Research Report

The Impact of Establishing a Full Scope of Practice for Advanced Practice Registered Nurses in the State of Indiana

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Preface

As the U.S. health care system expands, demand for health care services could soon outpace the supply of care. One potential solution to this problem is to increase the number—and make better use—of advanced practice registered nurses (APRNs), a group that includes nurse practitioners, certified nurse midwives, certified registered nurse anesthetists, and clinical nurse specialists. However, scope-of-practice (SOP) regulations at the state level affect both the range of health care services that APRNs can deliver and the extent to which they can do so without physician supervision or collaboration. In the state of Indiana, APRNs are limited in their ability to diagnose and treat conditions and perform procedures independent of physician collaboration. For example, state regulations require that an APRN have a collaborative agreement in place with a physician to prescribe medication. This report examines the literature on the relationship between state APRN SOP regulations and provider supply, access, utilization, quality, and costs. We use the effect estimates from the literature to examine how allowing full prescription authority for APRNs in Indiana would affect health care delivery in the state. The goal of this report is to help legislators, professional associations, and other interested stakeholders (particularly those in the state of Indiana) better understand the potential effect of establishing full SOP for APRNs.

This work is sponsored by the Coalition of Advanced Practice Nurses of Indiana. RAND Health produced a very similar report for the Michigan Council of Nurse Practitioners (Martsolf and Kandrack, 2016). Much of this report is directly taken or adapted from that report. RAND Health is a division of the RAND Corporation, a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest. For more information on RAND Health, see www.rand.org/health or contact the director at RAND_Health@rand.org.

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Summary

For many policymakers and clinicians, an important strategy for meeting the growing demand for health care services in the United States is to make better use—and increase the number—of advanced practice registered nurses (APRNs). APRNs include nurse practitioners (NPs), certified nurse midwives, certified registered nurse anesthetists, and clinical nurse specialists. However, scope-of-practice (SOP) regulations at the state level, which govern the breadth of services that APRNs can independently provide, may affect not only the supply of APRNs but also their ability to meet patients' care needs. Legislators in Indiana are considering the expansion of SOP to include full prescriptive authority, but APRNs are currently required to have collaborative agreements with physicians to prescribe medications. Drawing on a prior literature review and a previously developed conceptual framework to guide the research (Martsolf and Kandrack, 2016), this report examines the literature related to the relationship between state APRN SOP regulations and health care delivery, and it estimates the effect on the state of Indiana if the legislature were to define a full SOP for APRNs. Based on estimates from the literature, we constructed estimates specific to Indiana of the effect of a full SOP for APRNs. Although the evidence from the small number of high-quality studies we identified was relatively limited overall and largely limited to NPs in particular, our review of the literature nonetheless demonstrates that allowing APRNs full SOP has the potential to improve access to care, utilization, and provider supply. Given the limitations in the evidence, however, we were unable to estimate the effect of APRN SOP across a wide range of health care domains or for APRNs other than NPs.

Abbreviations

ACS	ambulatory care sensitive
APRN	advanced practice registered nurse
BMI	body mass index
CAPNI	Coalition of Advanced Practice Nurses of Indiana
CNM	certified nurse midwives
CNS	clinical nurse specialists
CRNA	certified registered nurse anesthetists
ED	emergency department
MEPS	Medical Expenditure Panel Survey
NP	nurse practitioner
SOP	scope of practice

1. Introduction

As the U.S. health care system responds to an aging population, an increasing number of people living with chronic diseases, and an increasing number of people with access to health care coverage, many policymakers, clinicians, and researchers worry that demand for health care services could soon outpace the supply of care (Petterson et al., 2012). One strategy for addressing this problem is to expand the supply of and utilization of advanced practice registered nurses (APRNs). While APRN programs prepare graduates to independently diagnose and treat patients, as well as prescribe medications, tests, and procedures, scope-of-practice (SOP) regulations at the state level, which govern the breadth of services that APRNs can independently provide, may affect APRNs' ability to meet patients' care needs (Dower, Moore, and Langelier, 2013; Tolbert, 2013). In some states, these regulations place restrictions on the type of care that APRNs can actually provide. Advocates of SOP regulations have argued that they are necessary to ensure patient safety and high-quality care, but other policymakers have noted that SOP regulations for APRNs may limit the supply of health care services without appreciably affecting quality or outcomes of care (Dower, Moore, and Langelier, 2013). Since 2010, an increasing number of states have removed SOP restrictions, especially for nurse practitioners (NPs), with a nationwide trend toward allowing full practice and prescription authority, referred to here as *full SOP* (Tolbert, 2013). Full SOP allows APRNs to provide all aspects of care for which they were trained, including diagnosis, treatment, prescribing medications, and performing minor procedures.

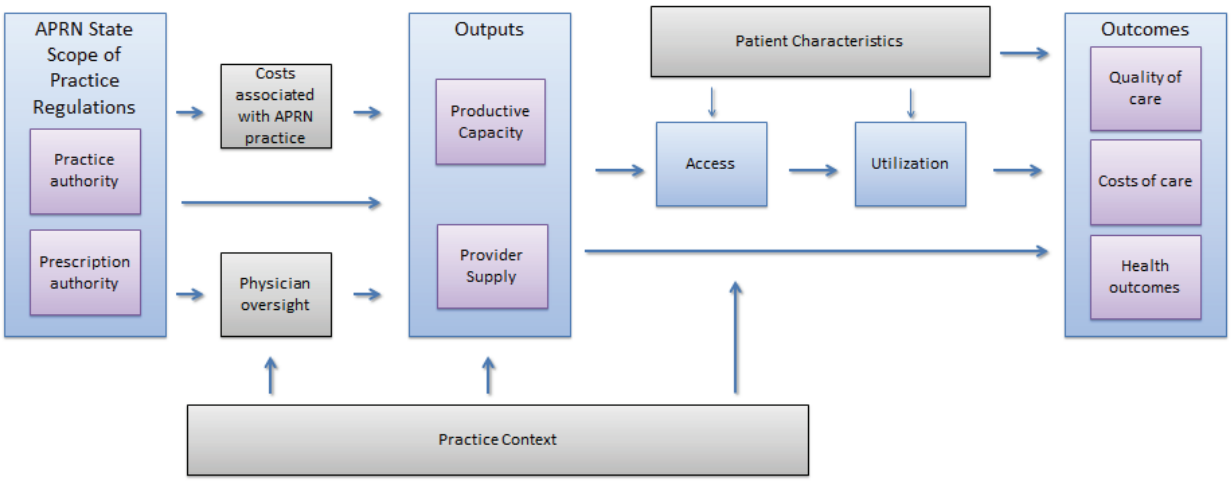
In the state of Indiana, APRNs are able to open their own practices and diagnose and treat patients. In order to prescribe medications, however, state law requires that APRNs have collaborative agreements in place with physicians. These collaborative agreements generally require that a physician review 5 percent of an APRN's prescriptions weekly; in exchange, APRNs must pay the collaborating physician an annual fee.

In recent years, the Indiana state legislature has considered allowing APRNs full practice and prescription authority. The Coalition of Advanced Practice Nurses of Indiana (CAPNI) commissioned RAND to study the potential effects of establishing full SOP for APRNs on provider supply, costs, access, and quality of care in the state of Indiana. CAPNI requested that we exclude certified registered nurse anesthetists (CRNAs) from our analysis because of differences in their SOP regulations and practice requirements. Using a conceptual framework previously developed by RAND and expanding a prior RAND review of literature (Martsolf and Kandrack, 2016), we used the effect sizes from the literature to estimate Indiana-specific effects if the state were to establish a full SOP for APRNs.

2. Conceptual Framework

In this chapter, we present a conceptual framework outlining the ways in which state APRN SOP regulations are most likely to affect the delivery of health care services in Indiana (Figure 2.1). First produced for a RAND report for the Michigan Council of Nurse Practitioners (Martsolf and Kandrack, 2016) that explored SOP regulations for NPs—and reproduced here for APRNs more generally—this framework provides an important conceptual foundation for examining the effects of granting full SOP to APRNs. The framework reflects factors that have been discussed in public policy debates and peer-reviewed literature (Yee et al., 2013, Martsolf, Auerbach, and Arifkhanova, 2015; Westat, 2015; Poghosyan, Boyd, and Clarke, 2016; Xue et al., 2016), and it focuses on patient outcomes, rather than provider outcomes such as burnout, job satisfaction, or turnover. We discuss the framework moving from left to right.

Figure 2.1. Conceptual Framework Diagram



State SOP regulations govern the procedures and actions that health care professionals are permitted to perform. These regulations establish the range of services that APRNs are allowed to provide, either autonomously or under the supervision of a physician. APRNs include CRNAs, NPs, certified nurse midwives (CNMs), and clinical nurse specialists (CNSs). CRNAs are master's- or doctoral-prepared registered nurses with advanced training in the delivery of anesthesia. (Again, because of differences in SOP regulations and practice requirements compared to other APRNs, CRNAs are excluded from consideration in this report.) NPs are master's- or doctoral-prepared registered nurses with advanced training in diagnosis and treatment of conditions and prescription of medications. CNMs are master's- or doctoral-prepared registered nurses with advanced training in the area of women's health care, including

birth-related services and family planning, along with well-woman and menopausal care. CNSs are master's- or doctoral-prepared nurses in specialized areas of nursing practice who provide direct patient care, act as consultants to hospitals' nursing staff, and participate in quality-improvement initiatives. Increasingly, CNSs provide direct patient care, including diagnosis, management, and prescribing.

SOP regulations specify the degree of prescription and/or practice authority granted to APRNs (National Conference of State Legislatures, 2013; Yee et al., 2013). Prescription authority refers to the extent to which an APRN can prescribe medications independent of a supervising or collaborating physician. Prescription authority can vary from medication to medication. For example, some states give NPs general prescriptive authority but do not allow them to prescribe narcotics without physician supervision or sign-off (Barton Associates, 2015). Practice authority refers to the extent to which APRNs can diagnose and treat patients independent of a supervising or collaborating physician. Practice authority can be limited in a number of ways: Some states require NPs to have collaborative agreements with physicians to review diagnoses and treatments and to provide consultations; some prohibit NPs from ordering physical therapy or signing death certificates; others allow NPs to sign handicap parking permits but not order physical therapy (Barton Associates, 2015). *Full SOP* is defined as placing no restrictions on either practice or prescription authority.

As stated in Chapter 1, while APRNs in Indiana are able to open their own practices and diagnose and treat patients, they are required by state law to have a collaborative agreement in place with a physician to prescribe medications. These collaborative agreements generally require that a physician review 5 percent of an APRN's prescriptions weekly; in exchange, most APRNs must pay the collaborating physician an annual fee.

