

Impact of state nurse practitioner scope-of-practice regulation on health care delivery: Systematic review

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ARTICLE INFO

Article history:

Received 19 May 2015

Revised 10 August 2015

Accepted 30 August 2015

Available online 9 September

2015

Keywords:

Nurse practitioner

Scope-of-practice regulation

Primary care

ABSTRACT

Background: One proposed strategy to expand primary care capacity is to use nurse practitioners (NPs) more effectively in health care delivery. However, the ability of NPs to provide care to the fullest extent of their education is moderated by state scope-of-practice (SOP) regulations.

Purpose: The purpose of this study was to examine the impact of state SOP regulations on the following three key issues: (a) NP workforce, (b) access to care and health care utilization, and (c) health care costs.

Methods: Systematic review.

Results/Discussion: States granting NPs greater SOP authority tend to exhibit an increase in the number and growth of NPs, greater care provision by NPs, and expanded health care utilization, especially among rural and vulnerable populations. Our review indicates that expanded NP practice regulation can impact health care delivery by increasing the number of NPs in combination with easing restrictions on their SOP.

Conclusions: Findings show promise that removing restrictions on NP SOP regulations could be a viable and effective strategy to increase primary care capacity.

Cite this article: Xue, Y., Ye, Z., Brewer, C., & Spetz, J. (2016, FEBRUARY). Impact of state nurse practitioner scope-of-practice regulation on health care delivery: Systematic review. *Nursing Outlook*, 64(1), 71–85. <http://dx.doi.org/10.1016/j.outlook.2015.08.005>.

Introduction

Provisions of the Patient Protection and Affordable Care Act (ACA), particularly those dealing with Medicaid expansion and payment reform, are expected to increase the demand for primary care within a health care system already facing severe physician

workforce shortages. These shortages impede the capacity to deliver sufficient care to an aging and more diverse population, with growing chronic disease burden, particularly among poor and minority populations (Bodenheimer, Chen, & Bennett, 2009). Although one recent state-level analysis suggested that the current physician workforce supply in both primary care and most specialties is sufficient to meet

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<http://dx.doi.org/10.1016/j.outlook.2015.08.005>

future demand (Glied & Ma, 2015), the analysis assumed an increase in physician workload and did not examine potential variation in supply and demand across local areas within states. Indeed, a within-state small area analysis examining the impact of ACA reforms using the same source of data suggested that about 44 million Americans live in areas where the expected increase in demand for primary care will exceed 5% and almost seven million reside in areas where the expected demand will increase by more than 10% (Huang & Finegold, 2013). The Health Resources and Services Administration (HRSA) estimates that the supply of primary care physicians (PCPs) will not meet future demand, with a projected shortage of approximately 20,400 full-time equivalent physicians by 2020 (HRSA, 2013). Within this backdrop of health care reform and physician workforce shortages, transforming the delivery of primary care, particularly for newly eligible Medicaid enrollees, has become a top priority for many state policy makers (AcademyHealth, 2015), with most state governors addressing this issue in their State of the State speeches in 2014 (National Academy for State Health Policy, 2015).

One policy recommendation aimed at expanding primary care capacity is to use nurse practitioners (NPs) more effectively (Dower, Moore, & Langelier, 2013; Naylor & Kurtzman, 2010; Pohl, Hanson, Newland, & Cronenwett, 2010). A projected increase in the NP workforce (HRSA, 2013), along with the essential and steadily growing contributions of NPs to primary care (Druss, Marcus, Olfson, Tanielian, & Pincus, 2003; Kuo, Loresto, Rounds, & Goodwin, 2013), especially their historic and evolving role in improving access to primary care for vulnerable populations (Morgan, Everett, & Hing, 2015), offers compelling evidence for this policy recommendation.

HRSA has projected a 30% increase in primary care NPs from 55,400 in 2010 to 72,100 NPs by 2020, which combined with an increase in physician assistants (PAs) could substantially reduce the projected shortage of full-time equivalent physicians from 20,400 to 6,400 if NPs and PAs are effectively integrated into the primary care system (HRSA, 2013). Perhaps most critical to health care reform, NPs have historically played a vital role in improving access to primary care for vulnerable populations (Morgan et al., 2015). NPs are key providers in 1,202 federally funded community health centers and 250 nurse-managed health clinics that embrace team-based care to serve >22 million minority and low-income patients (Hansen-Turton, Bailey, Torres, & Ritter, 2010; National Association of Community Health Centers, 2014). A recent analysis suggested that increasing nurse-managed health centers and expanding patient panel size in patient-centered medical homes could substantially mitigate primary care provider shortages (Auerbach et al., 2013).

