katz et al. 2011; HRSA, *The Affordable Care Act and Health Centers* n.d.), and their mandate to serve the needs of the medically underserved and vulnerable communities

(Hicks et al. 2006; Doty et al. 2010). Additionally, while HCs have traditionally and historically relied on a mix of clinicians to deliver care, these providers are increasingly relying on advanced practice clinicians (a categorization that includes NPs, PAs, and nurse midwives), especially NPs (Proser et al. 2015). To our knowledge, this is among the first studies to examine the impact of NP restrictions on patient-level outcomes, generally, and the only study to examine this phenomenon in HCs, specifically.

Study Design

We used six years of data (2006–2011) from the community health center subsample of the National Ambulatory Medical Care Survey (NAMCS). NAMCS is a federally conducted multistage probability sample survey of ambulatory care administered by the National Center for Health Statistics (NCHS), which included a stratum of approximately 104 HCs in the United States each of these years. For every HC, up to three practitioners were randomly selected to participate in the survey from all physicians, NPs, PAs, and nurse midwives, and approximately 30 patient visits per practitioner were sampled during a random 1-week period. Based on the sampling design, the unit of analysis was the "practitioner–patient visit unit."

A set of unique practitioner identifiers in each year's NAMCS visit file were used to identify the practitioner or practitioners seen. Using these identifiers, we isolated every NP-patient visit unit. To ensure appropriate practitioner accountability, we excluded any NP visit that was also attended by a physician, PA, or nurse midwife (i.e., comanaged). To be certain that we accurately assigned each NP-patient visit unit to the state in which the visit occurred, we also excluded visits to practitioners who saw patients at multiple clinic sites during the reporting week since NAMCS analysts assign such visits to a single site and that site's state. We pooled remaining visits across the study period and examined associations between visit-, NP-, and HC-level characteristics by state-granted NP independence. To test the primary hypothesis—that state-granted independence has no effect on NPs' practice patterns or quality of care[2]—we used multivariate logistic and negative binomial or Poisson regression analysis and, because of presumed heteroskedasticity, estimated and reported robust standard errors.

Although consensus exists regarding the inclusion of survey weights in estimating population descriptive statistics, the inclusion of weights in estimating causal effects is under debate (DuMouchel and Duncan 1983; Pfeffermann

1993; Korn and Graubard 1995; Hahns-Vaughn 2005, 2006; Gelman 2007). There appears to be a strong argument for including sampling weights to correct for heteroskedasticity and endogenous sampling and to identify average partial effects (Solon, Haider, and Wooldridge 2015). As it applies to our study, we contemplated the fact that NAMCS's survey design oversamples respondents from highly populous geographic sampling units together with the fact that patterns of state-granted NP independence and quality also vary regionally. Specifically, we generally found that NP independence was more common in the Northeast and West (see Principal Findings, Table 2) and know from published studies that higher quality is more common in less populous states and those in the Northeast (e.g., see Jencks et al. 2003). Given these patterns, we opted to conform to recommendations from seminal works on survey analysis that favor weighted estimation when weights serve as a "proxy" for some important feature of the sample design that has a bearing on the outcome of interest (Heeringa, West, and Berglund 2010). Even so, differences in our weighted and unweighted estimates led us to consider the possibility of misspecification, double-check our assumptions with appropriate diagnostics, and consider alternative covariates. Ultimately, finding no evidence of bias, we adjusted all estimates for NAMCS's sampling weights and survey design.[3] Stata/SE® 12.1 (StataCorp, LLP 2011) was used for all analyses, and study procedures were approved by The George Washington University's Institutional Review Board (IRB #101446).

VARIABLES OF INTEREST

Nine different outcomes were modeled, separately: three quality indicators, four service utilization measures, and two referral pattern measures (Table 1). The quality indicators' specifications conformed with published sources and were derived from ICD-9 diagnosis codes, NCHS' standardized drug classification codes (Lexicon Plus, Cerner Multum, Inc., 2000 South Colorado Blvd, Suite 11000 Denver, Colorado 80222, USA), and NAMCS Reason for Visit Classification codes, disease checkboxes, and other survey items.

The predictor of primary interest was state-granted NP independence in practice authority (i.e., treating and diagnosing) and prescriptive authority (i.e., prescribing medications). State identifiers were used to assign each NP-patient visit unit to its state-year, and variables reflecting that state's level of independence in practice authority and prescriptive authority were constructed from a widely recognized state-by-state rating of NP independence

Table 1: Outcomes of Interest

Quality Indicators
1. Smoking cessation counseling (*binary*)
   Numerator: Received smoking cessation intervention (i.e., nicotine replacement therapy or medications ordered, supplied, administered, or continued and/or smoking cessation counseling)
   Denominator: Visits by adults who were screened for tobacco use and identified as smokers
2. Depression treatment (*binary*)
   Numerator: Antidepressants ordered, supplied, administered, or continued and/or psychotherapy or mental health counseling
   Denominator: Visits by adults with depression
3. Statin for hyperlipidemia (*binary*)
   Numerator: Statin ordered, supplied, administered, or continued
   Denominator: Visits by adults with hyperlipidemia

Service Utilization Measures
4. Physical examination (*binary*)
5. Total number of health education/counseling services (*count*)
   All of the following services ordered/provided during the visit: asthma, diet/nutrition, exercise, family planning/contraception, growth/development, injury prevention, stress management, tobacco use/exposure, and weight reduction
6. Imaging services (*binary*)
   Any of the following services that were ordered/provided during the visit: X-ray, bone mineral density, CT scan, echocardiogram, and other ultrasound
7. Total number of medications (*count*)
   All of the following that were ordered, supplied, administered, or continued during the visit: prescription and over-the-counter drugs, immunizations, allergy shots, oxygen, anesthetics, chemotherapy, and dietary supplements

Referral Pattern Measures
8. Return visit at a specified time (*binary*)
9. Physician (MD) referral (*binary*)