One way to understand the effect of APRN SOP regulations on the delivery of health care services is to look at how they alter two "outputs": productive capacity and provider supply. *Productive capacity* refers to the number, types, and appropriateness of services that an individual APRN might produce,[1] holding constant all other production "inputs"—that is, other labor, such as registered nurses and medical doctors, or structural characteristics of practice settings, such as health information technology and care managers (Nicholson, 2005). Productive capacity is determined by the general characteristics of an APRN's clinical practice, including how quickly patients are seen, access to organizational resources, the types of patient care delivered, and the skill with which that care is delivered. We distinguish between the "potential" number, types, and appropriateness of services delivered (productive capacity) and the "realized" services actually received by patients. *Provider supply* refers to the number of providers, the number of clinical hours worked, and provider practice roles.

[1] We use the term *productive capacity* similarly to the term *marginal productivity*, which is more commonly used in economic theory.

State APRN SOP regulations can alter productive capacity and provider supply either directly—when they prohibit APRNs from performing certain activities, even under the supervision of a physician—or indirectly, through the extent to which they affect physician oversight of APRN practice (that is, requiring collaborative agreements or a physician's signature for prescriptions) or the costs associated with APRN practice. An important factor in the relationship between APRN SOP regulations and physician oversight is practice context. While health care organizations cannot expand state SOP regulations, they do have the freedom to modify—or restrict—them. For example, even if state SOP regulations allow CNMs to deliver babies without a supervising physician, a specific health care organization can mandate that its own CNMs perform deliveries under direct physician supervision. This means that even though state SOP regulations may change, changes in realized services delivered to patients still depend on the contextual characteristics of the specific settings in which APRNs practice.

Waiting for physician approval can increase the amount of time it takes APRNs to complete tasks, thus potentially reducing the number of services that APRNs can provide. Many stakeholders argue that because physicians have more experience, education, and skill than APRNs, physician oversight has a positive influence on the types and appropriateness of services that APRNs provide and ensures that APRNs deliver safe and effective care (French et al., 2011; Bodenheimer and Smith, 2013).

APRN SOP regulations also can affect provider supply insofar as they affect the costs associated with APRN practice. We distinguish between monetary costs incurred by health care organizations and costs incurred by APRNs themselves. SOP regulations that increase an organization's administrative burden by requiring the supervision of APRNs are likely to increase an organization's administrative costs as well. And more restrictive SOP regulations are likely to incur significant monetary costs for APRNs. For example, collaborative agreements between APRNs and physicians are expensive to establish and maintain, and they require a significant time investment by both APRNs and physicians. If an agreement is unexpectedly terminated, APRNs experience practice disruptions and then must incur further costs to establish a new collaboration (Westat, 2015). When monetary costs increase, the supply of APRNs is likely to decrease: Organizations may decide either not to hire APRNs or to have them work fewer hours, while APRNs may decide to relocate to a state with full SOP or to work fewer hours (Westat, 2015). Restrictive SOP regulations may also incur "psychic costs" for APRNs, whether from the stress of trying to find collaborative physicians or from the loss of quality of life as a result of not being able to practice to the full extent of one's abilities (Herzog and Schlottmann, 1981). Similarly, when psychic costs increase, APRNs may decide to relocate to a state with full SOP, or to work fewer hours.

The effect of SOP regulations on the productive capacity of APRNs and on the number and availability of APRNs can, in turn, have an effect on patients' ability to access care. Access to care—defined as the "ease with which an individual can obtain needed medical services" (RAND Corporation, undated)—can be measured by the geographic distribution of providers, as

well as by patient reports of their ability to access health care resources. Access to care, in combination with patients' clinical and sociodemographic characteristics, directly influences utilization of care, though utilization can be favorable or unfavorable, depending on whether APRN practice reflects or contributes to high-quality care. An ambulatory care sensitive (ACS) emergency department (ED) visit, or a cesarean section, could be considered unfavorable utilization, and a reflection of the fact that the patient did not have access to high-quality primary care or prenatal care. The characteristics of patient utilization contribute to various outcomes: quality of care, or care that is safe, effective, patient-centered, timely, efficient, and equitable (Agency for Healthcare Research and Quality, 2016); cost of care, or the amount of money paid by payers (for example, health insurance companies, patients) to health care providers and organizations in exchange for care delivered; and a patient's health status resulting from health care (Agency for Healthcare Research and Quality, 2015). Patients' clinical and sociodemographic characteristics are additional factors that contribute to these outcomes. APRNs' productive capacity also can directly affect outcomes that are not mediated by the access-utilization pathway. And, insofar as SOP regulations influence the type and appropriateness of services that APRNs provide, quality, outcomes, and costs could be affected. Finally, practice context plays an important role in terms of how, and to what extent, productive capacity and provider supply directly affect outcomes. Contextual factors include structural and organizational characteristics of practices—for example, health information technology and other labor inputs, collegial relations, etc. (Friedberg et al., 2009)—as well as the APRN work environment; that is, APRNs' specific roles within an organization, their access to organizational resources, their relationships with physicians and administrators, or how the APRN role is promoted within a practice.

3. Literature Review

In this chapter, we review the literature related to the relationship between state SOP regulations and the delivery of health care services. We summarize the methods used to conduct the literature review—initially conducted by RAND for the Michigan Council of Nurse Practitioners and reproduced here but updated to include recently published studies and expanded to include other APRNs besides NPs—and we present our findings from the reviewed studies (Martsolf and Kandrack, 2016).

Methods

To help identify databases and search terms, we consulted a research librarian who specializes in public policy analysis. We searched the PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Scopus databases for relevant studies published in English from the inception of each database (1959 for PubMed, 1937 for CINAHL, and 1966 for Scopus) through November 2, 2016. To retrieve the broadest set of studies possible, we used broad search terms (scope AND practice AND nurs*), as well as APRN-specific search terms ("certified nurse midwife," "clinical nurse specialist," and "advanced practice registered nurse").

This search strategy yielded 2,068 abstracts. We also identified eight abstracts from previous literature summaries that were not identified through our initial search, for a total of 2,076 abstracts. Both authors reviewed all titles and, once we had concordance, we eliminated 1,588 studies that were not conducted in the United States, not related to APRNs, not related to state SOP regulations, or duplicates. We then performed a full review of the remaining 488 abstracts and eliminated additional studies based on the same criteria, as well as studies that were not empirical—including commentaries, reviews, theoretical discussions, and literature reviews. This led to the elimination of 454 abstracts. Of the remaining 34 full-text articles, we eliminated 14 studies based on the criteria listed above, as well as qualitative studies, for a final count of 20 studies. (See Appendix A for a flow diagram of this entire process.) One author then extracted key information from each study, including aims, data sources, population studied, variables of interest, analytic methods, and results. To ensure its accuracy, this data extraction work was reviewed by the other author. (See Table B.1 in Appendix B for descriptions of how studies defined or identified the APRNs, how they defined and contrasted states' SOP regulations, and their data and study design and list of relevant outcomes.)

We summarized each study across three quality dimensions: recency of data used, generalizability of findings, and risk of bias in their estimates (see Appendix C). Studies that used longitudinal data and regression adjustment generally had the lowest risk of bias, while

cross-sectional designs and studies that did not use any methods for adjustment had the highest risk of bias.

Using the conceptual framework, we categorized each of the 20 studies based on the following outcomes of interest: provider supply, access, utilization, quality, costs, and patient outcomes. Studies that assessed more than one outcome of interest are included in multiple sections of this report. For each outcome of interest, we summarized the results across all applicable studies. Some studies estimated models based on different methodological assumptions and for multiple years after the implementation of a full SOP. We chose estimates drawn from the highest-quality models and results (see Appendix D). None of the studies estimated the relationship between SOP regulations and measures of dimensions of health care quality other than patient experience, such as adherence to evidence-based practice.

Finally, we summarize the evidence across all studies for each outcome of interest. As in previous studies (Martsolf, Auerbach, and Arifkhanova, 2015; Martsolf and Kandrack, 2016), we characterize the positive effect of full SOP on each outcome of interest as likely, possible, or inconclusive (Table 3.1). *Likely* indicates that theory and all or most empirical studies support an effect in the same direction; *possible* indicates that evidence is weak or suggestive but generally in the same direction; *inconclusive* indicates that some of the evidence would suggest an increase, while other evidence would suggest a decrease, and there is not enough evidence to suggest an overall effect.

Results

Most of the 20 studies focused solely on NPs (ten studies), while four focused solely on CNMs and six focused on APRNs generally (that is, NPs, CNMs, CNSs, CRNAs combined). The studies used data collected between 1988 and 2013. Fourteen studies used data through at least 2004, while three used data from the late 1980s to mid-1990s. All of the studies drew on national datasets or nationally representative datasets. Eight studies used a longitudinal design with some control for unobserved confounders, one used a longitudinal design but did not account for important unobserved confounders, six used a cross-sectional design with regression adjustment for observable confounders, and five used a cross-sectional design with no controls for any confounders. Studies that used longitudinal data and attempted to control for unobserved confounders had the lowest risk of bias; studies with cross-sectional designs and studies that did not use any methods for adjustment had the highest risk of bias. Five studies attempted to control for unobservable state characteristics but used very crude methods for measuring APRN supply, measuring any registered nurse with a graduate degree or all APRNs together (that is, NPs, CNMs, CRNAs, and CNSs).

The 11 cross-sectional studies compared states that have full SOP (prescriptive and/or practice authority) with states that have limited SOP. In those studies, depending on the approach to measuring SOP regulations, anywhere from ten to 17 states, most of which were in the west

and northeast, had full SOP. In the nine longitudinal studies, the effect estimates were based on within-state changes in prescriptive and/or practice authority over the course of the study. Of the studies that reported the number of states that experienced changes in authority, six to eight increased authority over the course of the study. One study focused on changes in prescriptive authority for controlled substances only. In this study, 30 states increased authority. Again, states that changed prescriptive and/or practice authority over the course of the studies were often in the west or northeast. Eleven of the studies used both practice and prescription authority as a measure of full SOP, while five used prescription authority alone, three used prescription authority and direct reimbursement, and one used practice authority and direct reimbursement. Most studies used either a binary measure of SOP (full vs. not full) or a three-level measure (full, reduced, restricted). However, some studies created their own categorizations. For example, Kuo et al. (2013) created a five-level variable that scored states on patient access to NPs. Declercq et al. (1998) created a scale that rated states on their regulatory support for CNMs based on their ability to write prescriptions, bill independently, and the extent to which CNMs provided input to their regulatory board. Markowitz et al. (2016) conceptualized "barriers" to full autonomy on a scale of no, low (collaborative agreement), moderate (written protocol required in addition to collaborative agreement), and high barriers (direct physician supervision required). Sekscenski et al. (1994) created a 100-point scoring mechanism for state practice environment, where a higher score indicated more authority and legal status.