In addition, expanding the role and scope of practice (SOP) of NPs in the delivery of primary care (e.g., independent practice and prescription authority) has had a significant impact on access to primary care and

improved management of chronic diseases among vulnerable populations, including Medicaid enrollees (Adashi, Geiger, & Fine, 2010; Landon et al., 2007). Supporting an expanded SOP for NPs is an extensive body of evidence that has consistently demonstrated comparable performance between NPs and PCPs on clinical outcomes, including reduction of symptoms, improvement in health and functional status, and mortality (Naylor & Kurtzman, 2010; Paradise, Dark, & Bitler, 2011). In addition, patients seen by NPs generally report higher satisfaction (Jennings, Clifford, Fox, Oconnell, & Gardner, 2015).

However, the ability of NPs to provide essential primary care to the fullest extent of their education is moderated by state SOP regulation, which is governed by state law under the state's Nurse Practice Act and is administered and regulated by each state's Board of Nursing. The National Council of State Boards of Nursing has developed a national standard (the Consensus Model) to provide guidance for states to adopt uniform APRN (advanced practice registered nurse) regulation on licensure, accreditation, certification, and education (National Council of State Boards of Nursing, 2014), and the National Governors Association recommended that states consider expanding SOP regulations to grant NPs authority in full practice (National Governors Association, 2012).

Yet, among the 24 states predicted to have an increase in demand for primary care providers above the national average due to the implementation of the ACA, 17 have restrictive NP SOP regulations (Huang & Finegold, 2013). To assist state policy makers in making evidence-based decisions on legislative reforms concerning the expansion of the NP role in health care delivery, we conducted a systematic review on the impact of state NP SOP regulations on health care delivery, specifically focusing on the following three key issues: (a) NP workforce, (b) access to care and health care utilization, and (c) health care costs.

Methods

Search Strategy

We searched the electronic databases PubMed, CINAHL, PsycINFO, and Cochrane library for the period up to January 31, 2015. In addition, we manually searched Google Scholar and the references of published studies. The search in title or abstract comprised the terms SOP, legislation, regulation, NP(s), advanced practice nurse(s), or APRN(s). As health care system and regulatory issues are different across countries, we restricted the publications to those that addressed these issues in the United States. Additional inclusion criteria were (a) published in English, (b) empirical quantitative study, (c) directly examined the effect of state SOP regulations on health care delivery, and (d) acceptable risk of bias in methodological approach. We

included studies with both time-series and cross-sectional research designs. Although studies with cross-sectional designs may be less desirable for assessing regulatory effects, they can nonetheless provide valuable insights if confounding factors were conceptually sound and controlled for in the analysis. Studies with bivariate analysis were therefore excluded, as results are inconclusive without adjusting for potential confounding factors.

Study Screening and Data Extraction

Two authors independently screened the retrieved studies for eligibility by title and abstract. Screening was not blinded to authors, institutions, or manuscript journals. If an abstract did not provide sufficient information, evaluation of the full text was performed and study eligibility was determined. Data on study characteristics and key findings of individual studies were also independently extracted by two authors. Disagreements in study screening and data extraction were resolved by consensus.

Assessment of Risk of Bias

Two authors independently assessed risk of bias in study methods that might threaten internal validity, including study design, data sources, measurement, and statistical analysis. Disagreements between the two reviewers were resolved through discussion.

Data Synthesis

Meta-analysis was not performed because the studies included in the review are heterogeneous in topic and methodology. Thematic summaries were conducted independently by two authors to extract the common themes across studies with disagreements resolved by consensus.

Results

Characteristics of Studies

Our search identified 529 published articles, which were screened initially for eligibility by title and abstract. Of these, 22 were selected for further assessment for eligibility by examining the full articles. Seven of the 22 articles were excluded because of potential high risk of bias in the methodological approach, leaving 15 articles in the present review and synthesis. A flow diagram of search and study selection is shown in [Figure 1](#). Characteristics of the selected studies are summarized in [Table 1](#). These studies were published from 1997 to 2015. Findings were generally consistent across study periods. Nine studies used a time-series design, and six employed a cross-sectional design. Most studies used national data sets and employed

multiple regression analysis; a few studies adjusted for clustering effects, and one study used multilevel modeling to examine factors on state and individual levels simultaneously.

SOP regulation was measured in two ways in the reviewed studies. Some studies employed an index measure based on a scoring system for various SOP regulation components, such as practice status, prescription authority, and independent reimbursement. However, most studies used categorical coding for presence or absence of the same or similar components. To compare and synthesize results across reviewed studies more effectively, we used a three-level classification for NP SOP regulation defined by the American Association of Nurse Practitioners: (a) full SOP regulation (independent practice and prescriptive authority), (b) reduced SOP regulation (requires a collaborative agreement with physicians for at least one practice component such as prescription), and (c) restrictive SOP regulation (requires supervision, delegation, or team management by physicians; [American Association of Nurse Practitioners, 2015](#)).

Risk of Bias

A total of seven studies were excluded because of risk of bias after full-article review. Six studies were excluded because they used bivariate analyses without adjusting for potential confounders, and one study was excluded because a substantial amount of missing data considerably diminished the validity of study findings. The risk of bias among the included studies was deemed acceptable.