Sources: Ma & Stafford, 2005; Chen et al., 2009; Ma et al., 2009; Romano & Stafford, 2011; Bishop et al., 2012; Goldman et al., 2012.

published annually in *The Nurse Practitioner Journal* (*NPJ*), which is commonly used for research. Specifically, *NPJ* rates each state on four levels of practice independence (no restrictions + sole authority by board of nursing [full independence], physician collaboration + sole authority by board of nursing, physician supervision + sole authority by board of nursing, collaboration or supervision + shared authority by boards of nursing and medicine) and three levels of prescriptive independence (no restrictions [full independence], physician involvement, physician involvement + no controlled substances). We created two, dichotomous variables—one representing full independence in each authority—which were both entered into every model.[4]

A variety of other covariates were also included in each model based on underlying theory and previous research. Diagnostics were used to expose

specification error, ensure linearity, and optimize fit. Because covariate nonresponse rates for race and ethnicity exceeded 10 percent, each model was re-estimated incorporating their imputed values, which are NCHS-derived using a model-based, single, sequential regression method (Lewis et al. 2014). Finding that differences were small, all reported results include imputed values.

Propensity Score Matching and Postmatching Regression Analyses

Unbiased estimates from these multivariate regression models depend on ignorable treatment assignment—that is, assignment to treatment being independent of the outcome; however, there are reasons to believe that this assumption may not hold. For example, it is well established that state policy adoption does not occur randomly—political, economic, and geographic factors tend to predict the timing and pattern of diffusion (Walker 1969; Zhou 1993; Berry and Berry 2007). As it applies to NP scope of practice, states' adoption patterns could be endogenous with their residents' health status or the quality of their health care delivery systems. At the same time, practitioner–patient visit assignments are not likely arbitrary, and nonrandom patterns of assignment may introduce confounding. Moreover, certain characteristics—both observed and unobserved—predispose people's residential choices. If those same characteristics also influence their health care outcomes, selection will bias estimates.

To mitigate this bias, we used propensity score matching. In simple terms, the propensity score is the conditional probability of assignment to treatment given a vector of observed covariates (Rosenbaum and Rubin 1983). It then provides the basis for matching—a process which pairs treatment units with comparison units that are as similar as possible based on their observable characteristics. By ensuring that there are no systematic differences in observables between the treatment and comparison groups, propensity score matching mimics experimental design.

In our study, we specified the propensity for treatment—that is, being seen by an NP in a state with independent practice and prescriptive authorities—using logistic regression and selected observables based on their empirical and theoretical relationship to treatment assignment. Ultimately, the covariates used in the final propensity score model included visit type, race, metropolitan status, region, payer, number of physicians in the HC, type of practice, HC type, and primary sampling unit/stratum identifier. Then, we separately generated a matched sample for each outcome using the

propensity score and radius matching—which pairs each treatment observation to all of the comparison observations within a specified distance (caliper) (Dehejia and Wahba 2002; Smith and Todd 2005). For each model, we used a caliper width that was consistent with the data's structure and consensus recommendations (i.e., one-quarter of a standard deviation of the sample's estimated propensity score; see Guo and Fraser 2015; Rosenbaum and Rubin 1985). In all cases, conventional statistical and graphical diagnostics were used to reveal imbalances across the treatment and comparison groups and ensure match "quality." These included density distributions of the propensity score, standardized bias, two-sample *t*-tests, and summary statistics such as Rubin's B and R statistics, which should be less than 25 percent and 0.5–2.0, respectively.[5] After balancing the treatment and comparison groups, we re-estimated the effect of NP independence on each outcome using only the matched samples and employing the approach to multivariate regression modeling previously described.

Although the study's primary aim was to examine the impact of state-granted NP independence on NP-delivered care, to rule out alternative explanations, each analysis was repeated using the subsample of PCMD and PA visits, separately. Methods, identical to those previously described, were employed with technical adjustments (e.g., caliper distance) for each subsample's data structure and size.

PRINCIPAL FINDINGS

Over the combined, 6-year study period, data from approximately 350 NPs—representing a population of approximately 3,300 clinicians in the United States—were collected in NAMCS. The majority of these practitioners were female (93 percent), white (88 percent), and non-Hispanic (94 percent) and located in Federally Qualified Health Centers (FQHCs) (91 percent). Twenty-two percent of NPs indicated that they practiced in rural settings, and 19 percent were located in states that had granted NPs full independence. The characteristics of NPs in independent states were similar to those in restricted states (Table 2).

After excluding visits to PCMDs (n = 18,644) and PAs (n = 3,475), the pooled, 6-year sample of visits included 6,498 to NPs (22 percent of all visits). The distribution of patient visit characteristics by states' independence status varied (Table 3). For example, patient visits to NPs in independent states were more likely to be located in the northeastern or western regions of the country

Table 2: Nurse Practitioner Characteristics by State-Granted NP Independence in Health Centers (2006–2011)[†] ($N = 347$[‡])

Characteristic		*Independent (%)*	*Not Independent (%)*	*p-Value*
Age	<35	10[§]	16	.32
	35–44	14[§]	27	
	45–54	37	33	
	55 and older	39[§]	24	
Gender	Female	92[§]	93	.74
Race	White	98	86	.29
	Black	2[§]	9[§]	
	Other	–	5[§]	
Ethnicity	Hispanic/Latino	<1[§]	7[§]	<.01
Health center type	FQHC	95	95	<.01
	FQHC-LA	1[§]	5[§]	
	IHC	4[§]	<1	
Metro status	Rural	36[§]	19[§]	.39
Region	Northeast	49[§]	21	.02
	Midwest	<1[§]	23	
	South	3[§]	35	
	West	48[§]	22	

[†]Adjusted for sampling weights and complex survey design.
[‡]Population of 3,314 NPs.
[§]Coefficient of variation/relative standard error >0.3 noted.
FQHC, Federally Qualified Health Center; FQHC-LA, "look-alike" health center; IHC, Indian health center; NP, nurse practitioner.

and counties designated as wholly primary care shortage areas. At the same time, these patients were less likely to be black and less likely to be seen for preventive care but more likely to be seen for chronic problems.