Fourteen studies examined the relationship between SOP and provider supply, one examined the relationship between SOP and access, four examined the relationship between SOP and utilization, four examined the relationship between SOP and costs, one examined the relationship between SOP and patient experience, and four examined the relationship between SOP and patient outcomes. Two of the highest-quality studies were National Bureau of Economic Research working papers not currently in a peer-reviewed journal (Traczynski and Udalova, 2014; Markowitz et al., 2016). (See Table 3.1 for a high-level summary of the results of the studies across each domain and Appendix E for a detailed results summary table.)

Table 3.1. Results of Establishing Full Scope-of-Practice Laws for Advanced Practice Registered Nurses

Aspect of Care	Overall Effect	Summary of the Evidence
Provider supply	Possible improvement	We found positive associations between full SOP for APRNs and provider counts in a plurality of the studies we reviewed. While this suggests that full APRN SOP may lead to higher levels of provider supply, the vast majority of these studies, although based on national samples, used cross-sectional analyses. As a result, we cannot conclusively determine a causal relationship between APRN SOP regulations and supply. We can, however, characterize the positive effect of establishing full APRN SOP on provider supply as "possible." There is also some evidence that NPs may be more likely to work in direct primary care in states with full SOP, and that states with full practice and prescription authority for CNMs have more CNM-attended births. But again, these studies are limited and based on cross-sectional designs.
Access	Possible improvement	The sole study examining the relationship between NP SOP regulations and access to care found that residents in states with full NP SOP tended to have better access to care, which suggests that establishing full NP SOP could improve access to care. However, the evidence remains relatively weak because it is drawn from a single study, albeit one with a strong design and relatively recent national data. More evidence is needed to fully understand the effect of NP SOP on access to care.
Utilization	Possible improvement	Four studies found some relationship between SOP regulation and utilization. Two, both using strong research designs based on relatively recent national data, found that less-restrictive SOP regulations led to increases in ambulatory utilization. A third study, which was cross-sectional but did use regression techniques in an attempt to control for bias, found more CNM ambulatory visits in states that grant a higher degree of regulatory support for CNMs. However, this study did not find an increase in ambulatory visits overall; the increase in CNM visits may have been a replacement for physician visits. Two studies showed that establishing liberal SOP for APRNs could reduce inpatient utilization, which may be characterized as "unfavorable" utilization. One study of high quality and drawn from national data found a reduction in ACS ED visits after states had established full SOP. A second study found reductions in hospitalizations. This second study, however, made little attempt to control for bias. Taken together, these four studies suggest that granting full SOP for APRNs might increase ambulatory utilization and reduce unfavorable utilization. The evidence remains relatively limited, however.
Costs	Inconclusive	We found mixed relationships between APRN SOP and costs of care. One high-quality national study found no effect of NP SOP on total costs; two other national studies found that some components of costs (that is, NP wages) were lower in states with less-restrictive SOP regulations; another study found lower wages among APRNs in states with expanded SOP. One found that well-child visit prices were no different in states with less restrictive SOP regulations, while another found no effect on outpatient charges. Overall, the effects of APRN SOP on costs were largely inconclusive.
Quality of care	Possible improvement (patient experience)	One high-quality national study found significant improvements across a number of patient-experience measures following full NP SOP expansion, but no other studies assessed other dimensions of health care quality.
Health outcomes	Inconclusive	Findings on the relationship between SOP regulations and patient outcomes were mixed. One national study found inconsistent improvements in BMI and self-reported health status after states expanded their NP SOP regulations. One national study, which was of relatively high quality, found no relationship between NP SOP regulations and infant mortality. One high-quality study found mixed effects of expanded SOP for CNMs on prenatal and birth outcomes: Some outcomes improved, some got worse, and other stayed the same. These findings do not conclusively demonstrate that establishing full SOP for NPs or CNMs will improve patient outcomes.

NOTES: *Likely* indicates that theory and all or most empirical studies support an effect in the same direction. *Possible* indicates that evidence is weak or suggestive or studies are limited, but generally in the same direction. *Inconclusive* indicates that some of the evidence would suggest an increase while others would suggest a decrease and there is not enough evidence to suggest an overall effect.

Provider Supply

In the 14 studies that examined the relationship between SOP regulations and APRN supply, "provider supply" was operationalized as the number of providers in a given geographic area, hours worked, or provider roles. Provider roles referred to employment of providers in specific types of practices (for example, primary care), the use of NPs as primary care providers, or the likelihood that CNMs attend births. Eight of these 14 studies were cross-sectional. Two of the six longitudinal studies were of relatively high quality (Perry, 2012; Markowitz et al., 2016), one calculated only simple correlations (Declercq et al., 1998), two used broad measures of APRNs that include any registered nurse with an advanced degree other than a doctorate (Kalist and Spurr, 2004) or any advanced degree (Kleiner et al., 2016), and one did not account for a significant potential source of bias (Kuo et al., 2013). We considered the Kuo study weak because it does not control for "incident-to" billing, which is a billing practice, especially in Medicare, wherein NPs provide services but bill under the physician identification number. Incident-to billing is likely more prevalent in states with more-limited SOP (Auerbach, 2013). Twelve of the 14 studies that examined the relationship between SOP regulations and APRN supply attempted to control for other factors through regression adjustment, while two presented only simple bivariate correlations.

Number of providers. Nine studies examined the relationship between SOP regulations and provider counts. Graves et al. (2016) found that states with full SOP (practice and prescription) had 25 percent more NPs, while Reagan and Salsberry (2013) found 27 percent more NPs in states that allowed full practice and prescription authority. Kuo et al. (2013) found an additional 18 NPs per 100,000 population in states with moderate SOP regulations compared with states with full SOP. Lin, Burns, and Nochajski (1997) found no effect on NP counts in states that allow full practice authority and direct reimbursement, while Sekenscenski et al. (1994) found more NPs in states with higher levels of SOP on a 100-point scale but did not report effect sizes. Graves et al. (2016) found that full NP SOP was also correlated with fewer physicians and more physician assistants. Although Perry (2012) did not directly investigate provider counts, this study did indicate that NPs were 46 percent less likely to move out of states that allow full prescription authority and direct reimbursement. Finally, although not directly applicable to provider counts, Kalist and Spurr (2004) found that states with full prescription authority have 12-percent higher enrollment per capita in APRN programs. Two studies focused on CNM supply: Declercq et al. (1998) found 34 percent more CNMs per 100,000 female population in states with a higher level of regulatory support for CNMs, and Markowitz et al. (2016) found no difference in CNM supply following SOP expansion.

Hours worked. Only one study assessed the relationship between SOP regulations and the number of hours worked. Kleiner et al. (2016) found that NPs in states that allowed full prescription authority worked 4 percent more hours on average per year. This study also found that allowing full prescription authority had no effect on hours worked by physicians. However,

this study defined NPs as any registered nurse with an advanced degree (that is, master's, doctorate, or professional degree), so it is difficult to determine the magnitude of the effect specifically for NPs.

Provider roles. Six studies examined the relationship between SOP and provider roles. Kuo et al. (2013), in a relatively weak study, found a 156-percent increase in the use of NPs as primary care providers over a ten-year time frame. (As already noted, we consider the Kuo study weak because it does not control for "incident-to" billing.) Therefore, the growth of NPs as primary care providers may be a billing artifact as opposed to any fundamental change in practice or access to NPs. A report by Westat (2015) found that NPs were 3 percentage points more likely to work in direct patient care, and no more likely to work in primary care, in states with full SOP (both practice and prescription authority) compared with states that had reduced SOP. Ku et al. (2015) found that states with full practice and prescription authority had 2 percent more advanced practice staff (NPs, physician assistants, and CNMs) in community health centers and 2 percent fewer physicians. We cannot determine the specific effect for any particular APRN (NPs and CNMs) in this study because all APRNs were combined with other advanced practice clinical staff (for example, physician assistants). Three studies specifically examined the relationship between SOP and CNM roles. Adams, Ekelund, and Jackson (2003) found no relationship between full prescription authority and the number of CNM deliveries, but they found a 109-percent increase in the number of CNM deliveries when states allow independent practice. Declercq et al. (1998) found 44 percent more CNM-attended births in states with a high level of regulatory support for CNMs than in those with a moderate level of support. Kozhimannil, Henning-Smith, and Hung (2016) found that rural and critical access hospitals were 47 percent more likely to have CNMs attending births in states that allow fully autonomous practice than in those that require a collaborative agreement.

Summary. We found positive associations between full SOP for APRNs and provider counts in a plurality of the studies we reviewed. While this suggests that full APRN SOP may lead to higher levels of provider supply, the vast majority of these studies, although based on national samples, used cross-sectional analyses. As a result, we cannot conclusively determine a causal relationship between APRN SOP regulations and supply. We can, however, characterize the positive effect of establishing full APRN SOP on provider supply as "possible." There is also some evidence that NPs may be more likely to work in direct primary care in states with full SOP, and that states with full practice and prescription authority for CNMs have more CNM-attended births. But again, these studies are limited and based on cross-sectional designs.

Access

Only one study examined the relationship between state SOP regulations and access to care, as measured by patient self-report. Traczynski and Udalova (2014), in a strong longitudinal study, found higher levels of patient-reported access to care in states with full practice and prescription authority for NPs than in states with restricted authority. Depending on the

observation period after changes to SOP regulations and the population studied (that is, adults or children), residents in states with full SOP were 7 to 24 percentage points more likely to report the highest levels of access. (Access was measured by being able to get an appointment when needed, being able to get care when needed, and having acceptable travel times to receive care.) Generally, the effects were larger in magnitude for children.

Summary. The sole study examining the relationship between NP SOP regulations and access to care found that residents in states with full NP SOP tended to have better access to care. These findings suggest that establishing full state NP SOP could improve access to care. However, the evidence remains relatively weak because it is drawn from a single study, albeit one with a strong design and relatively recent national data. More evidence is needed to fully understand the effect of NP SOP on access to care.

Utilization

Four studies examined the relationship between SOP regulations and utilization. We separated our results into ambulatory, inpatient, and prescription utilization. Two studies (Stange, 2014; Traczynski and Udalova, 2014) used strong longitudinal research designs with regression adjustments, while the other two studies (Declercq et al., 1998; Oliver et al., 2014) calculated simple correlations.

Ambulatory utilization. Three focused on the effect of SOP regulations on the number of ambulatory provider visits. These studies identified higher utilization of ambulatory care in states with full SOP. Stange (2014) found that individuals in states with less-restrictive prescriptive authority regulations had 3 percent more visits conditional on having at least one office-based provider. Traczynski and Udalova (2014) found that individuals in states with full SOP (both practice and prescription authority) had a higher probability of receiving a routine check-up by 3.9 to 6.8 percentage points. Declercq et al. (1998) found 39 percent more CNM visits per 10,000 female population in states with high regulatory support than in states with moderate support.

