

The Impact of Establishing a Full Scope of Practice for Nurse Practitioners in Michigan

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For more information on this publication, visit www.rand.org/t/RR1639

Library of Congress Cataloging-in-Publication Data is available for this publication.

ISBN: 978-0-8330-9651-7

Published by the RAND Corporation, Santa Monica, Calif.

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Preface

Policymakers and clinicians are concerned that future growth in demand for health care services will exceed current provider supply. One potential solution to meeting this demand is expanding the number and utilization of nurse practitioners (NPs). However, restrictive state scope-of-practice (SOP) regulations can affect NPs' potential to deliver health care services. NPs in Michigan do not currently have a defined SOP. Rather, they function under the SOP of registered nurses, which limits their ability to practice and prescribe. Legislators in Michigan are considering defining an SOP for NPs.

The purpose of this report is to examine the existing literature regarding the relationship between state NP SOP regulations and various health care delivery outcomes (provider supply, access to care, utilization of care, costs of care, and quality of care). We use the effect estimates from the literature to estimate the impact in Michigan if the state were to allow full practice and prescription authority for NPs. We intend for this report to help legislators, professional associations, and other interested stakeholders (particularly those in Michigan) understand the potential effects of establishing full SOP.

This work was sponsored by the Michigan Council of Nurse Practitioners. The research reported here was conducted in RAND Health, a division of the RAND Corporation. A profile of RAND Health, abstracts of its publications, and ordering information can be found at www.rand.org/health.

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Summary

Many policymakers and clinicians have argued that expanding the number and utilization of nurse practitioners (NPs) is an important strategy to meet future growth in the demand for health care services in the United States. State scope-of-practice (SOP) regulations, which govern the breadth of services that NPs can independently provide, affect the supply of NPs and their effectiveness in meeting patients' care needs. NPs in Michigan have no defined SOP; instead, they currently function under the SOP of registered nurses, which limits their ability to practice and prescribe. Legislators in Michigan are considering defining an SOP for NPs.

The purposes of this report are to (1) examine the existing literature on the relationship between state NP SOP regulations and various health care delivery outcomes (provider supply, access to care, utilization of care, costs of care, and quality of care) and (2) estimate the impact in Michigan if its legislature defined a full SOP for NPs. In this report, we define "full SOP" as allowing both autonomous practice and prescription authority. To do this, we developed a conceptual framework to guide the research and conducted an extensive literature review. We then applied estimates from the literature to construct Michigan-specific impacts of defining a full SOP for NPs. We identified only a small number of high-quality studies, making the evidence relatively limited.

Our review of the literature demonstrates that granting NPs full SOP would possibly improve access to care, utilization of care, and provider supply in Michigan. Given limitations in the evidence, we were unable to conclusively estimate the effect of a full NP SOP across a wide range of health care domains.

Abbreviations

ACS	ambulatory care sensitive
CINAHL	Cumulative Index to Nursing and Allied Health Literature
ED	emergency department
MEPS	Medical Expenditure Panel Survey
NAMCS	National Ambulatory Medical Care Survey
NP	nurse practitioner
RN	registered nurse
SOP	scope of practice