Outcomes by State-Granted NP Independence

Regarding the primary research question, there was little evidence to reject the null hypothesis—that is, that state-granted NP independence has no effect on NPs' practice patterns or quality of care—across the outcomes studied (Table 4). Among five of the nine outcomes examined—smoking cessation counseling, depression treatment, statin for hyperlipidemia, physical examinations, imaging, and return visits—no statistically significant differences were detected among NP visits by states' independence status after matching. Among two of the three outcomes for which statistically significant differences were detected, independent prescriptive authority—but not practice authority—increased the incidence of receiving health education services (adjusted

Table 3: Patient Visit Characteristics by State-Granted NP Independence in Health Centers (2006–2011)[†] ($N = 6{,}498$[‡])

Characteristic		*Independent (n = 1,491, %)*	*Not Independent (n = 5,007, %)*	*p-Value*
Age	<18	31	25	.55
	18–34	22	28	
	35–49	21	21	
	50–64	18	19	
	65 and older	8[§]	6	
Gender	Female	65	70	.14
Race	Black	9	35	<.01
	Other	91	65	
Ethnicity	Hispanic/Latino	21[§]	27	.71
Payer source	Private	30	12	.12
	Medicare	8	8	
	Medicaid	32	40	
	Self-pay	15[§]	19	
	Other	15[§]	21	
Visit type	New problem	45	39	<.01
	Chronic problem	34	27	
	Preventive care	20	34	
	Pre-/postsurgery	1[§]	1[§]	
Number of chronic conditions	None	44	52	.43
	1	27	23	
	2–3	21	19	
	≥4	8	6	
Number of past visits	None	6[§]	6	.34
	1–3	44	50	
	4–10	37	35	
	>10	13[§]	8	
Number of medications	None	16	20	.38
	1	29	26	
	2–4	39	33	
	≥5	16	20	
Health center type	FQHC	98	94	<.01
	FQHC-LA	<1[§]	5[§]	
	IHC	1[§]	<1[§]	
Metro status	Rural	19[§]	22[§]	.82
Region	Northeast	47[§]	14	.01
	Midwest	<1[§]	18[§]	
	South	2[§]	47	
	West	51[§]	22	
Primary care shortage area designation	None of county	–	4[§]	.01
	Whole county	81	36	
	Part of county	19[§]	60	

Continued

Table 3: *Continued*

Characteristic		*Independent (n = 1,491, %)*	*Not Independent (n = 5,007, %)*	*p-Value*
Mean percent of population with income less than poverty level		16	18	.42
Year	2006	7[§]	7	.10
	2007	13	12[§]	
	2008	29[§]	9[§]	
	2009	13[§]	30	
	2010	26	23	
	2011	12[§]	18	

[†]Adjusted for sampling weights and complex survey design.
[‡]Population of 6,542,244 NP visits.
[§]Coefficient of variation/relative standard error >0.3 noted.
FQHC, Federally Qualified Health Center; FQHC-LA, "look alike" health center; IHC, Indian health center; NP, nurse practitioner.

incidence rate ratio [aIRR] 1.66; 95 percent CI 1.09–2.53; $p = .02$) and medications (aIRR 1.26; 95 percent CI 1.04–1.53; $p = .02$). At the same time, visits to NPs in states that had granted independent practice authority—but not prescriptive authority—had an increased odds of being referred to a physician compared to visits to NP in states with restricted practice (adjusted odds ratio [AOR] 1.88; 95 percent CI 1.10–3.22; $p = .02$).

Results from the PCMD and PA "placebo" tests demonstrated some similar patterns (results not shown[6]). That is, the majority of outcomes appeared unaffected by states' NP independence status; however, exceptions did exist. For example, visits to PCMDs were more likely to receive depression treatment in states which had granted NPs independent practice authority (AOR 2.48; 95 percent CI 1.44–4.28; $p \leq .01$) and received more health education services in states that had granted NPs prescriptive independence (aIRR 2.16; 95 percent CI 1.45–3.22; $p \leq .01$). At the same time, patient visits to PAs were more likely to be referred to a physician in states which had granted NPs independent prescriptive authority (AOR 2.28; 95 percent CI 1.16–4.48; $p = .02$) but considerably less likely to be referred to a physician in states which had granted NPs independent practice authority (AOR 0.46; 95 percent CI 0.26–0.83; $p = .01$).

LIMITATIONS

Findings from this study should be viewed within the context of its limitations. Using NAMCS as the primary data source limited study outcomes to those

Table 4: Effect of State-Granted NP Independence on NP Patterns of Practice and Quality of Care in Health Centers (2006–2011)[†]