Inpatient utilization. Three studies focused on the relationship between state NP SOP regulations and inpatient utilization, including hospital admissions, readmissions, and ED visits. Traczynski and Udalova (2014) found no difference in overall ED visits but a reduction of 12 to 14 percent in ACS ED visits after states established full NP SOP (both practice and prescription authority). ACS ED visits are those that might have been avoided through better ambulatory care. Oliver at al. (2014) found that states with full (both practice and prescription) NP SOP had 33-percent lower hospitalization rates for Medicare and Medicaid beneficiaries than states with more-restrictive NP SOP regulations. This study also showed 10-percent lower 30-day hospital readmissions rates from rehabilitation facilities, as well as a 30-percent reduction in annual hospitalizations of nursing home patients in states with full NP SOP (both practice and prescription). It is important to note, however, that Oliver et al. (2014) employed very little control for differences across states that may have influenced hospital utilization independent of

SOP regulations. Finally, Markowitz et al. (2016) found that expanding SOP for CNMs had no effect on rates of induction or cesarean sections for mothers.

Prescription utilization. One study focused on the relationship between APRN SOP and prescribing rates. In a cross-sectional analysis, Schirle and McCabe (2016) found that states with full prescriptive authority for APRNs had 21-percent lower opioid prescription rates and 31-percent lower benzodiazepine prescription rates

Summary of the evidence. All four of these studies found some relationship between SOP regulation and utilization. Two of the studies, both using strong research designs based on relatively recent national data, found that less-restrictive SOP regulations led to increases in ambulatory utilization. A third study, which was cross-sectional but used regression techniques in an attempt to control for bias, found more CNM ambulatory visits in states that grant a higher degree of regulatory support for CNMs. This study did not, however, find an increase in ambulatory visits overall; the increase in CNM visits may have been a replacement for physician visits. Two studies showed that establishing liberal SOP for APRNs might reduce inpatient utilization, which may be characterized as "unfavorable" utilization. One study, of high quality and drawn from national data, found a reduction in ACS ED visits after states had established full SOP. A second study found reductions in hospitalizations, although this one made little attempt to control for bias. Taken together, these four studies suggest that granting full SOP for APRNs could increase ambulatory utilization and reduce unfavorable utilization. The evidence, however, remains relatively limited.

Costs

There were four studies that examined the relationship between SOP regulations and the costs of care, or components thereof. Following our conceptual framework, we differentiated between costs associated with APRN practice and costs of care. Two studies (Perry, 2012; Stange, 2014) used strong longitudinal research designs and relatively recent data. One study (Kleiner et al., 2016) used a strong research design but a very broad measure of APRNs—essentially any registered nurse that held a graduate or professional degree. The fourth study (Dueker et al., 2005) used a strong longitudinal research design with regression adjustment, but also used a very broad measure of APRNs—any registered nurse with a master's or professional degree.

Costs associated with APRN practice. Three studies investigated the relationship between SOP regulations and wages of APRNs and other providers—that is, physicians. These studies showed that NPs in states with full prescription authority earn up to 1.6 percent more than NPs practicing in states with more-restrictive SOPs. The relationship between NP SOP and physician salaries was mixed. Perry (2009) found physician wages were 7 percent lower in states with full NP SOP, while Kleiner et al. (2016) found no relationship between physician wages and prescription authority. Kleiner et al. also examined the relationship between NP SOP and malpractice insurance rates but found no relationship. Dueker et al. (2005) found APRN wages

were 21 percent lower and physician assistant wages were 36 percent higher in states with full prescriptive authority.

Costs of care. Two studies investigated the effect of NP SOP regulations on unit prices (or charges) for office visits for either well-child visits or general office visits. Kleiner et al. (2016) found no difference in the price for well-child visits in states with full prescription authority, while Stange (2014) found no effect of full prescription authority on charges for outpatient visits. Stange focused on total health care costs and found that SOP regulations for prescription authority had little or no effect on total costs of care.

Summary. We found mixed relationships between APRN SOP and costs of care. One high-quality national study found no effect of NP SOP on total costs; two other national studies found that some components of costs (that is, NP wages) were lower in states with less-restrictive SOP regulations; and another study found lower wages among APRNs in states with expanded SOP. One found that well-child visit prices were no different in states with less-restrictive SOP regulations, while another found no effect on outpatient charges. Overall, the effects of APRN SOP on costs were largely inconclusive.

Quality of Care: Patient Experience

One study focused on patient experience with care, but no other studies assessed any other dimension of quality of care. In a longitudinal national study, Traczynski and Udalova (2014) investigated the relationship between state NP SOP regulations and patient experience with care. This study found that when states expanded NP SOP (practice and prescription authority), scores on patient-experience measures rose compared with states that did not expand SOP; this included ratings of time spent with a provider, whether the provider listened carefully, and whether the provider explained clearly. Adults in states with full NP SOP reported higher levels on two of three measures—with an increase of 8.8–8.9 percentage points in the probability of reporting that providers listened carefully, and an increase of 7.4–8.5 percentage points in the probability of reporting that providers explained things clearly. Caregivers of children reported higher levels on all three measures, with an increase of 12.4–18.9 percentage points in reporting that providers spent enough time with them, an increase of 9.2–15.3 percentage points in reporting that providers listened carefully, and an increase of 10.2–13.5 percentage points in reporting that providers explained carefully.

Summary. One high-quality national study found significant improvements across a number of patient-experience measures following full NP SOP expansion, but no other studies assessed other dimensions of health care quality.

Health Outcomes

Three studies examined the relationship between SOP regulations and other patient outcomes, such as infant outcomes, health status, body mass index (BMI), and maternal health behaviors and perinatal outcomes. All three studies used strong longitudinal research designs

with regression adjustment. Two (Traczynski and Udalova, 2014; Kleiner et al., 2016) focused on NP SOP while Markowitz et al. (2016) focused on CNM SOP.

Traczynski and Udalova (2014) found that adults reported improved health status and decreased BMI after states granted full NP practice and prescription authority, although these associations are not consistently significant across various estimation models. Kleiner et al. (2016) found no relationship between NP prescription authority regulations and infant mortality rates. Markowitz et al. (2016) found that in states with low SOP barriers, mothers who had a CNM attend their delivery were 2 percent more likely to drink during pregnancy. They found no effect of changes in SOP on receipt of prenatal care, smoking during pregnancy, or adequate weight gain. They found that moving from low to no SOP restrictions increased both average birth weight, by about 8 grams, and gestation period, by about half a day—both of these findings suggests an effect on prenatal care in states where CNMs have no barriers. They also found no effect on the likelihood of injuries to the infant at birth.

Summary. Findings on the relationship between SOP regulations and patient outcomes were mixed. One national study found inconsistent improvements in BMI and self-reported health status after states expanded their NP SOP regulations. One national study of relatively high quality found no relationship between NP SOP regulations and infant mortality. One high-quality study found mixed effects of expanded SOP for CNMs on prenatal and birth outcomes: Some outcomes improved, some got worse, and other stayed the same. These findings do not conclusively demonstrate that establishing full SOP for NPs or CNMs will improve patient outcomes.

Summary of Evidence

Evidence of the relationship between APRN SOP regulations and specific aspects of health care delivery is relatively limited, both in terms of the number and quality of the studies. Furthermore, most of the evidence is limited to the effect of SOP regulations on NP practice. Of the 20 studies we identified, only eight used longitudinal research designs with control for confounders—all of these studies were based on national data sets. The cross-sectional studies we examined were based on comparisons of a large number of states with different levels of SOP regulations. The longitudinal studies, however, were based on a relatively small number of states where SOP regulations changed over a relatively long time horizon. The states with less restrictive SOP regulations were most often located in the northeast and west. Because the studies we examined used varying definitions of full SOP and focused primarily on NPs, it is difficult to assess the extent to which our findings are fully generalizable to Indiana. But taken together, these available studies (despite their limitations) suggest that granting APRNs full SOP might contribute to improvements in provider supply, access, utilization, and patient experience with care. Our findings on the effect of full APRN SOP on costs and health outcomes were largely inconclusive. None of the studies we reviewed estimated the effect of APRN SOP regulations on a dimension of quality of care other than patient experience.

4. Indiana-Specific Effect

In this chapter, we use the results from the literature review to estimate how full SOP for APRNs would affect the delivery of health care services in the state of Indiana. Again, this section is largely reproduced from the report to the Michigan Council of Nurse Practitioners but uses data specific to Indiana to generate effect estimates.

Methods

To estimate Indiana-specific results if the state were to define a full SOP for APRNs, we applied the effect sizes from the literature to publicly available population data for Indiana and national data related to access, utilization, and patient experience. It is important to note that the effect sizes in the literature were generally drawn from national samples (that is, data from all or nearly all states). As a result, our estimates for the state of Indiana are not exact estimates of the effect of SOP changes on the outcomes of interest. However, if we assume that the effects in Indiana would be similar to those observed in other states, we can produce reasonable Indiana-specific estimates. As noted in the literature review section, we compare states that have no SOP restrictions with states where SOP regulations most closely resemble Indiana's, based on the authors' descriptions of how they measured SOP regulations.

Given the degree of uncertainty about the potential effects of granting full APRN SOP in Indiana, we have erred on the side of conservatism in our estimates. To this end, we only estimated effects from longitudinal studies that use the highest-quality evaluation methods, adequate approaches to control for confounding, and relatively recent data. We are most confident in studies that meet these criteria. We constructed 95-percent confidence intervals around the published estimates of how SOP affects outcomes of interest based on the reported standard errors on effect estimates. To do so, we multiplied the 1.96 test statistic by the reported standard errors corresponding to each significant effect estimate and subtracted that value from the mean to get the lower limit or added that value from the mean to get the upper limit.

This approach assumes the 95-percent confidence area under a normally distributed curve. We only calculated Indiana-specific effects for statistically significant results in the literature with a p-value of less than 0.05. In cases where a study used various methods or measures (for example, regression models with or without county fixed effects), we selected results only from those deemed the highest quality and most robust (see Appendix D for more detail). Finally, we calculated Indiana-specific effects only when we were able to access publicly available data sources. We did not calculate effects on health care status and BMI based on Traczynski and Udalova (2014) because the data needed to do so are only available in restricted-access Medical Expenditure Panel Survey (MEPS) files. While these inclusion criteria limit the number of

results we are able to calculate for Indiana, they also ensure that the results we do calculate are those in which we are most confident.

Ultimately, only four studies met our eligibility criteria (Perry, 2009; Perry, 2012; Stange, 2014; Traczynski and Udalova, 2014). Two of these studies were included in a previous report for the state of Michigan; here, the effect sizes are smaller primarily because the population in Indiana is smaller. We have added two other studies to this report. With regard to the excluded studies, three longitudinal studies (Kalist and Spurr, 2004; Dueker et al., 2005; Kleiner et al., 2016) used extremely broad measures of APRNs by counting all registered nurses with a master's or professional degree: it is impossible to say with confidence that this measure truly represents APRNs. Moreover, it does not allow us to isolate the effect for any particular APRN type. While the study by Kuo et al. (2013) is longitudinal, includes regression adjustment, and uses relatively recent data, the authors do not control for "incident-to" billing, which we believe is a significant source of bias (see Chapter 3), and likely overestimates the use of NPs. Therefore, we do not consider this study. One additional study would have been included (Markowitz et al., 2016) but there is no public data available to extrapolate their findings to the state of Indiana.