The Impact of State SOP Regulation on NP Workforce

Eight studies included in this review examined the effects of state SOP regulations on the NP workforce, including supply, mobility, and geographic distribution. Consistent evidence has shown that the number of NPs and growth of the NP workforce were highest in states with greater practice authority. Evidence from four studies indicates that states with more favorable NP practice environments have higher per capita NPs ([Auerbach, 2000](#); [Kuo et al., 2013](#); [Reagan & Salsberry, 2013](#); [Stange, 2014](#)). By 2010, states with full SOP regulations had an average of 25 more NPs per 100,000 population (95% confidence interval [1.2, 48.3]) compared with states with the most restrictive SOP regulations ([Kuo et al., 2013](#)).

One study found that growth of the NP workforce from 2001 to 2008 was significantly higher in states with full SOP regulations: 100% growth in states with full SOP regulations, 92% in states with reduced regulations, and 73% in states with restrictive regulations ([Reagan & Salsberry, 2013](#)). Another study found that growth in the number of NPs per capita was 14.8% higher in states with the least restrictive SOP regulations compared with states with the most restrictions between 2006 and 2010 ([Kuo et al., 2013](#)). Consistent

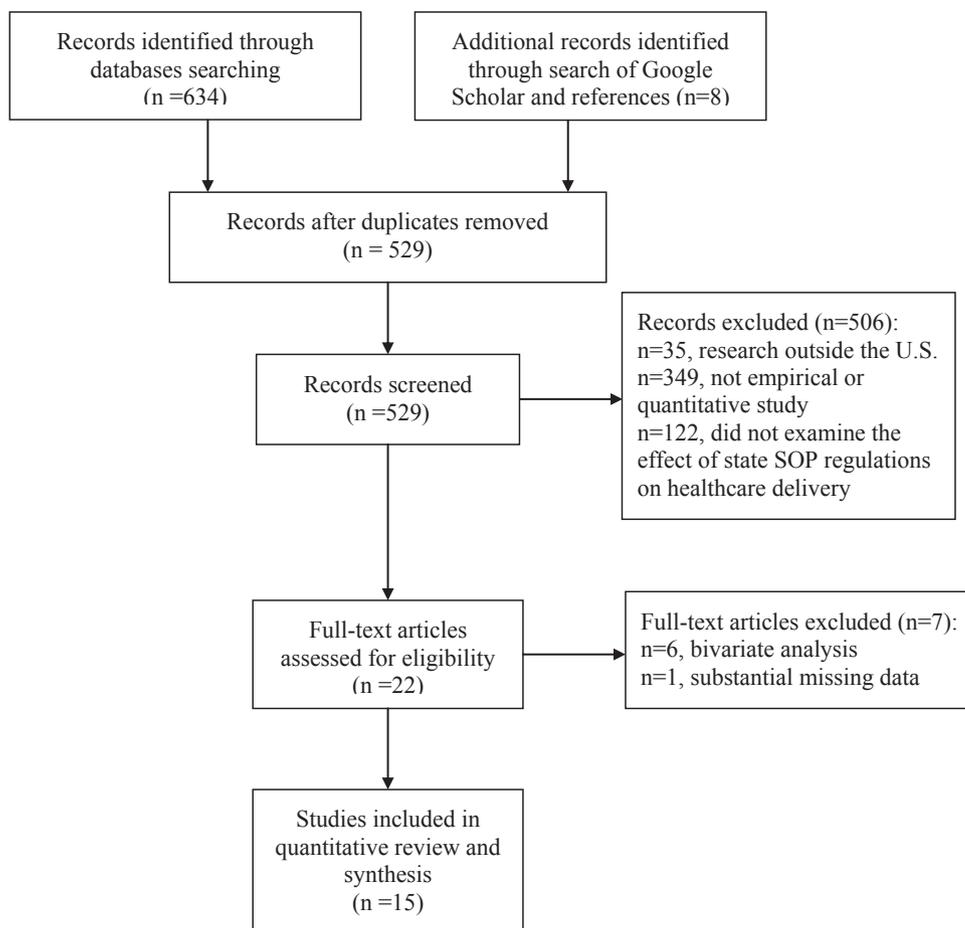


Figure 1 – Flow diagram of search and study selection.

with these findings, states with regulations granting NPs independent practice or prescription authority had 30% and 13% higher enrollments in APRN programs, respectively (Kalist & Spurr, 2004). In addition, state SOP regulation has been associated with NPs' migration, with NPs more likely to move from states without controlled substances prescription authority to states with this authority (Perry, 2012).

Two studies reported moderate effects of state SOP regulations on the geographic distribution of NPs. States that granted independent practice and third-party reimbursement had a more equitable distribution of NPs per capita across counties than states that did not (Lin, Burns, & Nochajski, 1997). Moreover, in a study examining the distribution of NPs in urban and rural areas, a trend was observed in which NPs were 1.5 times more likely to practice in rural areas in states with full SOP regulations compared with states with restrictive regulations (Kaplan, Skillman, Fordyce, McMenamin, & Doescher, 2012).