	Full Sample Adjusted Odds Ratio (CI[§§])		*Propensity Score Matched Sample Adjusted Odds Ratio (CI[§§])*	
Outcome (N = 6,498)	*Practice Authority*	*Prescriptive Authority*	*Practice Authority*	*Prescriptive Authority*
Quality indicator[‡]				
Smoking cessation (n = 1,213; 1,035[††] [289, 746[‡‡]])	1.98 (0.72–5.46)	0.73 (0.25–2.15)	2.12 (0.70–6.38)	0.66 (0.20–2.13)
Depression treatment (n = 872; 708[††] [192, 516[‡‡]])	1.32 (0.62–2.81)	0.43** (0.23–0.81)	1.11 (0.47–2.62)	0.51 (0.24–1.05)
Statin for hyperlipidemia (n = 727; 658[††] [152, 506[‡‡]])	1.14 (0.46–2.81)	0.42 (0.12–1.44)	0.94 (0.35–2.56)	0.54 (0.14–2.09)
Service utilization and referral pattern measure[§]				
Physical examination (n = 5,896; 5,342[††] [1,118, 4,224[‡‡]])	0.63 (0.33–1.18)	1.66 (0.82–3.36)	0.61 (0.31–1.18)	1.64 (0.78–3.45)
Health education/counseling services[¶] (n = 5,856; 5,302[††] [1,120, 4,182[‡‡]])	0.94 (0.65–1.37)	1.65* (1.10–2.48)	0.94 (0.64–1.38)	1.66* (1.09–2.53)
Medications[¶] (n = 5,930; 5,433[††] [1,190, 4,243[‡‡]])	0.96 (0.80–1.17)	1.16 (0.92–1.46)	0.87 (0.75–1.01)	1.26* (1.04–1.53)
Imaging (n = 5,930;5,433[††] [1,190, 4,243[‡‡]])	0.51 (0.19–1.36)	2.10 (0.79–5.56)	0.54 (0.19–1.47)	2.06 (0.77–5.52)
Return visit (n = 5,930; 5,433[††] [1,190, 4,243[‡‡]])	0.94 (0.45–1.93)	1.63 (0.71–3.73)	0.97 (0.44–2.13)	1.68 (0.67–4.19)
MD referral (n = 5,930; 5,383[††] [1,140, 4,243[‡‡]])	1.87** (1.17–3.00)	0.61 (0.37–1.02)	1.88* (1.10–3.22)	0.64 (0.37–1.12)

*$p \leq .05$; **$p \leq .01$.
[†]Adjusted for sampling weights and complex survey design.
[‡]QIs controlled for age, age^2, gender, race, ethnicity, payer, metropolitan status (rural), region, number of chronic conditions, number of chronic conditions^2, health center type, percent with high school diploma or higher, and year.
[§]Service utilization and referral pattern outcomes controlled for age, age^2, gender, race, ethnicity, payer, metropolitan status (rural), region, reason for visit, health center type, percent with high school diploma or higher, and year.
[¶]Negative binomial or Poisson distribution and adjusted incidence rate ratio reported.
[††]Sample size differences reflect trimming due to propensity score matching.
[‡‡]Number of treatment and comparison group observations in the matched sample.
[§§]Confidence intervals based on Taylor linearized standard errors.
MD, physician; NP, nurse practitioner.

which could be derived from the survey. Additionally, the self-reported nature of these data could result in over reporting or underreporting (Gilchrist et al. 2004; Crawford et al. 2010); however, to our knowledge, differences between NPs and other practitioner types are untested. Also, the source of identification in this study was the propensity score. It is possible that in our approach to its estimation or in our use of it for matching, we may not have controlled for all important sources of selection bias. As previously noted, unweighted and weighted estimates differed. Although we carefully examined those differences and found no evidence to support misspecification, some degree is still possible. Finally, the study was set in HCs. It is possible that the institutional norms or rules established by these providers heavily influence NPs' quality of care and could moderate the impact of state restrictions. At the same time, it prevents generalizability of our findings to other settings, including those in which NPs prominently serve (e.g., retail clinics).

Implications for Policy and Practice

As noted, economic theory explains the role of occupational restrictions in maintaining quality when consumers are faced with uncertainties. If restrictions are effective in protecting consumers from suboptimal care—that is, at assuring quality in markets characterized by information asymmetries—one would expect visits to NPs in restricted states to receive higher quality of care than visits to NPs in unrestricted states. Findings from this study did not conform to this pattern. In fact, state independence had no statistically significant effect on any of the three quality indicators studied.

Occupational restrictions can also be explained by "capture theory"—guild efforts to persuade states to limit entry into a specific profession for the benefit of those in the guild profession and at the expense of the public (Friedman 1962; Stigler 1971). In practice, "capture" would produce persistent restrictions among NPs; enable anticompetitive behavior including barriers to entry, monopoly rents, and market division (Gellhorn 1976; Rose 1979; Gaumer 1984); and result in reduced access to primary care, especially to those services most frequently provided by NPs (i.e., patient counseling and education, physical assessment and screening, management and coordination of acute and chronic illnesses, preventive care, referrals, and diagnostic studies [HRSA 2014]). In this case, findings—which demonstrate a positive service provision-NP independence effect—lend some support to this conceptualization. Although visits to NPs in states with independent prescriptive authority

received more health education services and medications, the net effect of these differences on social welfare is unknown. If they reflect underuse and result from barriers to medically necessary care, NP restrictions could exacerbate existing disparities in access among low-income, uninsured, and minority populations who frequently receive their care at HCs. At the same time, if these service differences reflect overuse, misuse, and/or waste, restrictions could be cost effective and welfare enhancing.

That independent prescriptive authority was associated with an increase in the number of medications suggests that restrictions—which, in some states, require NPs to obtain physician cosignatures on prescriptions—might prove sufficiently burdensome to change these practitioners' prescribing habits. Findings from recent qualitative studies, which have examined the organizational climate in a variety of primary care settings (e.g., physician offices group, practices, outpatient clinics, and HCs) and the influence of organizational climate on NP practice, have echoed the burdens associated with state restrictions and described how these burdens extend beyond NPs to influence both PCMDs, who have to provide NP oversight, and patients, who must tolerate delays and interruptions in care because of them (Poghosyan, Nannini, and Clarke 2013; Poghosyan et al. 2013a, 2013b). Even in HCs—settings in which oversight of NPs by physicians should be facilitated by these clinicians' colocation, close physical proximity, and these providers' inclusive staffing models—restrictions were found to reduce the number of medications ordered, supplied, administered, or continued by NPs during patient visits.

The fact that practice independence was associated with an increase in the odds of receiving a physician referral is somewhat curious. It is possible that the effect reflects differences in patients' medical complexity, especially given the absence of NAMCS's data elements that permit severity adjustment. Nevertheless, each model included covariates that were intended to control for such factors (e.g., age, gender, race, ethnicity, payer, reason for visit). Even so, the covariate structure could have been inadequate, or the presence of unobservables could have introduced bias. Alternatively, it is possible that NPs located in independent practice states may have fewer resources—including fewer medical colleagues with whom to consult—necessitating a greater use of formal referral networks. At the same time, an increase in physician referrals among visits to NPs in these states could signal uncertainty among NPs with their clinical decision making when no formal supervision is required. Otherwise, concerns about liability and/or malpractice could incentivize NPs in independent states to refer at higher rates.