Because of a lack of state-specific data, many of the Indiana-specific variables had to be estimated. For example, many of the databases used in the studies do not include publicly available data at the state level, which prevents us from creating Indiana-specific effects. In addition, we were unable to purchase data to create our own state-level estimates for Indiana. Therefore, we often used a combination of Indiana-specific and national data to create estimates, based on the assumption that, on average, Indiana resembles the rest of the country. In the next section, we provide detailed information about how we calculated each variable used in the analysis.

Results

Provider Supply

There were 3,590 NPs in the state of Indiana in 2015 (Bureau of Labor Statistics, 2016). Perry (2012) reported a 46-percent reduction in the rate of NPs who move out of state following prescription authority expansion and found a base move rate of 6.5 percent nationally. So, applying that national move rate, we would expect roughly 233 NPs to move out of Indiana in a given year. Based on Perry's finding of a 46-percent reduction in the number of NPs who move out of state following prescription authority expansion, we would expect roughly 126 fewer NPs to move out of state (Table 4.1).

Table 4.1. Estimated Change in the Number of Nurse Practitioners in Indiana Who Would Move Out of State

Measure	Number of NPs Moving Out of State
Baseline	233
Difference	–126 (–224 to –28)

SOURCES: Perry, 2012; Bureau of Labor Statistics, 2016.
NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Access

Traczynski and Udalova (2014) found improvements on three patient-reported measures of access after states established full SOP for NPs (both practice and prescriptive authority). First, they found that the proportion of adults who reported being able to get an appointment when wanted increased by about 7.5 percentage points one to two years after a state established full SOP. Roughly 52 percent of U.S. adults report that they are able to schedule an appointment when wanted, which would equate to about 2,643,652 adults in Indiana (MEPS, 2013). Based on this, we estimate that roughly 379,330 additional adults in Indiana would report being able to schedule an appointment when wanted one to two years after the state grants full APRN SOP (Table 4.2). Traczynski and Udalova's estimate for 11 or more years following SOP reform was not statistically significant. Second, Traczynski and Udalova found that the proportion of adults who reported being able to get care when they are sick increased by 8.87 percentage points one to two years after a state established full NP SOP, but again, the increase was not statistically significant after 11 or more years. Based on this finding, we estimate that roughly 446,833 additional adults in Indiana would report being able to get an appointment when sick one to two years after the state grants full APRN SOP. It is worth noting that the confidence interval on the estimate of the effect one to two years after establishing full SOP is quite wide, indicating that the effect could be as small as 77,559 additional adults or as large as 816,108 additional adults. Moreover, the fact that the estimate at 11 or more years is either not statistically significant or not significant at $p < 0.05$ may simply reflect the uncertainty of the effect that far into the future. Third, Traczynski and Udalova found that the proportion of adults who reported being easily able to travel to their provider increased by about 6.37 percentage points one to two years after a state established full NP SOP and by about 12.8 percentage points after 11 or more years. Based on this finding, we estimate that there may be 320,894 additional adults in Indiana who would report the ability to easily travel to their provider one to two years after the state grants full APNR SOP, and 644,810 more adults after 11 or more years.

Table 4.2. Estimated Change in the Number of Adults in Indiana Reporting the Highest Levels on Three Measures of Access to Care

Measure	Adults Who Can:		
	Get Appointment When Wanted	Get Appointment When Sick	Easily Travel to Provider
Baseline	2,634,652	2,881,494	3,375,176
Difference 1–2 years after SOP reforms	379,330 (177,907 to 580,752)	446,833 (77,559 to 816,108)	320,894 (99,724 to 542,063)
Difference 11+ years after SOP reforms	*Not significant*	*Not significant*	644,810 (160,014 to 1,129,606)

SOURCES: Traczynski and Udalova, 2014; MEPS, 2013; U.S. Census Bureau, 2015.
NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

These effects were larger among children (Table 4.3). Applying Traczynski and Udalova's estimate that self-reported access measures for children would increase from between 12 and 25 percentage points following the establishment of full NP SOP, we estimate an increase in access for between roughly 189,000 and 394,000 children in Indiana. These results are based on the assumption that there are 1,582,104 children under the age of 18 in the state of Indiana (U.S. Census Bureau, 2015), approximately 76 percent of whom can get an appointment when wanted, 84 percent of whom can get an appointment when sick, and 81 percent of whom can easily travel to their provider (MEPS, 2013). (See Appendix E for specific effect sizes for children.)

Table 4.3. Estimated Change in the Number of Children in Indiana Reporting the Highest Levels on Three Measures of Access to Care

Measure	Children Who Can:		
	Get Appointment When Wanted	Get Appointment When Sick	Easily Travel to Provider
Baseline	1,202,399	1,327,385	1,281,504
Difference 1–2 years after SOP reforms	191,435 (46,932 to 335,938)	248,390 (52,412 to 444,369)	189,852 (20,542 to 359,163)
Difference 11+ years after SOP reforms	393,944 (243,859 to 544,028)	215,166 (25,700 to 404,632)	262,629 (84,636 to 440,622)

SOURCES: Traczynski and Udalova, 2014; MEPS, 2013; U.S. Census Bureau Population Estimates, 2015.
NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Ambulatory Utilization

Two studies, both good quality, examined the effect of SOP regulation on utilization. Stange (2014) estimated that establishing full prescriptive authority for NPs is associated with a 3.1-percent increase in the number of office-based provider visits.[1] The most recent estimate of

office visit counts in the state of Indiana is from the 2012 National Ambulatory Medicare Care Survey Annual report. Based on that report, we estimate that in 2012 there were approximately 18,456,000 office visits in Indiana. So, establishing full APRN prescriptive authority in Indiana could lead to roughly 572,136 more office visits per year (Table 4.4).

Table 4.4. Estimated Change in the Number of Office-Based Provider Visits

Measure	Number of Office-Based Provider Visits
Baseline	18,456,000
Difference	572,136 (332,208 to 812,064)

SOURCES: Stange, 2014; National Center for Health Statistics, 2012; U.S. Census Bureau Population Estimates, 2015.
NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Traczysnki and Udalova (2014) estimated that the likelihood of an adult receiving an annual check-up would increase by about 3.9 percentage points in the two years following the establishment of full NP SOP and about 6.8 percentage points after 11 years. The latest national estimate indicates that roughly 63 percent of people receive their annual check-up (MEPS, 2013), which would equate to 3,173,673 adult Indiana residents. Within one to two years of establishing full SOP, Indiana might therefore expect that 199,488 additional adults would receive an annual check-up, and 342,555 additional adults would receive an annual check-up after at least 11 years (Table 4.5).

Table 4.5. Estimated Change in the Number of Adults Who Would Receive an Annual Checkup in Indiana After a Change in the Scope-of-Practice Laws

Measure	Number of Adults Receiving Annual Check-Up
Baseline	3,173,673
Difference 1–2 years after SOP reforms	199,488 (93,840 to305,136)
Difference 11+ years after SOP reforms	342,555 (158,905 to 526,205)

SOURCES: Traczynski and Udalova, 2014; MEPS, 2013; U.S. Census Bureau Population Estimates, 2015.
NOTE: Numbers indicate the number of adults in Indiana who would have received a routine checkup in the past 12 months.

Costs

Perry (2009) examined changes in wages following prescription authority expansions for NPs. Specifically, he found a 1.6-percent increase in NP salary, a 1.4-percent reduction in physician assistant salary, and a 7.6-percent reduction in physician salary following expansion in

prescription authority. Applying these effect estimates to 2015 salary data for these providers in Indiana (Bureau of Labor Statistics, 2016), we would expect an increase of $1,552 in NP annual salary, a reduction of $1,388 in physician assistant salary, and a reduction of $17,311 in physician salary (Table 4.6).

Table 4.6. Estimated Change in Nurse Practitioner, Physician Assistant, and Physician Salaries in Indiana

Measure	NP Annual Salary	Physician Assistant Annual Salary	Physician Annual Salary
Baseline	$97,030	$99,130	$227,780
Difference	$1,552 ($194 to $2,911)	–$1,388 (–$2,015 to –$761)	–$17,311 (–$31,048 to –$3,574)

SOURCES: Perry, 2009; Bureau of Labor Statistics, 2016.
NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Quality of Care: Patient Experience

Traczynski and Udalova (2014) found no significant effects related to patients thinking that providers spent enough time with them after a state established full NP SOP. They found that the proportion of adults who reported that their provider listened carefully could increase 8.9 percentage points one to two years after a state grants full NP SOP, and 8.8 percentage points after 11 or more years. Based on national estimates that roughly 64 percent of adults reported that their provider listened carefully (MEPS, 2013), which would equate to about 3,203,899 adults in Indiana, we might expect an additional 451,367 adults in Indiana to report that their provider listened carefully one to two years after the state grants full APRN SOP, and an additional 446,833 adults after 11 or more years (Table 4.7). Traczynski and Udalova also found that the proportion of adults who report that their provider explained things clearly could increase by about 7.4 percentage points one to two years after a state grants full NP SOP, but after 11 or more years the result was not statistically significant. Roughly 64 percent of adults report that their provider explained things clearly (MEPS, 2013), or roughly 3,234,124 adults in Indiana (MEPS, 2013). Applying the effect estimates to Indiana, establishing full SOP for APRNs might result in an additional 374,796 adults reporting that their provider explained things clearly.

Table 4.7. Estimated Change in Indiana Adults' Reporting the Highest Levels of Quality of Care

	Adults Reporting That the Provider:		
Measure	**Spent Enough Time**	**Listened Carefully**	**Explained Things Clearly**
Baseline	2,760,592	3,203,899	3,234,124
Difference 1–2 years after SOP reforms	*Not significant*	451,367 (335,845 to 566,889)	374,796 (82,536 to 667,056)
Difference 11+ years after SOP reforms	*Not significant*	446,833 (94,344 to 799,322)	*Not significant*

SOURCES: Traczynski and Udalova, 2014; MEPS, 2013; U.S. Census Bureau Population Estimates, 2015.
NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Again, the effects are larger for children (Table 4.8). Applying Traczynski and Udalova's estimate that self-reported provider quality measures for children would increase from between 9.2 and 18.9 percentage points following the establishment of full NP SOP, we estimate an expected increase in self-reported provider quality measures for between roughly 146,000 and 300,000 children in Indiana, based on the assumption that there are 1,582,104 children under the age of 18 in the state (U.S. Census Bureau, 2015), approximately 77 percent of whom report that their provider spent enough time, 81 percent of whom report that their provider listened carefully, and 81 percent of whom report that their provider explained things clearly (MEPS, 2013).