Chapter One. Introduction

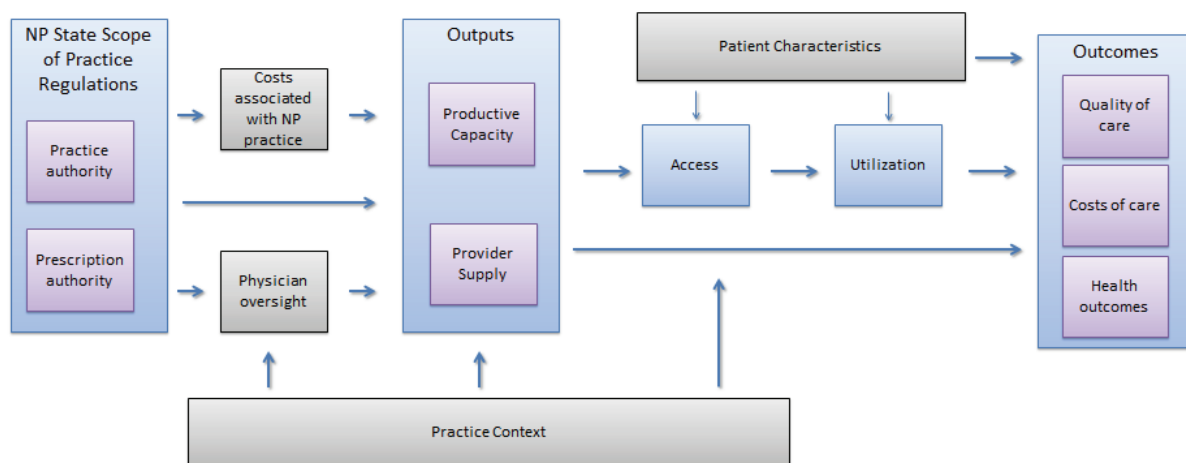
Many policymakers, clinicians, and researchers are concerned that demand for health care services could exceed provider supply as the population ages, more people live with chronic conditions, and health insurance coverage rates increase.¹ One strategy to help meet the demand for health care providers is to expand the supply of and access to nurse practitioners (NPs). However, state scope-of-practice (SOP) regulations, which govern the breadth of services that NPs can independently provide, affect the supply of NPs and their effectiveness in meeting patients' care needs.^{2,3} NP education prepares graduates to independently diagnose and treat conditions, as well as prescribe necessary medications, tests, and procedures. In some states, SOP regulations impose restrictions on which of these aspects of care NPs can provide. Some advocates and policymakers have argued that SOP regulations are necessary to ensure patient safety and high-quality care, while others have argued that restrictive SOP regulations for NPs could unnecessarily limit the supply of health care services without appreciably affecting quality or outcomes of care.² Nationwide, the trend in recent years has been toward allowing full practice and prescription authority (referred to in this report as "full SOP") for NPs, with an increasing number of states removing SOP restrictions since 2010.³ Full SOP allows NPs to perform all activities within their educational preparation, including diagnosing and treating conditions, prescribing medications, and performing minor procedures.

Recent efforts have established full NP SOP in many states across the United States. However, NPs in Michigan have no defined SOP; instead, they function under the SOP of registered nurses (RNs). RNs are bachelor-, associate-, or diploma-prepared nurses whose education does not prepare them to diagnose patients or prescribe medications; in contrast, NPs are advanced-practice RNs whose education does prepare them to diagnose and prescribe. But without a defined SOP, NPs are precluded from practicing independently and prescribing medication. In recent years, the Michigan legislature has considered defining an SOP for NPs. The Michigan Council of Nurse Practitioners commissioned the RAND Corporation to study the potential effects on various health care delivery outcomes (e.g., provider supply, access to care, and costs and quality of care) in Michigan of defining an NP SOP that allows full SOP. To address this aim, we first developed a conceptual framework outlining how and why establishing a full NP SOP might affect health care delivery. Second, we performed an extensive summary of literature estimating the relationship between NP SOP regulations and health care delivery. Third, we used the effect sizes from the literature to estimate Michigan-specific impacts if the effects of the state defining a full NP SOP were similar to those experienced by other states.

Chapter Two. Conceptual Framework

In this chapter, we present a conceptual framework outlining the mechanisms through which state NP SOP regulations likely affect health care delivery (Figure 2.1). This framework provides an important conceptual foundation for the Michigan Council of Nurse Practitioners and other stakeholders when considering the effects of full SOP for NPs. The framework reflects factors that have been discussed in public policy debates and peer-reviewed literature.⁴⁻⁸ We also use this conceptual framework to select areas of focus for the literature review and Michigan-specific impact estimates. In this framework, we focus primarily on patient outcomes (e.g., quality and cost of care) and not provider outcomes (e.g., burnout, job satisfaction, and turnover).