The Impact of State SOP Regulation on Care Provision by NPs

Five studies provide evidence indicating that states with expanded practice authority showed the greatest

growth and advancement of NP primary care provision. NPs had more authority in prescribing selected medications in states with less restrictive SOP regulatory environment (Pan, Straub, & Geller, 1997). From 1998 to 2010, the number of NPs providing primary care for Medicare fee-for-service patients increased from 0.6% to 5.3% in states with full SOP regulations, from 0.2% to 3% in states with reduced SOP regulations, and from 0.2% to 2.5% in states with restrictive SOP regulations. These differential growth rates resulted in a sizable gap in NP care provision across states by 2010; the odds of Medicare fee-for-service beneficiaries having an NP as a primary care provider was 2.5 times higher in states with the least restrictive NP SOP regulation than those in states with the most restrictive regulation (Kuo et al., 2013).

Evidence further suggests that less restrictive SOP regulation was linked with promoting care provision by NPs in rural and medically underserved areas. Rural hospitals located in states granting prescriptive authority to NPs were 30% more likely than rural hospitals in states without this authority to establish a provider-based rural health clinic, which are designed to stimulate the use of NPs and PAs to improve access to primary care in underserved rural areas (Krein, 1999). Community health centers, which are key

Table 1 – Characteristics of Studies

Study	Purpose	Study Design and Data	Measure for NP SOP Regulation	Statistical Analysis	Comments
Auerbach, 2000	One aim examined the impact of state SOP regulation on the number of NPs.	Cross-sectional time series analysis using multiple data sets including NSSRN from 1987 to 1996.	Index measure of state NP SOP regulatory environment on legal authority, reimbursement, and prescriptive authority, developed by Sekscenski et al.*	State-level multiple regression analysis.	Examined the impact of SOP regulation on the number of PCPs and NPs separately. Did not specify NP clinical specialty. Did not control for the effect of the number of PAs in the model.
Dueker et al., 2005	Examined how variation in the professional independence of APRNs affects the earnings of APRNs, physicians, and PAs.	Cross-sectional time series analysis using Current Population Survey 1988–2002.	Whether APRNs have independent prescriptive authority for controlled substances.	Individual-level multiple regression analysis including state-fixed effects.	Analysis was conducted for the sample of APRNs. Specialty APRNs' salary is usually higher than NPs, and this was not adjusted for in the analysis leading to potential bias in the results. The study did not specify whether the physician sample was composed of all primary care physicians and did not describe how physicians and PAs were identified from the data. All incomes were capped at 100,000 in the original data; physicians' income was more likely affected by this measure.
Kalish and Spurr, 2004	Examined whether legislation on SOP of APRNs affects enrollment in APRN Master's programs.	Cross-sectional time series analysis using data from National League for Nursing reports on enrollment in Master's programs from 1989 to 1995.	Two measures: (a) prescription authority (high vs. low: whether NPs can prescribe controlled substance) and (b) professional independence (high vs. low: whether NPs can practice independently or whether the Board of Medicine has a role in determining the SOP).	State-level multiple ordinary least squares regression, weighted by state population.	The sample consisted of APRNs. Did not control for number of nursing schools that had Master's programs in nursing, a time-varying variable that might affect total number of enrollments in a state.

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Table 1 – (Continued)

Study	Purpose	Study Design and Data	Measure for NP SOP Regulation	Statistical Analysis	Comments
Kaplan et al., 2012	Examined the distribution of NPs and CRNAs in rural and urban areas, and whether SOP regulations were associated with this distribution.	Retrospective cross-sectional design using National Provider Identifier data 2010.	Three-level categorical variable: (a) full autonomous, (b) requires physician collaboration, and (c) requires physician supervision.	Individual-level multiple regression analysis.	Did not specify NP clinical specialty. The analysis was conducted at the individual level to examine the association between NP SOP regulations and NP practice location (rural/urban). The analysis did not adjust for the clustering effect by state and only controlled for gender and per capita NP supply in a state. The model might have omitted other important covariates.
Krein, 1999	One aim examined whether rural hospitals located in states with a more favorable state practice environment for NPs and/or PAs were more likely to establish provider-based rural health clinics.	Cross-sectional time series analysis using multiple data sets including AHRF from 1990 to 1995.	A dichotomized variable on whether a state grants NPs prescriptive authority.	Hospital level discrete-time logistic regression.	NP specialty was not specified; however, it is very likely to be primary care as NP practice setting was rural health clinics. Authors acknowledged that the model might have omitted important covariates. Indeed, the model did not control for the supply of NPs and PAs.
Ku et al., 2015	Examined different medical staffing patterns in community health centers, the impact of staffing on productivity, staff roles, and the factors, including NP SOP regulation, that affect staffing patterns.	Cross-sectional analysis using data from 2012 HRSA Uniform Data System and AHRF.	Three-level categorical variable: (a) full SOP, (b) partial SOP (NPs could treat but not prescribe), and (c) restricted SOP (most NPs' actions must be authorized by a physician).	Multivariate ordinary least squares regression analysis.	The sample of advanced-practice staff included NPs, PAs, and CNMs. NP specialty was not specified; however, it is very likely to be primary care as practice setting was community health centers. Authors acknowledged that the study might misclassify staff roles because of limitation in the data.