Table 4.8. Estimated Change in Indiana Children's Reporting Highest Levels of Quality of Care

	Children Reporting That the Provider:		
Measure	**Spent Enough Time**	**Listened Carefully**	**Explained Things Clearly**
Baseline	1,218,220	1,287,832	1,284,668
Difference 1–2 years after SOP reforms	196,181 (108,735 to 283,627)	146,028 (51,450 to 240,606)	161,375 (26,484 to 296,265)
Difference 11+ years after SOP reforms	299,018 (160,716 to 437,319)	242,062 (131,359 to 352,765)	213,584 (49,235 to 377,933)

SOURCES: Traczynski and Udalova, 2014; MEPS, 2013; U.S. Census Bureau Population Estimates, 2015.
NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Only one high-quality study reported an effect on potentially "unfavorable" utilization. Traczynski and Udalova (2014) estimated a 14-percent decrease in the number of ACS ED visits one to two years after a state established full SOP for NPs, and a 12.8-percent decrease after 11 or more years. As of 2012, there were roughly 131,884 ACS ED visits in Indiana, based on the assumption that the number of ACS ED visits is similar to the rate observed nationally using data from the Hospital Cost and Utilization Project (Fingar et al., 2015). Applying the estimates from Traczynski and Udalova, we might expect roughly 18,464 fewer ACS ED visits in Indiana one to two years after the state grants full APRN SOP, and 16,881 after 11 or more years (Table 4.9).

Table 4.9. Estimated Change in the Number of Ambulatory Care Sensitive Emergency Department Visits

Measure	ACS ED Visits
Baseline	131,884
Difference 1–2 years after SOP reforms	–18,464 (–4,177 to –993)
Difference 11+ years after SOP reforms	–16,881 (–3,819 to –908)

SOURCES: Traczynski and Udalova, 2014; Fingar et al., 2015; U.S. Census Bureau Population Estimates, 2015.
NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Health Outcomes

No studies estimating the effect of SOP on health outcomes met our inclusion criteria.

5. Discussion

Many policymakers and clinicians say an important strategy for meeting the growing demand for health care services in the United States is to make better use—and increase the number—of APRNs. However, state SOP regulations, which govern the breadth of services that APRNs can provide, may affect not only the supply of APRNs but also their ability to meet patients' care needs. In the state of Indiana, APRNs are able to open their own practices and diagnose and treat patients, but are required by state law to have a collaborative agreement in place with a physician in order to prescribe medications. These collaborative agreements generally require that physicians review 5 percent of an APRN's prescriptions weekly and, in exchange, APRNs must pay the physician an annual fee. In this report, we have examined the literature on the relationship between state APRN SOP regulations and provider supply, access, utilization, cost, quality, and health outcomes, and we have estimated what the effects might be on the state of Indiana if the state legislature were to define a full SOP for APRNs.

Evidence of the relationship between APRN SOP regulations and specific aspects of health care delivery is relatively limited in terms of the number and quality of the studies. Furthermore, most of the evidence is limited to the effect of SOP regulations on NP practice. Of the 20 studies we identified, only eight used longitudinal research designs with control for confounders—all of these studies were based on national data sets. The cross-sectional studies we examined were based on comparisons of a large number of states with different levels of SOP regulations. The longitudinal studies, however, were based on a relatively small number of states where SOP regulations changed over a relatively long time horizon. The states with less-restrictive SOP regulations were most often located in the northeast and west. Because the studies we examined used varying definitions of full SOP and focused primarily on NPs, it is difficult to assess the extent to which our findings are fully generalizable to Indiana. Yet despite the limitations of these available studies, they nonetheless suggest that granting APRNs full SOP might contribute to improvements in provider supply, access, utilization, and patient experience with care. Our findings on the effect of full APRN SOP on costs and health outcomes were largely inconclusive. None of the studies we reviewed estimated the effect of APRN SOP regulations on a dimension of quality of care other than patient experience.

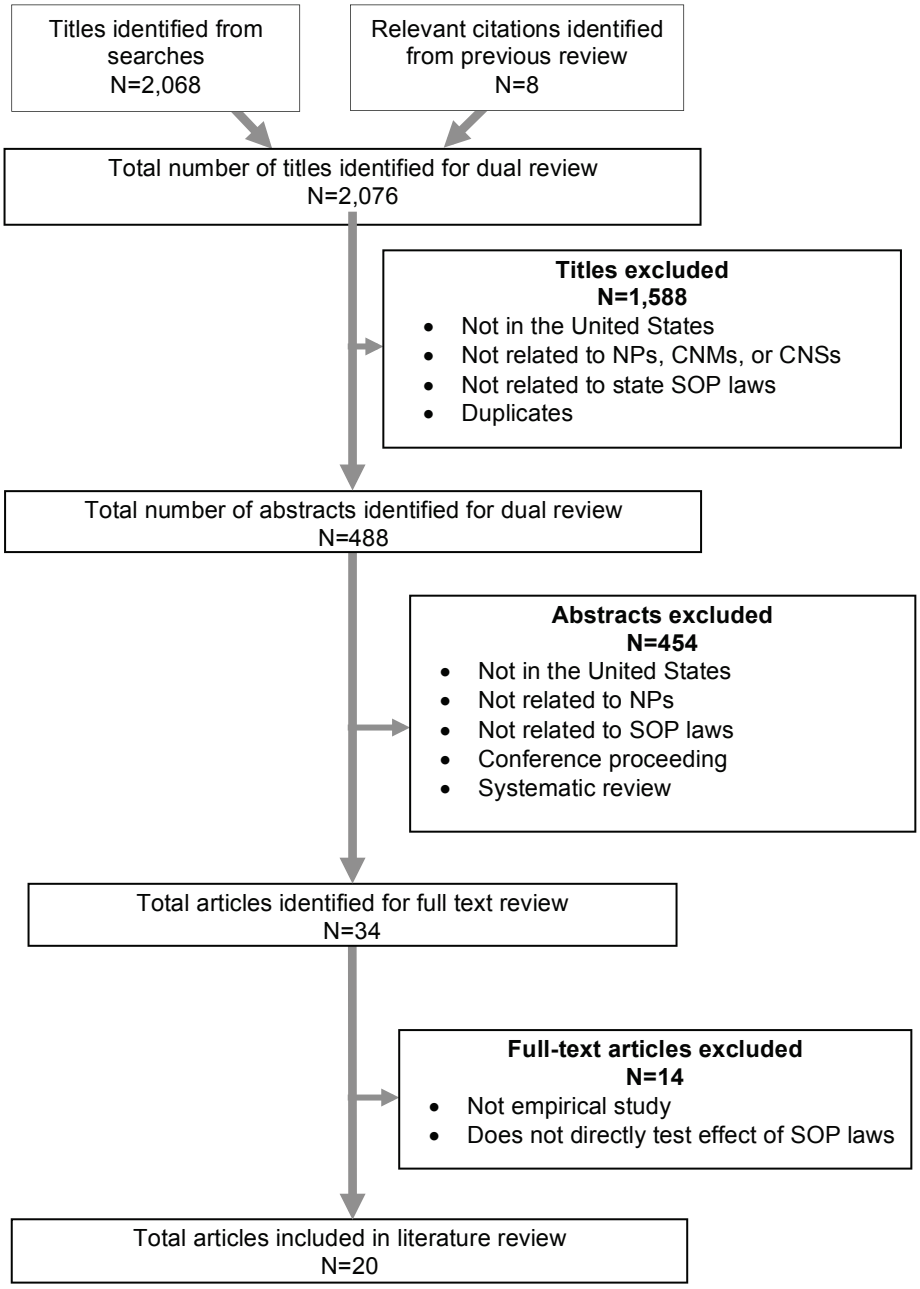
In analyzing effects specific to Indiana, we used only the most convincing and complete results from the highest-quality studies to create conservative estimates and to limit bias. Only four studies met the inclusion criteria we used for estimating the Indiana-specific effects. Using these restrictions, we were able to calculate expected effects on supply, access, cost, and quality. Our estimates suggest that establishing full SOP for APRNs could lead to potentially meaningful improvements in provider supply, access, and patient experience with care, as well as increases in salaries for NPs, with reductions in physician assistant and physician salaries.

Taken together, our findings suggest that there could be improvements in access, utilization, provider supply, and patient experience with care as a result of granting full SOP for APRNs in the state of Indiana. Further research is needed to assess the effects of expanding SOP for APRNs on costs and other dimensions of health care quality.

Appendix A: Literature Review Flow Diagram

Figure A.1 summarizes the literature review process. It begins at the top with the number of titles originally identified and continues through each step of the decisionmaking process, including enumerating how many articles were excluded and the reasons for exclusion.

Figure A.1. Literature Review Flow Diagram



Appendix B: Detailed Article Summaries

Table B.1 summarizes the 20 included articles in terms of how they defined or identified the provider of interest, how SOP was measured and conceptualized, the type of data and study design, and a list of relevant outcome measures.

Table B.1. Summary of 20 Included Articles

Reference	Provider Type and Definition/Identification	SOP Measure	Data and Study Design	Relevant Outcomes
Adams, Ekelund, and Jackson, 2003	CNM: Used state-level data on the number of CNM-attended births	Categorized states as granting prescriptive authority to CNMs compared with those that do not	National cross-sectional study using data on CNM births from the U.S. Department of Health and Human Services and population data from the U.S. Census Bureau and Department of Labor	Percentage of all births attended by CNMs
Declercq et al., 1998	CNMs identified through the American College of Nurse-Midwives	Created scale to rate states on regulatory support for CNMs. Scale was a function of reimbursement policies, prescriptive authority, and hospital admitting privileges	National longitudinal survey sent in 1992 and 1995 to midwives who functioned as state liaisons who are knowledgeable about the status of regulation in their state	CNM supply, percentage of CNM-attended births, CNM visits per capita
Dueker et al., 2005	APRNs (NPs, CNMs, CNSs, CRNAs) identified as those registered nurses with master's or professional degrees (not doctorates)	Created a 4-point scale for prescriptive authority ranging from 1 (low) to 4 (high) and contrasted states that were 3 or 4 against all others	National longitudinal study using data on state SOP laws and labor market data from the U.S. Census Bureau from 1988 to 2002	Annual earnings
Graves et al., 2016	NPs counted using the National Provider Identifier from administrative data	Categorized states as full (both prescriptive and practice authority), reduced (one of two), or restricted (none) practice, comparing reduced- and restricted-practice states with full-practice states	National cross-sectional study using administrative county-level data on NP counts and location, and U.S. Census Bureau data from 2013	NP supply
Kalist and Spurr, 2004	APRN: Combined all APRNs (that is, NPs, CNMs, CRNAs, and CNSs)	Levels of prescriptive and practice authority (high and low prescriptive or practice authority). They include terms for contrasts between high and low prescriptive authority, high and low practice authority, and an interaction term for both high practice and prescriptive authority	Longitudinal national study combining SOP laws and master's degree nursing program enrollment in each state from 1989 to 1995	Enrollment in APRN programs
Kleiner et al., 2016	All registered nurses with an advanced degree (master's, doctorate, or professional degree)	Independent prescription authority and whether NPs can prescribe controlled substances. Compared supervised prescription authority and limited prescription authority with full, independent prescription authority	Longitudinal national study using data on state SOP laws and labor market data from the U.S. Census Bureau for 2002–2009	Hours worked, infant mortality, and well-child visit costs