Figure 2.1. Conceptual Framework Through Which State Scope-of-Practice Regulations for Nurse Practitioners Likely Affect Health Care Delivery



We describe the framework moving from left to right. First, SOP regulations are state-governed laws that determine which actions health care professionals are permitted to perform. For NPs, these SOP regulations determine the breadth of services they can provide either independently or under the supervision of physicians. Generally, SOP regulations are described based on the extent to which they grant NPs practice authority, prescription authority, or both.^{8,9} *Practice authority* refers to the extent to which NPs can diagnose and treat patients without the supervision of or collaboration with a physician. Practice authority can be limited in several ways. For example, some states require NPs to have an established collaborative agreement with a physician to review the NPs' diagnoses and treatments and provide consultations, while other states do not require such an agreement but do not allow NPs to order physical therapy or sign

death certificates.¹⁰ In addition, some states allow NPs to sign handicap parking permits but not order physical therapy.¹⁰ *Prescription authority* refers to the extent to which NPs can prescribe medications without the supervision of or collaboration with physicians. Prescription authority also can vary based on the type of medication. For example, some states grant NPs general prescriptive authority but do not allow NPs to independently prescribe narcotics.¹⁰ *Full SOP* is defined as having no restrictions on practice authority or prescription authority.

NP SOP regulations likely affect health care delivery particularly by altering NP productive capacity and provider supply. We show these constructs as “outputs” of the effect of NP SOP regulations on health care delivery. We define *productive capacity* as the number, types, and appropriateness of services that an NP potentially can produce, holding all other production inputs constant.¹¹ (We use *productive capacity* similarly to the term *marginal productivity*, which is more commonly used in economic theory.) In this case, production inputs could be thought of as other labor (e.g., RNs and medical doctors) or structural characteristics of practice settings (e.g., health information technology and care managers). This notion of productive capacity is determined by the general characteristics of NPs’ clinical practice, including the speed at which NPs can see patients, NPs’ access to organizational resources, the choices about the types of patient care to deliver, and the skill by which NPs deliver those services. We distinguish between the *potential* number, types, and appropriateness of services delivered (productive capacity) and the *realized* services actually received by a patient. We define *provider supply* as the number of providers, the clinical hours that they work, and provider practice roles.

State NP SOP regulations can affect these outputs directly or by influencing physician oversight of NP practice or the costs associated with NP practice. NP SOP regulations can have direct effects on these outputs when NPs are not permitted to perform certain activities at all, even under the direction of a physician. Physician oversight can take many forms, such as requiring NPs and physicians to establish collaborative agreements or physicians to co-sign prescriptions. Particularly important to the relationship between NP SOP regulations and physician oversight is practice context. Health care organizations have the freedom to modify the SOP for their own NPs, but organization-specific NP SOP rules can never be more expanded than the state SOP regulations; they can only be more restrictive. For example, state SOP regulations may allow NPs to independently diagnose and treat, but a specific health care organization might decide that NPs must diagnose and treat under direct physician supervision. So, even though state SOP regulations might change, improvements in realized services delivered to patients still rely on the characteristics of the settings in which NPs practice.

NP SOP regulations could affect productive capacity and lead to a drop in the number of services that NPs can potentially produce by increasing the amount of time that it takes NPs to complete tasks as they wait for physician approval of their work. Conversely, many stakeholders argue that the physicians have more experience, education, and skill, so their oversight leads to changes in the types and appropriateness of services that NPs provide, ensuring that the NPs can deliver safe and effective care.^{12,13} Therefore, NP SOP regulations presuppose that physicians do

exert influence over NP practice and that there are meaningful differences in practice patterns among physicians and NPs.