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Table 1 – (Continued)

Study	Purpose	Study Design and Data	Measure for NP SOP Regulation	Statistical Analysis	Comments
Kuo et al., 2013	Assessed the growth in primary care provision by NPs and how it varied by practice settings and by NP SOP regulations.	Cross-sectional time series analysis using Medicare beneficiary sample claims data from 1998 to 2010.	Three-level categorical variable: (a) independent practice and prescription authority, (b) allowing independent practice but requiring supervision for prescriptions, and (c) requiring physician supervision for practice and prescriptions.	Multilevel modeling including individual patient and state-level variables.	NP sample consisted of those who provided primary care to a 5% random sample of Medicare fee-for-service beneficiaries in all states. Authors acknowledged that “measuring only NP charges would tend to underestimate total NP activity.” They also mentioned that they might overestimate the extent of primary care services provided by NPs by including approximately 5% of NPs in adult outpatient settings who were not in primary care. It is unclear whether NPs in states with full SOP were more likely to submit billing claims than NPs in other states with restrictive regulations.
Lin et al., 1997	One aim examined the relationship between state legal environments for NPs and the availability and supply of NPs.	Cross-sectional study design using State Board of Nursing listing of NPs in 1994, the listing of certified NPs from American Nurses Credential Center for those states that did not have the listing, and AHRF 1993.	Categorical coding for presence or absence of independent practice and third-party reimbursement.	County-level multiple regression analysis.	Did not specify NP clinical specialty. The unit of analysis was county, which is not a desirable area unit to examine availability of providers.

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Table 1 – (Continued)

Study	Purpose	Study Design and Data	Measure for NP SOP Regulation	Statistical Analysis	Comments
Pan et al., 1997	Examined the effects of state NP SOP regulation on NP's autonomy in prescribing selected categories of medications.	Cross-sectional design using 1992 national sample survey of certified NPs and CNSs.	Index measure for NP practice environment developed by the New York Rural Health Research Center. [†] The measure was based on legal recognition, requirements for educational program and certification, continuing education clause, grandfather clause, regulatory agency, prescribing authority, scope of practice, and reimbursement regulations, with score ranges from 20 (least) to 82 (most).	Individual-level multiple regression analysis.	More than 90% of the NP sample practiced in the areas of adults, family/community, pediatric, gerontological/geriatric, and OB/GYN. State-level variables were disaggregated at the individual level.
Perry, 2009	Examined the impact of changes in SOP regulations for NPs and PAs on NPs', PAs', and physicians' incomes.	Cross-sectional time series analysis using NSSRN 1992–2004 (for NPs), AAPAAC 1996–2004 (for PAs), and CPS annual social and economic supplement 1996–2005 (for physicians).	Dichotomous variable for presence or absence of prescriptive authority for controlled substances and third-party reimbursement for NPs and PAs, respectively.	Individual-level multiple regression analysis used Huber–White standard errors to adjust for cluster effect.	Did not specify NP clinical specialty. The analysis was disaggregated on the individual level with adjustment for standard errors using Huber–White method. Did not control for overall supply of NPs, PAs, or physicians, which might have an impact on income.
Perry, 2012	Examined the impact of NPs' prescriptive authority for controlled substances on NP migration choices from state to state.	Cross-sectional time series analysis using NSSRN 1992–2004.	Dichotomous variable for presence or absence of prescriptive authority for controlled substances.	Individual-level multiple regression analysis.	Did not specify NP clinical specialty. Lack of theoretical guidance on selection of covariates. It is likely that the model omitted some important covariates, such as income.

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Table 1 – (Continued)

Study	Purpose	Study Design and Data	Measure for NP SOP Regulation	Statistical Analysis	Comments
Reagan and Salsberry, 2013	Examined the impact of state NP SOP regulation on the number and growth of NPs.	Cross-sectional analysis using AHRF 2008.	Three-level categorical variable: (a) no practice restrictions, (b) some restrictions (require collaborative agreement for prescription), or (c) most restrictions (collaborative agreement for diagnosis, treatment, and prescription).	Health service area level least squared multiple regression, weighted by area population.	Did not specify NP clinical specialty. The growth of NPs was evaluated based on the changes in the number of NPs between 2000 and 2008; however, covariates were only available for Year 2008.
Shi and Samuels, 1997	Examined the relationship between state variations in the regulation of NPs, PAs, and CNMs and the employment of these practitioners by community health centers.	Cross-sectional design using data from community health center survey in 1992.	Index measure method developed by Sekscenski et al.*	Individual community health center–level multiple regression analysis.	NP specialty was not specified; however, it is very likely to be primary care as practice setting was community health centers. It is unclear whether the analysis adjusted for clustering effect of community health centers by state. Authors acknowledged that the analysis might omit potentially important covariates, such as the employment of practitioners, physicians, other center characteristics (e.g., financial arrangement), and personal characteristics (e.g., rural exposure).