Reference	Provider Type and Definition/Identification	SOP Measure	Data and Study Design	Relevant Outcomes
Kozhimannil Henning-Smith, and Hung, 2016	CNMs: Conducted survey and interviews with hospital administrators to determine whether CNMs attend births in their hospital	Categorized states as those that allow full authority (that is, without supervision or collaborative agreement) and those that do not	Cross-sectional study that focused on rural and critical access hospitals and that combined interview and survey data with material from the American Hospital Association	CNM-attended births
Ku et al., 2015	Combined all advanced practice staff (NPs, physician assistants, and CNMs)	Categorized states as full (both prescriptive and practice authority), partial (one of two), or restricted (none) practice. Compared full and partial with restricted practice authority	Cross-sectional national analysis using 2012 data on characteristics of all community health centers and state-level NP SOP laws	Employment in community health centers
Kuo et al., 2013	NPs identified based on Unique Provider Identification or National Provider Identifier	Categorized states as full (both prescriptive and practice authority), reduced (one of two), or restricted (none) practice. Also categorized states into five categories based on patient access to NPs	Longitudinal national study using Medicare claims data on care provided by NPs and state-level SOP laws from 1998 to 2010	Use of NPs as primary care providers
Lin, Burns, and Nochajski 1997	NPs indicated by state boards of nursing as certified or registered NPs	Whether states allowed independent practice and direct reimbursement to NPs, compared with states that do not allow independent practice and direct reimbursement, respectively	Cross-sectional, national county-level study combining data from state nursing board licensing, SOP laws, and county characteristics from the Area Health Resource File in 1994	NP supply
Markowitz et al., 2016	CNMs identified through administrative data	Categorized state barriers to CNM practice as none, low (collaborative agreement), moderate (written protocol on practices that may include collaborative agreement or supervisory relationship with physician), or high (must be supervised by physician and may not be able to write prescriptions)	Longitudinal national patient-level study combining data on state SOP laws with data from birth certificates and county-level market characteristics from administrative data	CNM supply and maternal and infant health outcomes
Oliver et al., 2014	Combined all APRNs (that is, NPs, CNMs, CRNAs, and CNSs)	Categorized states as full (both prescriptive and practice authority), reduced (one of two), or restricted (none) practice. Compared full with reduced and restricted; also compared reduced with restricted	Cross-sectional national analysis combining state data on SOP laws in 2013 and public reports on state-level outcomes	Hospitalizations and readmissions
Perry, 2009	Little detail on how NPs were defined other than they were identified from the National Sample Survey of Registered Nurses (NSSRN)	Measured whether states allowed NPs to prescribe medication and/or if states allowed NPs to receive reimbursement directly. Compared states that do allow prescription authority or direct reimbursement with those that do not	Longitudinal national study combining individual-level data on wages with state SOP laws in 1992, 1996, 2000, and 2004	NP wages

Reference	Provider Type and Definition/Identification	SOP Measure	Data and Study Design	Relevant Outcomes
Perry, 2012	Little detail on how NPs were defined other than they were identified from the NSSRN	Measured whether states allowed NPs to prescribe medication and/or if states allowed NPs to receive reimbursement directly. Compared states that do allow prescription authority or direct reimbursement with those that do not	Longitudinal national study on individual-level data, including NP location and demographics, combined with state SOP laws in 1992, 1996, 2000, and 2004	The likelihood of NPs moving from a state with more-restrictive SOP laws to states with less-restrictive laws
Reagan and Salsberry, 2013	No definition given	Categorized states as full (no restrictions), partial (practice but not prescriptive authority), or restricted (no authority) practice. Compared full and partial with restricted authority	Cross-sectional nationally representative study combining state SOP laws with county-level counts of NPs and other county characteristics in 2008	NP supply per 100,000 population
Schirle and McCabe, 2016	APRNs (that is, NPs, CNMs, CRNAs, CNSs)	Categorized states as allowing independent prescribing for APRNs or those that have any restrictions on prescribing	Cross-sectional national study at the state level combining state SOP laws with prescription rates from the Centers for Disease Control and Prevention	Utilization of opioid and benzodiazepine prescriptions
Sekscenski et al., 1994	Estimated number of NPs based on a previous study	Created a 100-point scoring mechanism for state practice environment where a higher score indicated more authority and legal status	Cross-sectional national study combining state regulatory data with data that appeared in previously published studies in 1992	NP supply
Stange, 2014	Created a unique dataset of licensed NPs using state licensing records	Practice environment index that ranks states' legal standing and authority for NPs. Also measured as whether states grant prescriptive authority to NPs for controlled substances	Longitudinal national study using individual-level patient data from multiple waves of the MEPS combined with state SOP laws and county-level NP counts from 1996 to 2008	Number of office-based provider visits, charges, and total costs
Traczynski and Udalova, 2014	Study does not include data on NP supply	Categorize states by full or limited SOP and compare the two	Longitudinal national study using rich individual-level patient data from multiple waves of the MEPS combined with state SOP laws, and other state-level control variables from 1996 to 2010	Self-reported access measures, patient experience, and utilization
Westat, 2015	Identified NPs through the National Sample Survey of Nurse Practitioners	Categorized states based on whether they granted full practice or prescriptive authority to NPs, as well as whether a state granted neither	Cross-sectional national study using individual-level patient data from the Medicare Claims file combined with state SOP laws and provider supply in 2012, and population characteristics from the Bureau of Labor Statistics and U.S. Census Bureau	Likelihood of NP to work in patient or primary care, and likelihood of NP having high-volume patient panel

Appendix C: Study Quality Dimensions

Table C.1 summarizes each included study based on three quality dimensions: recency of data used, generalizability of findings, and risk of bias in the estimates.

Table C.1. Summary of Studies by Quality Dimension

Reference	Recency	Generalizability	Bias
Adams, Ekelund, and Jackson 2003	1995	National cross-sectional study from all 50 states; study included 40 states that granted prescriptive authority to CNMs (AK, AZ, AR, CA, CO, CT, FL, ID, IN, IA, KS, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OR, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY) and 7 states that require physician oversight for prescriptive authority (AL, HI, LA, OH, PA, SC, SD).	Cross-sectional analysis with regression adjustment does not allow for causal inferences.
Declercq et al., 1998	1992 and 1995	National survey administered to representatives from all 50 states, about half of which had changes to their SOP regulatory support over the study period.	Only calculates simple correlations and does not use regression adjustment.
Dueker et al., 2005	1988–2002	National longitudinal study on all 50 states. Study does not list which states fall into the SOP categories, but the authors note the increasing trend of professional independence over time.	Strong longitudinal research design with regression adjustment but extremely broad measure of APRNs by counting all registered nurses with a master's or professional degree.
Graves et al., 2016	2013	National cross-sectional study. Eighteen states were categorized as full practice (AK, AZ, CO, DC, HI, IA, ID, ME, MT, ND, NH, NM, NV, OR, RI, VT, WA, WY) compared with 21 reduced-practice states (AL, AR, CT, DE, IL, IN, KS, KY, LA, MD, MN, MS, NE, NJ, NY, OH, PA, SD, UT, WI, WV).	Cross-sectional analysis with regression adjustment does not allow for causal inferences.
Kalist and Spurr, 2004	1989–1995	National longitudinal study. The number of states with full practice authority (both practice and prescription authority) increased over the study period, starting with 6 states in 1989 and increasing to 16 states in 1995. The study does not list these states.	Strong longitudinal research design with regression adjustment but combining enrollment of all APRNs makes it impossible to isolate effect for NPs.
Kleiner et al., 2016	2002–2009	National longitudinal study. During the study period, 6 states went from restricted to supervised/delegated prescription authority (LA, NV, MS, TX, KY, MO), and 5 states went from supervised/delegated to independent prescription authority (WI, ID, CO, MD, HI).	Strong longitudinal research design with regression adjustment, but measures NPs as all registered nurses with any advanced degree.

Reference	Recency	Generalizability	Bias
Kozhimannil Henning-Smith, and Hung, 2016	2013	Cross-sectional study limited to rural and critical access hospitals in 9 states. Six states were categorized as having independent authority for CNMs (CO, LA, NY, OR, VT, WA) while 3 were categorized as requiring a collaborative agreement (KY, NC, WI).	Cross-sectional study with regression adjustment.
Ku et al., 2015	2012	Cross-sectional national analysis limited to staffing in community health centers (1,191 of 1,198 CHCs in the United States in 2012 included in analyses). Study does not list or enumerate states by SOP.	Cross-sectional analysis with regression adjustment and broad measure of NPs (combined NPs, physician assistants, and CNMs).
Kuo et al., 2013	1998–2010	National longitudinal study. Three states went from independent practice/supervised prescriptive authority in 1998 to full independence in 2010 (AZ, CO, HI).	Longitudinal study with regression adjustment but no control for "incident-to" billing. Many NPs provide patient care but bill under a physician. Because this is likely to happen more often in states with more-restrictive SOP laws, effects measured in this study are very likely biased.
Lin, Burns, and Nochajski 1997	1994	Cross-sectional, national county-level study. Does not list states by NP SOP.	Cross-sectional analysis with very few control variables in regression models.
Markowitz et al., 2016	1994–2013	National longitudinal study with roughly half of states moving to lower barriers to CNM autonomy over the study period.	Strong longitudinal research design with regression adjustment.
Oliver et al., 2014	2013	National study with 17 states categorized as having full NP SOP and 12 with restricted SOP. Study does not list specific states.	Cross-sectional study with no regression adjustments (one-way analysis of variance).
Perry, 2009	1992, 1996, 2000, and 2004	National study. Roughly 37% of states authorized NPs to prescribe controlled substances in 1992, and 90% of states in 2005. 43% of states authorized NPs to receive direct reimbursement in 1992, and 63% in 2005. The study does not list specific states.	Strong longitudinal research design with regression adjustment.
Perry, 2012	1992, 1996, 2000, and 2004	Longitudinal national study. In 1991, 15 states authorized NPs to prescribe controlled substances; this increased to 45 states in 2003. The study does not list specific states.	Strong longitudinal research design with regression adjustment.
Reagan and Salsberry, 2013	2008	Cross-sectional nationally representative study. The study did not have data on NPs from the following states: AK, AR, DE, HI, NH, SC, VT, WI, and WY. There were 10 states with full authority (AZ, ID, IA, ME, MT, NM, OR, RI, UT, WA), 9 with moderate restrictions (CO, IN, KY, MI, NJ, ND, OK, TN, WV), and 22 with restricted authority (AL, CA, CT, FL, GA, IL, KS, LA, MD, MA, MN, MS, MO, NE, NV, NY, NC, OH, PA, SD, TX, VA) in the study.	Cross-sectional analysis with regression adjustment.