While findings from the primary analyses can generally be explained, results from the PCMD and PA "placebo" tests are more difficult to reconcile. These tests were justified on the basis that NP restrictions should not affect PCMD- or PA-delivered quality of care or their practice patterns. While there was variation in the affected outcomes and the direction, magnitude, and consistency of the effects, the fact that any associations were evident raises questions. On the one hand, these findings introduce the possibility that some alternative explanation might be responsible. On the other hand, these findings could represent a cross-occupational effect of NP regulation that has been previously overlooked. HCs are unique environments that rely on diverse teams of colocated health care practitioners to fulfill their missions. It is possible that the changes in PCMD and PA care that were associated with NP independence and detected in this study were by-products of the burdens associated with state restrictions and describe how these burdens extend beyond NPs to influence other clinicians. Regardless of their origin, findings from the "placebo" tests should stimulate further research about the impact of NP independence on diverse target populations, including practitioners, providers, and policy makers.

CONCLUSIONS

The growing demand for primary care in the United States coupled with a shortage of PCMDs, which is expected to worsen over the next decade, has sparked a national debate about the adequacy of the health care workforce and the options for closing the primary care workforce gap. Expanding the use of advanced practice clinicians, especially NPs, is a frequently discussed solution. While it has some appeal, the extent to which this direction becomes a solution is contingent on states easing restrictions in their NP scope of practice policies; yet little research informs the consequence of such state action. A 2012 review of the evidence by the National Governors Association found "[n]o studies . . . designed to measure differences in health care quality, access, or costs between states with more and less restrictive scope of practice laws" and urged researchers to study this phenomenon (National Governors Association [NGA] 2012, p. 10).

This study was motivated by this gap in the evidence and was designed to provide policy makers with actionable information on which to base their reform decisions—specifically, to produce valid and nationally representative estimates of the effect of NP independence on social welfare. Study findings—

which did not demonstrate a scope of practice-quality effect—do not substantiate the use of restrictions for the sole purpose of consumer protection. In terms of our other analyses, the net effect of NP independence on service utilization and referral patterns and the effect of NP independence on PCMD- and PA-delivered care were unclear. Certainly, there may be justifiable reasons to ease NP restrictions beyond the relationships we explored (e.g., autonomy's impact on health care access). Given our equivocal findings, policy makers may want to examine the purpose of NP restrictions, account for the welfare gains/losses associated with regulating these practitioners, including the economic costs and administrative burdens—an exercise which was beyond the scope of this study—and, on those grounds, determine the content and scope their occupational policies.

ACKNOWLEDGMENTS

Joint Acknowledgments/Disclaimer Statement: Funding support for this work was provided through the 2014 National Center for Health Statistics/Academy-Health Health Policy Fellowship. The views presented here are solely those of the authors.

Disclosure: No conflicts to disclose.

Disclaimer: None.

NOTES

1. This evidence includes dozens of empirical studies, independent evaluations, and evidence syntheses. See Sackett et al. (1974), Spitzer et al. (1974), Sox (1979), U.S. Congress, OTA (1981, 1986), Mundinger et al. (2000), Horrocks, Anderson, and Salisbury (2002), Laurant et al. (2005), Houweling et al. (2009), Dierick-van Daele et al. (2010), Naylor and Kurtzman (2010), Schuttelaar et al. (2010), Newhouse et al. (2011), Day et al. (2014), Donald et al. (2014), Martinez-Gonzalez et al. (2014), Martin-Misener et al. (2015), Swan et al. (2015).
2. Our primary interest was in comparing NP-delivered care in independent and restricted states. We repeated this analysis for PCMDs and PAs, separately. We did not compare outcomes between or among the different types of practitioners (e.g., NP-delivered care compared to PCMD-delivered care).
3. Unweighted estimates are available from the authors upon request.
4. In their binary form, the predictor variables captured states' movement into/out of full independence—a condition that applied to six states during the study period: Two states eased their restrictions and became fully independent in prescriptive authority (0→1) and four states that were fully independent in practice authority

strengthened their restrictions (1→0). Taken together, these changes affected approximately 20 percent of the U.S. population.

5. Specifications of the propensity score, results from each matching algorithm, and the accompanying diagnostics are available from the authors upon request.
6. Results available from the authors upon request.

REFERENCES

Addressing Healthcare Workforce Issues for the Future: Hearing before the United States Senate Committee on Health, Education, Labor, and Pensions. 110th Cong., 2nd sess. (2008) (testimony of A.B. Steinwald).

Akerlof, G. A. 1970. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanisms." *Quarterly Journal of Economics* 84 (3): 488–500.

APRN Consensus Work Group & the National Council of State Boards of Nursing APRN Advisory Committee. (2008). "Consensus Model for APRN Regulation: Licensure, Accreditation, Certification & Education." Available at https://ncsbn.org/Consensus_Model_for_APRN_Regulation_July_2008.pdf

Auerbach, D. I. 2012. "Will the NP Workforce Grow in the Future? New Forecasts and Implications for Healthcare Delivery." *Medical Care* 50 (7): 606–10.

Berry, F., and W. Berry. 2007. "Innovation and Diffusion Models in Policy Research." In *Theories of the Policy Process*, 2nd edition, edited by P. A. Sabatier, pp. 223–60. Cambridge, MA: Westview Press.

Bishop, T. F., A. D. Federman, and J. S. Ross. 2012. "Association between Physician Quality Improvement Incentives and Ambulatory Quality Measures." *American Journal of Managed Care* 18 (4): e126–34.

Chen, L. M., W. R. Farwell, and A. K. Jha. 2009. "Primary Care Visit Duration and Quality: Does Good Care Take Longer?" *Archives of Internal Medicine* 169 (20): 1866–72.