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Table 1 – (Continued)

Study	Purpose	Study Design and Data	Measure for NP SOP Regulation	Statistical Analysis	Comments
Spetz et al., 2013	Examined variation in NP SOP regulations across states on the costs of retail clinics.	Cross-sectional time series analysis using administrative claims data from 2004 to 2007. The data included 27 states with different types of SOP regulations for NPs.	Three-level categorical variable: (a) NPs practice and prescribe independently, (b) NPs practice independently, prescribe only when collaborating with or supervised by a physician, and (c) NPs practice and prescribe collaboratively with a physician, or NPs are supervised for practice and prescribing by a physician.	Individual-level multiple regression analysis.	NP specialty was not specified; however, it is very likely to be primary care as practice setting was retail clinics. Authors acknowledged that the study might have sample selection bias. It is unclear whether the analysis adjusted for cluster effect by state.
Stange, 2014	Examined the impact of changes in NP workforce and SOP regulations for NPs and PAs on access, costs, and patterns of health care utilization.	Cross-sectional time series analysis using state licensing records, AHRF, and MEPS from 1996 to 2008.	Used two different measures for SOP regulations for NPs and PAs. One is an index measure for the overall practice environment for NPs and PAs in the state at a single point in time, and the second is an indicator for whether NPs and PAs are permitted to write prescriptions for any controlled substances in a given state and year.	Fixed effects ordinary least squares multiple regression analysis and two-stage least squares multiple regression analysis.	Did not specify NP clinical specialty. Measurement for provider supply was based on license data which might overestimate the number of practitioners in active practice. However, the author differentiated outcomes in primary care and nonprimary care (i.e., primary care office-based visits, nonprimary care office-based visits etc.). The study only examined one aspect of access to care, which is having a usual source of care.

AAPAAC, American Academy of Physician Assistants Annual Census; AHRF, area health resource file; APRN, advance practice registered nurse; CNMs, certified nurse-midwives; CNSs, clinical nurse specialists; CRNAs, certified registered nurse anesthetists; CPS, current population survey; HRSA, health resources and services administration; MEPS, Medical Expenditure Panel Survey; NP, nurse practitioner; NSSRN, national sample survey of registered nurses; OB/GYN, obstetrician/gynecologist; PA, physician assistant; PCP, primary care physicians; SOP, scope-of-practice.

* Sekscenski, E. S., Sansom, S., Bazell, C., Salmon, M. E., & Mullan, F. (1994). State practice environments and the supply of physician assistants, nurse practitioners, and certified nurse-midwives. *New England Journal of Medicine*, 331(19), 1266–1271.

† Burns, P., Nochajski, T. (1995). *Interrelationship of practice environment with the distribution of nurse practitioner and health related outcomes*. Buffalo, New York: New York Rural Health Research Center, State University of New York at Buffalo.

providers for medically underserved populations, were more likely to hire additional NPs if located in states with more positive practice environments (Shi & Samuels, 1997). This finding was confirmed in a recent study by Ku, Frogner, Steinmetz, and Pittman, (2015) who found that SOP regulation was one of the most important determinants of staff composition in federally funded community health centers. Community health centers located in states with full SOP regulations used slightly fewer physicians and slightly more advanced practice staff including NPs, PAs, and certified nurse-midwives. Community health centers benefited from full SOP regulation by having more flexibility in staffing choice, which is especially significant given these centers are located in areas with a short supply of PCPs (Ku et al., 2015).

The Impact of State SOP Regulation on Access to Care and Health Care Utilization

Only a single study, conducted by Stange (2014) examined the impact of state NP SOP regulations on primary care access and utilization; fortunately, the study was rigorously designed and provided insightful results. Access to care was defined as whether an individual had a usual source of care, and health care utilization was examined as the number of office-based visits (primary care, nonprimary care and overall) and use of preventive care services, such as getting a flu shot, checking blood pressure or cholesterol, having a breast examination, or having a pap smear, in the past 12 months.

The study found a significant impact of NP SOP regulations on health care utilization but no conclusive evidence of an impact on access to care. With regard to health care utilization, the study revealed four important findings. First, the study found no evidence that a larger supply of NPs alone had any effect on health care utilization. Second, granting prescriptive authority to NPs had a modest direct impact on health care utilization, increasing primary care and overall office-based visits by 3% among individuals who had at least one visit. Third, this impact was moderated by NP supply; specifically, the effect of full NP SOP regulation on increased health care utilization was greatest in states with a larger per capita supply of NPs, indicating that changes in both practice environment and provider supply may be necessary to produce the greatest impact on health care utilization. Finally, further subgroup analysis by insurance status indicated a trend in which the interactive effects of full NP SOP regulation together with larger NP supply on health care expenditure was only apparent for the uninsured group but not for the insured group.