NP SOP regulations also could affect these outputs—especially provider supply—by affecting the costs associated with NP practice. We distinguish between monetary costs incurred by health care organizations and those incurred by NPs themselves. If SOP regulations require added administrative burden for supervising NPs, an organization’s administrative costs may increase. NPs likely incur significant monetary costs associated with more-restrictive SOP laws. For example, cooperative agreements between NPs and physicians are expensive to establish and maintain and require significant time investments by both NPs and physicians. If the agreement is unexpectedly terminated, NPs experience practice disruptions and incur further costs to establish a new collaborator.⁷ As monetary costs increase, the supply of NPs is likely to decrease as organizations decide to have NPs work fewer hours or not hire them, or NPs decide to work fewer hours or practice in states with full SOP.⁷ Furthermore, although not of a monetary nature, restrictive SOP rules may also generate “psychic costs” for NPs, such as the stress of trying to find collaborative physicians or the loss of quality of life that comes from not being able to practice to the full extent of one’s abilities.¹⁴ Increased psychic costs also may lead NPs to decide to work fewer hours or practice in states with full SOP.

Changes in NPs’ productive capacity and provider supply could have various effects on health care delivery. First, these could affect patient access to care. The RAND Corporation defines *access to care* as the “ease with which an individual can obtain needed medical services.”¹⁵ Access can be measured in several different ways, including by the geographic distribution of providers and by patient reports of the ease with which they are able to access health care resources. To the extent that NP SOP regulations reduce the productive capacity of NPs or lead to reductions in the number of NPs, patients may experience worse access to care.

In combination with various clinical and sociodemographic characteristics of patients, access to care directly determines *utilization* of care. Importantly, utilization might be either “favorable” or “unfavorable,” as determined by the extent to which NP practice reflects or contributes to high-quality care. For example, an ambulatory care-sensitive (ACS) emergency department (ED) visit might be considered unfavorable utilization because it may reflect that a patient did not have access to high-quality primary care. So, the characteristics of patient utilization would contribute to various outcomes, such as quality of care, costs of care, and health outcomes.

Costs of care refers to the amount of money paid by payers (e.g., patients and health insurance companies) to health care providers and organizations in exchange for care delivered. *Quality of care* measures the extent to which care is safe, effective, patient-centered, timely, efficient, and equitable.¹⁶ *Health outcomes* are a patient’s health states resulting from health care¹⁷; these outcomes are also determined by patients’ clinical and sociodemographic characteristics. Finally, provider productive capacity also could have direct effects on outcomes that are not mediated by the access-utilization pathway. Costs of care, quality of care, and health

outcomes would be affected by NP SOP regulations to the extent that those regulations affect the types and appropriateness of services that NPs provide.

The extent to which productive capacity and provider supply directly affect outcomes depends on practice context. A practice's structural and organizational characteristics (e.g., health information technology and other labor inputs, collegial relations) are important contextual factors.¹⁸ One particularly important factor likely is the NP work environment, which includes NPs' specific roles within an organization, access to organizational resources, and relationships with physicians and administrators, as well as how an NP is promoted within a practice. Previous research suggests that there is significant variation in NP work environment across organizations.¹⁹⁻²³

Chapter Three. Literature Review

In this chapter, we review the literature related to the relationship between NP SOP regulations and health care delivery. We discuss the methods that we used to conduct the literature review and then present the results from the reviewed studies.

Methods

To identify databases and search terms for our literature review, we worked with a librarian specializing in public policy analysis. We searched the PubMed database and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) database for relevant studies. To retrieve the broadest set of studies possible, we employed a broad search strategy using the following search terms: scope AND practice AND nurs*. The initial search was limited to journal articles in English. We searched all dates starting from inception of PubMed, which returned articles published from 1959 through April 2016.