Crawford, A. G., C. Cote, J. Couto, M. Daskiran, C. Gunnarsson, K. Haas, S. Haas, S. C. Nigam, R. Schuette, and J. Yaskin. 2010. "Comparison of GE Centricity Electronic Medical Record Database and National Ambulatory Medical Care Survey Findings on the Prevalence of Major Conditions in the United States." *Population Health Management* 13 (3): 139–50.

Day, L. W., D. Siao, J. M. Inadomi, and M. Somsouk. 2014. "Non-Physician Performance of Lower and Upper Endoscopy: A Systematic Review and Meta-Analysis." *Endoscopy* 46 (5): 401–10.

Dehejia, R. H., and S. Wahba. 2002. "Propensity Score-Matching Methods for Nonexperimental Causal Studies." *Review of Economics and Statistics* 84 (1): 151–61.

Dierick-van Daele, A. T., L. M. Steuten, J. F. Metsemakers, E. W. Derckx, C. Spreeuwenberg, and H. J. Vrijhoef. 2010. "Economic Evaluation of Nurse Practitioners Versus GPs in Treating Common Conditions." *British Journal of General Practice* 60 (570): e28–e35.

Donald, F., K. Kilpatrick, K. Reid, N. Carter, R. Martin-Misener, D. Bryant-Lukosius, P. Harbman, S. Kaasalainen, D. A. Marshall, R. Charbonneau-Smith, and E. E. Donald. 2014. "A Systematic Review of the Cost-Effectiveness of Nurse

Practitioners and Clinical Nurse Specialists: What Is the Quality of the Evidence?" *Nursing Research and Practice* 2014, doi: 10.1155/2014/896587.

Doty, M. M., M. K. Abrams, S. E. Hernandez, K. Stremikis, and A. C. Beal. 2010. Enhancing the Capacity of Community Health Centers to Achieve High Performance: Findings from the 2009 Commonwealth Fund National Survey of Federally Qualified Health Centers. The Commonwealth Fund [accessed on February 25, 2016]. Available at http://www.commonwealthfund.org/~/media/Files/Publications/Fund%20Report/2010/May/1392_Doty_enhancing_capacity_community_hlt_ctrs_2009_FQHC_survey_v5.pdf

DuMouchel, W. H., and G. J. Duncan. 1983. "Using Sample Survey Weights in Multiple Regression Analyses of Stratified Samples." *Journal of the American Statistical Association* 78 (383): 535–43.

Friedman, M. 1962. *Capitalism and Freedom.* Chicago, IL: University of Chicago Press.

Gaumer, G. L. 1984. "Regulating Health Professionals: A Review of the Empirical Literature." *Milbank Memorial Fund Quarterly. Health and Society* 62 (3): 380–416.

Gellhorn, W. 1976. "The Abuse of Occupational Licensing." *University of Chicago Law Review* 44 (1): 6–27.

Gelman, A. 2007. "Struggles with Survey Weighting and Regression Modeling." *Statistical Science* 22 (2): 153–64.

Gilchrist, V. J., K. C. Stange, S. A. Flocke, G. McCord, and C. Bourguet. 2004. "A Comparison of the National Ambulatory Medical Care Survey (NAMCS) Measurement Approach with Direct Observation of Outpatient Visits." *Medical Care* 42 (3): 276–80.

Goldman, L. E., P. W. Chu, H. Tran, M. J. Romano, and R. S. Stafford. 2012. "Federally Qualified Health Centers and Private Practice Performance on Ambulatory Care Measures." *American Journal of Preventive Medicine* 43 (2): 142–9.

Green, L. A., G. E. Fryer Jr, B. P. Yawn, D. Lanier, and S. M. Dovey. 2001. "Ecology of Medical Care." *New England Journal of Medicine* 344 (26): 2021–5.

Guo, S., and M. W. Fraser. 2015. *Propensity Score Analysis: Statistical Methods and Applications.* Thousand Oaks, CA: Sage.

Hahns-Vaughn, D. L. 2005. "A Primer for Using and Understanding Weights with National Datasets." *Journal of Experimental Education* 73 (3): 221–48.

Hahns-Vaughn, D. L. 2006. Fall. "Weighting Omissions and Best Practices When Using Large-Scale Data in Educational Research." *Association for Institutional Research (AIR) Professional File* 101 (9): 1–2.

Health Affairs (Millwood). 2013, May 15. Health Policy Brief: Nurse Practitioners and Primary Care [accessed February 25, 2016]. Available at http://healthaffairs.org/healthpolicybriefs/brief_pdfs/healthpolicybrief_92.pdf

Heeringa, S. G., B. T. West, and P. A. Berglund. 2010. *Applied Survey Data Analysis.* Boca Raton, FL: Chapman & Hall.

Hicks, L. S., J. O'Malley, T. A. Lieu, T. Keegan, N. L. Cook, B. J. McNeil, B. E. Landon, and E. Guadagnoli. 2006. "The Quality of Chronic Disease Care in U.S. Community Health Centers." *Health Affairs (Millwood)* 25 (6): 1712–23.

Hofer, A. N., J. M. Abraham, and I. Moscovice. 2011. "Expansion of Coverage under the Patient Protection and Affordable Care Act and Primary Care Utilization." *Milbank Quarterly* 89 (1): 69–89.

Horrocks, S., E. Anderson, and C. Salisbury. 2002. "Systematic Review of Whether Nurse Practitioners Working in Primary Care Can Provide Equivalent Care to Doctors." *British Medical Journal* 324 (7341): 819–23.

Houweling, S. T., N. Kleefstra, K. J. J. van Hateren, A. Kooy, K. H. Groenier, E. ten Vergert, B. Meyboom-de Jong, H. J. G. Bilo, and Langerhans Medical Research Group. 2009. "Diabetes Specialist Nurse as Main Care Provider for Patients with Type 2 Diabetes." *Netherlands Journal of Medicine* 67: 278–84.