Impact of State NP SOP Regulation on Health Care Costs

From a societal point of view, the cost of health care delivery includes many facets, such as compensation

for health care providers, unit price of health care services, health care utilization expenditures, and others. Four of the reviewed studies provided information on the impact of state NP SOP regulations on health care costs, including health care providers' income, office-based visit expenditures, and retail clinic costs.

Two studies that examined the effects of NP SOP regulation on health care providers' incomes arrived at partially inconsistent results. Dueker, Jacox, Kalist, and Spurr (2005) found that granting prescriptive authority to APRNs for controlled substances was associated with lower earnings for APRNs and physicians but higher earnings for PAs. Perry (2009) found that expanded SOP regulation granting greater prescriptive authority for controlled substances for NPs was associated with slightly higher earnings for NPs but lower earnings for physicians and PAs. The mixed findings might be explained, in part, by the different samples used in these studies. The study by Dueker et al. (2005) focused on a sample of APRNs that included NPs, certified registered nurse anesthetists, certified nurse-midwives, and clinical nurse specialists, whereas the study by Perry (2009) involved a sample consisting exclusively of NPs. Future studies are needed to better understand the impact of SOP regulation on health care providers' incomes and the mechanisms underlying this potential relationship.

According to conventional labor market theory, greater practice authority combined with increased NP supply should reduce office-based visit unit price by increasing market competition or improving productivity through effective collaboration. However, Stange (2014) found that the expansion of NP SOP regulation did not affect office-based visit price, which was measured as the total charges per visit. As explained by the author, this finding might be due to a noncompetitive primary care market in which current reimbursement-driven policies involve rigid price-setting, restrictions in NP service reimbursement, and incentives for physician involvement to bill at a higher rate. Alternatively, if health care demand is higher in states with full NP SOP regulations, then such regulatory changes in practice environment along with increased NP supply are less likely to affect office-based visit price, which was not examined in the study.

Spetz, Parente, Town, and Bazarko (2013) examined the economic impact of state SOP regulations in retail clinics where NPs provided primary care services. The authors evaluated a 14-day episode of health care use and costs that included both insurers' expenditures and patients' out-of-pocket payments for 10 of the most common clinical conditions across all health care settings. They found that the weighted average 14-day cost was \$543 per clinic visit in states with restrictive SOP regulations, \$484 in states with reduced SOP regulations, and \$509 in states with full SOP regulations. Consistent with expectations, retail clinic costs were highest in states with the most restrictive NP practice environments. However, the unexpected finding of

higher costs in states granting NPs both independent practice and prescription authority compared with states with only independent practice authority might have been due to the greater number of prescriptions (and concomitant higher cost) in states granting prescription authority to NPs.

Discussion

Synthesis of the extant literature reveals an emerging pattern regarding the potential impact of NP SOP regulation on health care delivery. States granting NPs greater SOP authority tend to exhibit (a) an increase in the number and growth of NPs through higher APRN educational enrollment and migration and (b) greater provision of primary care by NPs and expanded health care utilization, especially among rural and vulnerable populations. Research findings on the effects of full NP SOP regulation on health care costs are mixed.

Role of NP SOP Regulations in Health Care Delivery

State NP SOP regulations play a central role in NPs' care delivery. Our review indicates that a large supply of NPs alone does not appear to have an impact on health care utilization, only when combined with greater practice authority is the expansion of the NP workforce related to increases in health care utilization. The greater the supply of NPs, the stronger the effect of full NP SOP regulation on NP primary care provision and health care utilization. Thus, the evidence is consistent with the view that expanded NP practice regulation can impact health care delivery by increasing the number of NPs in combination with easing restrictions on their SOP. Under restrictive SOP regulations, NPs cannot function as independent providers, and requirements for collaboration or supervision by physicians limit how and where NPs can deliver care. One qualitative study that was conducted across six states with different types of NP SOP regulations provides illustrative insights (Yee, Boukus, Cross, & Samuel, 2013). The study found that NPs in states with reduced or restrictive SOP regulations performed the same types of primary care services as NPs in states with full SOP regulation. However, restrictive state regulations requiring physician collaboration and supervision created documentation requirements that restricted NPs to be geographically close to physicians, thereby limiting their choice of practice location. As physicians are more likely to be concentrated in urban/suburban settings and in non-Health Professional Shortage Areas (HPSAs), these restrictive regulations disproportionately impacted underserved and rural communities.

The current review does not lend any evidence supporting an association between NP SOP regulation and access to care, which is defined in one study as having a usual source of care among the general population. Several factors, which were not examined in

the reviewed study, may help explain this finding. First, research has shown that having a usual source of care is primarily dependent on health insurance status and ability to pay (DeVoe, Tillotson, & Wallace, 2009). Therefore, the effect of NP SOP regulation on having a usual source of care would most likely be moderated by health insurance status. Second, the effect of NP SOP regulation on having a usual source of care would likely be stronger in HPSAs where commensurate health facilities, such as community health centers, were available. Third, regardless of full SOP authority, NPs might not be listed in provider directories, thereby diminishing the public's awareness of the availability of care provision by NPs (Poghosyan et al., 2013). Fourth, access to care is a multidimensional concept that encompasses availability, accessibility, accommodation, affordability, and acceptability (Penchansky & Thomas, 1981). Dimensions of access to care other than usual source of care, such as appointment waiting time, might be more responsive to NP SOP regulation when the effect is assessed among the insured population.