Reference	Recency	Generalizability	Bias
Schirle and McCabe, 2016	2012	National cross-sectional study. Nineteen states were categorized as having independent prescribing authority for at least one type of APRN (AK, AZ, CO, DC, HI, ID, ME, MA, MT, NE, NH, NM, ND, OR, RI, UT, VT, WA, WY) while 32 were categorized as nonindependent states (AL, AR, CA, CT, DE, FL, GA, IL, IN, IA, KA, KY, LA, MD, MI, MN, MS, MO, NV, NJ, NY, NC, OH, OK, PA, SC, SD, TN, TX, VA, WV, WI).	Cross-sectional analysis with no regression adjustment and very coarse measures of both SOP and APRNs.
Sekscenski et al., 1994	1992	Cross-sectional national study. Created a 100-point scale to describe the continuum of practice authority for NPs. The study only lists the overall score for each state, not individual components of each state. Scores for NP practice environment range from a low of 14 in Illinois and Ohio to a high of 100 in Oregon.	Cross-sectional study with no regression adjustment and little detail.
Stange, 2014	1996–2008	Longitudinal national study. The study does not specify which states have different levels of prescription authority, but does mention that roughly 79% of NPs live in states with full prescription authority for controlled substances.	Strong longitudinal research design with regression adjustment.
Traczynski and Udalova, 2014	1996–2010	Longitudinal national study. Ten states expanded (practice and prescriptive) authority during the study period: AZ, CO, HI, ID, MD, ME, ND, UT, VT, and WA.	Strong longitudinal research design with regression adjustment.
Westat, 2015	2012	Cross-sectional national study. Study does not specify which states had different levels of authority, but does report that in 2012, 19 states had full SOP, 8 had practice authority only, and 24 had restricted practice and prescription authority.	Cross-sectional research design with regression adjustment.

Appendix D: Methods Details

Selecting the Highest-Quality Results

One study used multiple methods to examine the effect of implementing full SOP for NPs (Stange, 2014). Specifically, Stange constructed two different models for each relevant outcome: one that does not control for supply and includes state fixed effects, and another that controls for supply and includes county fixed effects. In this case, we selected results corresponding to the model that controlled for supply and included county fixed effects. Changes in SOP may be correlated with provider supply growth, so, by accounting for local provider supply and including county fixed effects to account for time invariant county characteristics, these models are relatively less likely to be biased than models that do not account for supply trends and instead include higher-level (state) fixed effects.

Another study also used multiple methods (Kleiner et al., 2016). The authors use two sequential models: The first regressed individual-level outcomes on covariates with a state-by-year difference-in-differences framework; the second uses the regression-adjusted covariate means and regresses on SOP, state, and year fixed effects. The results are generally robust across stages, but we report results from the second stage, which includes a more comprehensive set of control variables.

Reporting Effect Estimates

We generally reported the statistically significant model coefficients from each study as the effect estimates throughout the literature summary. For example, many coefficients were the natural log of a variable of interest, allowing for them to be interpreted as percentage changes. In one study, the coefficients were difficult to interpret or not directly usable, so we performed additional calculations. Graves et al. (2016) reported adjusted mean differences in the geographic accessibility of providers from a nonparametric gravity model. These numbers are difficult to interpret, so we calculated a percentage change as the predicted difference in the number of NPs in reduced-practice states relative to the predicted number in full-practice states. For example, we calculated the percent effect on the number of NPs per 100,000 as 4.11 / 16.55 = 25% increase, where 4.11 is the effect of full-practice states relative to reduced-practice and 16.55 represents the reduced-practice baseline.

Appendix E: Summary of Effect Estimates

Provider Supply Estimates

Table E.1 summarizes the provider supply estimates from the final set of included articles.

Table E.1. Summary of Provider Supply Effect Estimates

Construct	Reference	Overall Effect of Expanded SOP
Number of providers	Lin, Burns, and Nochajski, 1997	No effect[a]
	Graves et al., 2016	25% more primary care NPs[a]
	Graves et al., 2016	3% fewer primary care physicians[a]
	Graves et al., 2016	37% more primary care physician assistants[a]
	Perry, 2012	NPs 46% less likely to move out of state[b]
	Sekscenski et al., 1994	More NPs (no effect sizes reported)[a]
	Reagan and Salsberry, 2013	27% more NPs[a]
	Kalist and Spurr, 2004	12% higher enrollment per capita in APRN programs[b]
	Declercq et al., 1998	34% more CNMs per 100,000 female population[b]
	Markowitz et al., 2016	No difference in CNM supply[a]
	Kuo et al., 2013	18 additional NPs per 100,000 population[a]
Hours worked	Kleiner et al., 2016	4% increase in hours worked per year for NPs, no effect for physicians[b]
Provider roles	Kuo et al., 2013	156% increase in the use of NPs as primary care physicians[a]
	Westat, 2015	NPs 3 percentage points more likely to work in patient care[a]
	Westat, 2015	No difference in NP's likelihood of working in primary care[a]
	Ku et al., 2015	2% more advanced practice staff and 2% fewer physicians in community health centers[a]
	Adams, Ekelund, and Jackson, 2003	No effect on the number of CNM-attended births[b] 109% increase in the number of CNM deliveries[c]
	Kozhimannil, Henning-Smith, and Hung, 2016	47% higher probability that a rural hospital has CNMs attending births
	Declercq et al., 1998	44% increase in the number of CNM-attended births[b]

[a] Prescription and practice authority.
[b] Prescription only.
[c] Practice only.

Access Estimates

Table E.2 summarizes the access and utilization effect estimates from the final set of included articles.

Table E.2. Summary of Access Effect Estimates

Construct	Reference	Overall Effect of Expanded SOP
Patient-reported access	Traczynski and Udalova, 2014	Appointment when wanted, 1–2 years after expansion: 7.5 percentage points higher for adults; 12 percentage pointshigher for children[a] Appointment when wanted, 11+ years after expansion: no difference for adults; 24.9 percentage points higher for children[a]
	Traczynski and Udalova, 2014	Able to get care when needed, 1–2 years after expansion: 8.87 percentage points higher for adults; 15.7 percentage points higher for children[a] Able to get care when needed, 11+ years after expansion: 11.6 percentage points higher for adults; 13.6 percentage points higher for children[a]
	Traczynski and Udalova, 2014	Acceptable travel time, 1–2 years after expansion: 6.37 percentage points higher for adults; 12 percentage points for children[a] Acceptable travel time, 11+ years after expansion: 12.8 percentage points higher for adults; 16.6 percentage points higher for children[a]

[a] Prescription and practice authority.

Utilization Estimates

Table E.3 summarizes utilization effect estimates from the final set of included articles.

Table E.3. Summary of Utilization Effect Estimates

Construct	Reference	Overall Effect of Expanded SOP
Ambulatory utilization	Stange, 2014	3.1% increase in office-based provider visits[b]
	Traczynski and Udalova, 2014	3.9–6.8 percentage point increase in probability of adults receiving annual check-up[a]
	Declercq et al., 1998	39% more CNM visits per 10,000 female population
Inpatient utilization	Oliver et al., 2014	33% lower rates of avoidable hospital admissions
	Oliver et al., 2014	30% lower rates of hospital admissions among NH residents
	Oliver et al., 2014	10% lower rates of readmissions
	Traczynski and Udalova, 2014	No differences in all ED visits[a]
	Traczynski and Udalova, 2014	ACS ED visits, 1–2 years after expansion: 14% lower[a] ACS ED visits, 11+ years after expansion: 12.8% lower[a]
	Markowitz et al., 2016	No effect on rates of induction or cesarean sections for mothers[a]
Prescription rates	Schirle and McCabe, 2016	21% lower opioid and 31% lower benzodiazepine prescription rates[b]

[a] Prescription and practice authority.
[b] Prescription only.

Cost Estimates

Table E.4 summarizes the cost effect estimates from the final set of included articles.

Table E.4. Summary of Cost Effect Estimates

Construct	Reference	Overall Effect of Expanded SOP
Unit costs and prices	Kleiner et al., 2016	No effect on prices for well-child visits[a]
	Stange, 2014	No difference on charges or amount paid[a]
Total costs	Stange, 2014	No difference in total costs[a]
Malpractice premiums	Kleiner et al., 2016	No effect[a]
Provider wages	Kleiner et al., 2016	No effect on NP wages[a]
	Kleiner et al., 2016	No effect on physician wages[a]
	Perry, 2009	1.6% increase in NP wages per year[a]
	Perry, 2009	1.4% reduction in physician assistant wages per year[a]
	Perry, 2009	7.6% reduction in physician wages[a]
	Dueker et al., 2005	36% increase in physician assistant wages[a]
	Dueker et al., 2005	21% reduction in APRN wages[a]

[a] Prescription only.

Patient Experience Estimates

Table E.5 summarizes the patient experience effect estimates from the final set of included articles.

Table E.5. Summary of Patient Experience Effect Estimates

Construct	Reference	Overall Effect of Expanded SOP
Patient experience	Traczynski and Udalova, 2014	Enough time with provider, 1–2 years after expansion: no difference for adults; 12.4 percentage points higher for children[a] Enough time with provider, 11+ years after expansion: no difference for adults; 18.9 percentage points higher for children[a]
	Traczynski and Udalova, 2014	Provider listens carefully, 1–2 years after expansion: 8.9 percentage points higher for adults; 9.2 percentage points higher for children[a] Provider listens carefully, 11+ years after expansion: 8.8 percentage points higher for adults; 15.3 percentage points higher for children[a]
	Traczynski and Udalova, 2014	Provider explains clearly 1–2 years after expansion: 7.4 percentage points higher for adults; 10.2 percentage points higher for children[a] Provider explains clearly 11+ years after expansion: 8.5 percentage points higher for adults; 13.5 percentage points higher for children[a]

[a] Prescription and practice authority.

Patient Outcome Estimates

Table E.6 summarizes the patient outcome effect estimates from the final set of included articles.

Table E.6. Summary of Patient Outcome Effect Estimates

Construct	Reference	Overall Effect of Expanded SOP
Infant mortality	Kleiner et al., 2016	No effect[b]
Health status	Traczynski and Udalova, 2014	No consistent difference in self-reported health status[a]
BMI	Traczynski and Udalova, 2014	No consistent difference in BMI[a]
Maternal health behaviors	Markowitz et al., 2016	Mothers are 2% less likely to drink during pregnancy
Infant birth outcomes	Markowitz et al., 2016	Increase in average birth weight by 8.37 grams and increased gestation period by one-half day[a]

[a] Prescription and practice authority.
[b] Prescription only.

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