Institute of Medicine (IOM). 2011. *The Future of Nursing—Leading Change, Advancing Health.* Washington, DC: National Academy Press.

Jencks, S. F., T. Cuerdon, D. R. Burwen, B. Fleming, P. M. Houck, A. E. Kussmaul, D. S. Nilasena, D. L. Ordin, and D. R. Arday. 2003. "Quality of Medical Care Delivered to Medicare Beneficiaries: A Profile at State and National Levels." *Journal of the American Medical Association* 284 (13): 1670–6.

Katz, A. B., L. E. Felland, I. Hill, and L. B. Stark. 2011. *A Long and Winding Road: Federally Qualified Health Centers, Community Variation and Prospects Under Reform.* Research Brief No. 21. Washington, DC: Center for Studying Health System Change.

Kirch, D. G., M. K. Henderson, and M. J. Dill. 2012. "Physician Workforce Projections in an Era of Health Care Reform." *Annual Review of Medicine* 63: 435–45.

Korn, E. L., and B. I. Graubard. 1995. "Examples of Differing Weighted and Unweighted Estimates from a Sample Survey." *American Statistician* 49 (3): 291–5.

Ku, L. C., P. Richard, A. Dor, E. Tan, P. Shin, and S. J. Rosenbaum. 2010. *Strengthening Primary Care to Bend the Cost Curve: The Expansion of Community Health Centers Through Health Reform. Geiger Gibson/RCHN Community Health Foundation Research Collaborative.* Policy Research Brief No. 19. Washington, DC: The George Washington University, Department of Health Policy.

Laurant, M., D. Reeves, R. Hermens, J. Braspenning, R. Grol, and B. Sibbald. 2005. "Substitution of Doctors by Nurses in Primary Care." *Cochrane Database of Systematic Reviews* 2(2), doi: 10.1002/14651858.CD001271.pub2.

Lewis, T., E. Goldberg, N. Schenker, V. Beresovsky, S. Schappert, S. Decker, N. Sonnenfeld, and I. Shimizu. 2014. "The Relative Impacts of Design Effects and Multiple Imputation on Variance Estimates: A Case Study with the 2008 National Ambulatory Medical Care Survey." *Journal of Official Statistics* 30 (1): 147–61.

Ma, J., and R. S. Stafford. 2005. "Quality of US Outpatient Care: Temporal Changes and Racial/Ethnic Disparities." *Archives of Internal Medicine* 165 (12): 1354–61.

Ma, J., L. Xiao, and R. S. Stafford. 2009. "Adult Obesity and Office-Based Quality of Care in the United States." *Obesity* 17 (5): 1077–85.

Martinez-Gonzalez, N. A., S. Djalali, R. Tandjung, F. Huber-Geismann, S. Markun, M. Wensing, and T. Rosemann. 2014. "Substitution of Physicians by Nurses in Primary Care: A Systematic Review and Meta-Analysis." *BMC Health Services Research* 14: 214.

Martin-Misener, R., P. Harbman, F. Donald, K. Reid, K. Kilpatrick, N. Carter, D. Bryant-Lukosius, S. Kaasalainen, D. A. Marshall, R. Charbonneau-Smith, and A. DiCenso. 2015. "Cost-Effectiveness of Nurse Practitioners in Primary and Specialised Ambulatory Care: Systematic Review." *British Medical Journal Open* 5 (6): e007167.

Mundinger, M. O., R. L. Kane, E. R. Lenz, A. M. Totten, W. Y. Tsai, P. D. Cleary, W. T. Friedeewald, A. L. Siu, and M. L. Shelanski. 2000. "Primary Care Outcomes in Patients Treated by Nurse Practitioners or Physicians: A Randomized Trial." *Journal of the American Medical Association* 283 (1): 59–68.

National Governors Association (NGA). 2012. *The Role of Nurse Practitioners in Meeting Increasing Demand for Primary Care.* Washington, DC: NGA [accessed February 25, 2016]. Available at http://www.nga.org/cms/home/nga-center-for-best-practices/center-publications/page-health-publications/col2-content/main-content-list/the-role-of-nurse-practitioners.html

Naylor, M. D., and E. T. Kurtzman. 2010. "The Role of Nurse Practitioners in Reinventing Primary Care." *Health Affairs (Millwood)* 29 (5): 893–9.

Newhouse, R. P., J. Stanik-Hutt, K. M. White, M. Johantgen, E. B. Bass, G. Zangaro, R. F. Wilson, L. Fountain, D. M. Steinwachs, L. Heindel, and J. P. Weiner. 2011. "Advanced Practice Nurse Outcomes 1990–2008: A Systematic Review." *Nursing Economics* 29 (5): 1–21.

Petterson, S. M., W. R. Liaw, R. L. Phillips, D. L. Rabin, and A. W. Bazemore. 2012. "Projecting U.S. Primary Care Physician Workforce Needs: 2010–2025." *Annals of Family Medicine* 10: 503–9.

Pfeffermann, D. 1993. "The Role of Sampling Weights When Modeling Survey Data." *International Statistical Review* 61 (2): 317–37.

Poghosyan, L., A. Nannini, and S. Clarke. 2013. "Organizational Climate in Primary Care Settings: Implications for Nurse Practitioner Practice." *Journal of the American Academy of Nurse Practitioners* 25 (3): 134–40.

Poghosyan, L., A. Nannini, A. Smaldone, S. Clarke, N. C. O'Rourke, B. G. Rosato, and B. Berkowitz. 2013a. "Revisiting Scope of Practice Facilitators and Barriers for Primary Care Nurse Practitioners: A Qualitative Investigation." *Policy, Politics, & Nursing Practice* 14 (1): 6–15.

Poghosyan, L., A. Nannini, P. W. Stone, and A. Smaldone. 2013b. "Nurse Practitioner Organizational Climate in Primary Care Settings: Implications for Professional Practice." *Journal of Professional Nursing* 29 (6): 338–49.