Study results on the effects of NP SOP regulation on health care costs are inconclusive. One study reported substantial cost reductions in retail clinics in states with less restrictive regulations, whereas another study found no evidence that less restrictive NP SOP regulation was associated with a decrease in office-based visit price. The expected health care cost reductions afforded by the effective use of NPs in providing primary care can be obfuscated by a practice known as "incident billing," in which services provided by an NP under a physician's supervision can be billed exclusively under the physician's provider number and reimbursement rate.

Two recent simulation studies provide further insights on the potential economic impact of state NP SOP regulations. One study estimated the potential cost savings in primary care in Alabama and suggested that removing restrictions in NP/PA SOP regulations would result in net saving of more than \$729 million over a 10-year period from 2013 to 2022, which was in large part due to decreases in compensating expenditures per primary care visit (Hooker & Muchow, 2015). The other study assessed the economic impact of legislating full SOP regulations for APRNs in North Carolina and concluded that such legislation could increase the state's economic output, gross domestic product, and tax revenue (Conover & Richards, 2015).

Implications

An important implication for state policy makers and stakeholders is that the differential growth rates in the NP workforce between states with and without restrictive regulations could result in sizeable gaps in the number of NPs across states, which, in combination with changes to the regulatory environment, might translate into substantial state-level disparities in health care provision, utilization, and outcomes,

especially in rural and vulnerable population areas. Although existing evidence is limited on the effect of NP SOP regulation on access to care, the evidence is unequivocal with regard to increased health care utilization, including office-based visits and prescriptions filled. Although more research is needed on the impact of NP SOP regulation on lowering health care costs, one study has shown a reduction in retail clinic costs associated with such state legislation.

Our review identified several major gaps in extant literature that can inform future research. First, limited research has been conducted on the geographic distribution of NPs, nationally, in relation to vulnerable or medically underserved populations, and, importantly, the extent to which state NP SOP regulation affects this distribution. Although NPs tend to be more likely to serve in low-income, minority, and rural areas when compared with PCPs (Grumbach, Hart, Mertz, Coffman, & Palazzo, 2003), the distribution of NPs per capita in relation to vulnerable populations is not well understood. Understanding how the regulatory environment can influence the distribution of NPs in relation to vulnerable populations is critical for the development of effective health policy directives and levers to improve access to care and meet the growing demand for primary care among vulnerable populations. Second, research on the effect of SOP regulation on access to care and health care utilization should focus more on the groups and areas where demand for access to care and health care utilization is greatest, such as medically underserved populations or HPSAs. We currently do not know whether the observed increases in health care utilization (such as office visits and prescriptions) in states with full NP SOP regulations are reaching those with the greatest health care needs. Third, research is needed to examine the effect of SOP regulations on the role of NPs in team-based care, an approach that has been increasingly adopted to improve efficiency and effectiveness of primary care delivery. Initial evidence has indicated a potential link between full SOP regulations and improved team work (Poghosyan, Boyd, & Knutson, 2014).

Limitations

The findings of our review must be interpreted within the context of limitations. The number of studies examining the impact of state NP SOP regulation on care provision by NPs, access to care and health care utilization, and health care costs is small. More research is needed in these areas. In addition, reviewed studies on NP workforce did not specify NP clinical specialty (i.e., primary care or specialty care). Recent evidence has shown that at least half of NPs did not practice in primary care and instead were in specialty clinical fields (Spetz, Fraher, Li, & Bates, 2015; U.S. Department of Health and Human Services, Health Resources and Services Administration, & National Center for Health Workforce Analysis, 2014). To better understand the role of NPs in health care delivery, it is

important that future studies differentiate NP primary care and specialty care practice, thus providing more fine-tuned evidence to inform health care policy. Therefore, although a discernible pattern has emerged from the existing studies, more research is needed to replicate these results and to more fully explore factors, such as insurance status and NP service reimbursement policies, that might moderate the effects of NP SOP regulation on health care delivery.

Conclusion

In summary, our review of the available evidence revealed several consistent and promising patterns with regard to the potential impact of state NP SOP regulation on health care delivery. This evidence generally supports recommendations consistent with recent trends in which state legislatures have reduced restrictions on SOP regulations to provide a more independent NP practice environment as a viable and effective strategy to increase primary care capacity and health care utilization and potentially reduce costs (Gadbois, Miller, Tyler, & Intrator, 2015). This is especially critical for states that face substantial shortages of PCPs and increased care demand from rural and medically underserved communities.

Acknowledgments

The authors gratefully acknowledge funding from the National Council of State Boards of Nursing (Y.X., PI).

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