Proser, M., T. Bysshe, D. Weaver, and R. Yee. 2015. "Community Health Centers at the Crossroads: Growth and Staffing Needs." *Journal of the American Academy of Physician Assistants* 28 (4): 49–53.

Romano, M. J., and R. S. Stafford. 2011. "Electronic Health Records and Clinical Decision Support Systems: Impact on National Ambulatory Care Quality." *Archives of Internal Medicine* 171 (10): 897–903.

Rose, J. 1979. "Occupational Licensing: A Framework for Analysis." *Arizona State Law Journal*, 1(1979): 189–202.

Rosenbaum, P. R., and D. B. Rubin. 1983. "The Central Role of the Propensity Score in Observational Studies for Causal Effects." *Biometrika* 70 (1): 41–55.

———. 1985. "Constructing a Control Group Using Multivariate Matched Sampling Methods That Incorporate the Propensity Score." *American Statistician* 39 (1): 33–8.

Sackett, D. L., W. O. Spitzer, M. Gent, R. S. Roberts, W. I. Hay, G. M. Lefroy, G. P. Sweeny, I. Vandervlist, J. C. Sibley, L. W. Chambers, and C. H. Goldsmith. 1974. "The Burlington Randomized Trial of the Nurse Practitioner: Health Outcomes of Patients." *Annals of Internal Medicine* 80 (2): 137–42.

Schuttelaar, M. L. A., K. M. Vermeulen, N. Drukker, and P. J. Coenraads. 2010. "A Randomized Controlled Trial in Children with Eczema: Nurse Practitioner vs. Dermatologist." *British Journal of Dermatology* 162: 162–70.

Smith, J. A., and P. E. Todd. 2005. "Does Matching Overcome LaLonde's Critique of Nonexperimental Estimators?" *Journal of Econometrics* 125 (2005): 305–53.

Solon, G., S. J. Haider, and J. Wooldridge. 2015. "What Are We Weighting for?" *Journal of Human Resources* 50 (2): 301–16.

Sox, H. C. 1979. "Quality of Patient Care by Nurse Practitioners and Physician's Assistants: A Ten-Year Perspective." *Annals of Internal Medicine* 91: 459–68.

Spitzer, W. O., D. L. Sackett, J. C. Sibley, R. S. Roberts, M. Gent, D. J. Kergin, B. C. Hackett, A. Olynich, W. I. Hay, G. Lefroy, and G. Sweeny. 1974. "The Burlington Randomized Trial of the Nurse Practitioner." *New England Journal of Medicine* 290 (5): 251–6.

Starfield, B., N. R. Powe, J. R. Weiner, M. Stuart, D. Steinwachs, S. H. Scholle, and A. Gerstenberger. 1994. "Costs vs. Quality in Different Types of Primary Care Settings." *Journal of the American Medical Association* 272: 1903–8.

StataCorp, LLP. 2011. *Stata/SE Version 12.1 [Computer Software]*. College Station, TX: Stata Corp, LLP.

Stigler, G. J. 1971. "The Theory of Economic Regulation." *Bell Journal of Economics and Management Science* 2 (10): 3–21.

Swan, M., S. Ferguson, A. Chang, E. Larson, and A. Smaldone. 2015. "Quality of Primary Care by Advanced Practice Nurses: A Systematic Review." *International Journal for Quality in Health Care: Journal of the International Society for Quality in Health Care/ISQua* 27 (5): 396–404.

U.S. Congress, Office of Technology Assessment. 1981. "The Costs and Effectiveness of Nurse Practitioners." Case Study No. 16, Pub. No. OTA-HCS-16, Washington, DC: U.S. Government Printing Office. [accessed February 25, 2016]. Available at http://ota.fas.org/reports/8131.pdf

U.S. Congress, Office of Technology Assessment. 1986. "Nurse Practitioners, Physician Assistants, and Certified Nurse-Midwives: A Policy Analysis." Health Technology Case Study No. 37, Pub. No. OTA-HCS-37, Washington, DC: U.S. Government Printing Office. [accessed February 25, 2016]. Available at http://ota.fas.org/reports/8615.pdf

U.S. Department of Health & Human Services (DHHS), Agency for Healthcare Research and Quality (AHRQ). 2011. *Primary Care Workforce Facts and Stats No. 2.* Rockville, MD: AHRQ [accessed February 25, 2016]. Available at http://www.ahrq.gov/sites/default/files/publications/files/pcwork2.pdf

U.S. Department of Health & Human Services, Health Resources and Services Administration (HRSA). 2013. *Projecting the Supply and Demand for Primary Care Practitioners Through 2020.* Rockville, Maryland: HRSA [accessed February 25, 2016]. Available at http://bhpr.hrsa.gov/healthworkforce/supplydemand/usworkforce/primarycare/projectingprimarycare.pdf.

U.S. Department of Health & Human Services, Health Resources and Services Administration (HRSA). 2014. *Highlights from the 2012 National Sample Survey of Nurse Practitioners.* Rockville, MD: HRSA [accessed February 25, 2016]. Available at http://bhpr.hrsa.gov/healthworkforce/supplydemand/nursing/nursepractitionersurvey/npsurveyhighlights.pdf

U.S. Department of Health & Human Services, Health Resources Services Administration (HRSA). n.d. *The Affordable Care Act and Health Centers.* Rockville, MD: HRSA [accessed February 25, 2016]. Available at http://www.bphc.hrsa.gov/about/healthcenterfactsheet.pdf

Walker, J. 1969. "The Diffusion of Innovation Among the American States." *American Political Science Review* 63: 880–99.

Xue, Y., Z. Ye, C. Brewer, and J. Spetz. 2016. "Impact of State Nurse Practitioner Scope-of-Practice Regulation on Healthcare Delivery: Systematic Review." *Nursing Outlook* 64: 71–85.

Zhou, X. 1993. "Occupational Power, State Capacities, and the Diffusion of Licensing in the American States: 1890 to 1950." *American Sociological Review* 58 (4): 536–52.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.