The original search strategy yielded 1,159 abstracts. We also identified eight abstracts from previous literature summaries that were not identified through the initial search, for a total of 1,167 abstracts. We each reviewed all titles and eliminated studies that were duplicates, not conducted in the United States, not related to NPs, or not related to state SOP regulations. We also performed a full review of the remaining abstracts and eliminated additional studies based on the same criteria. Furthermore, we eliminated studies that were literature reviews and that were not empirical, including commentaries, reviews, and theoretical discussions. This led to an elimination of 1,027 titles. We retrieved abstracts for the remaining 140 studies, of which we eliminated 100 after abstract review. We reviewed all included studies for concordance across authors. Next, we reviewed the remaining 40 full-text articles. Based on that review, we further eliminated 26 studies that were qualitative or that did not meet the aforementioned criteria, leaving a final count of 14 studies. See Appendix A for a flow diagram of the literature review results and process of narrowing to 14 studies.

After we identified the studies for inclusion, one author extracted key information from each study, including aims, data sources, population studied, variables of interest, analytic methods, and results. The work was reviewed by the other author to ensure the accuracy of the data extraction. See Appendix B, Table B.1 for a description of how each study defined or identified NPs, how it defined and contrasted states' SOP regulations, its data and study design, and a list of its relevant outcomes.

Next, we summarized the quality of the studies across three dimensions: recency of data used, generalizability of findings, and risk of bias in the estimates. We present narrative summaries across these three domains in 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.

Based on the conceptual framework, we then categorized each of the studies based on the outcomes of interest, including provider supply, access to care, utilization of care, costs of care, quality of care, and health outcomes. Some of the studies assessed more than one outcome of interest, so these studies are included in multiple sections of this report. For each of these categories, we summarized the results across all applicable studies. Some of the 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). We found no studies estimating the relationship between SOP regulations and measures of dimensions of health care quality other than patient-centeredness, such as adherence to evidence-based practice.

Importantly, the studies reviewed in this report used various approaches to measuring NP SOP regulation. Specifically, they varied on how they incorporated practice versus prescription authority into the SOP measures and how they defined the extent of SOP regulations. Studies used three basic approaches to measure state SOP laws: use only prescription authority to categorize states' SOP regulations, focus on both practice and prescription authority separately, or create combined measures. The studies also employed various approaches to scaling practice authority. Some used binary approaches that measured full versus limited SOP, while others created a three-level taxonomy that combined information on both practice and prescription authority to categorize states as some variant of full, reduced, or restricted SOP. When possible, we used results comparing the most-restrictive to the least-restrictive SOP regulations. Furthermore, for parsimony, we refer to “expanded” or “full” SOP throughout the results section, and depending on the study, this could refer to practice authority, prescription authority, or both. In this chapter, we provide a brief description of each study's approach to measuring SOP, but Appendix B provides more information on those approaches.

Finally, we summarize the evidence across all studies within a category. We provide a narrative summary and categorize the effect of full NP SOP as likely, possible, or inconclusive. *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

In the following subsections, we describe the results of each of the 14 studies, which were based on data ranging from 1989 through 2013. Eleven studies used data through at least 2004, while three studies used data from the early to mid-1990s. All of the studies were based on national or nationally representative data sets. Six studies used a longitudinal design with some

control for unobserved confounders, one study used a longitudinal design but did not account for important unobserved confounders, five studies used a cross-sectional design with regression adjustment for observable confounders, and two studies 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, while studies with cross-sectional designs and studies that did not use any methods for adjustment had the highest risk of bias. Two of the studies attempted to control for unobservable state characteristics but used very crude methods of measuring NP supply, measuring either any RN with a graduate degree²⁴ or all advanced-practice RNs (NPs, certified nurse-midwives, certified nurse anesthetists, and clinical nurse specialists).²⁵

The cross-sectional studies compared states with full SOP (practice and/or prescriptive authority) to states with limited SOP. In those studies, depending on the approach to measuring SOP regulations, anywhere between ten and 17 states had full SOP. These states tended to be in the western and northeastern United States. In the longitudinal studies, the effect estimates were based on within-state changes in practice and/or prescriptive authority over the course of the study. Of the studies that reported the number of states that experienced changes in authority, six to eight states increased authority over the course of the studies. One study focused on changes in prescriptive authority for controlled substances only. In this study, 30 states increased authority. Again, states that changed practice and/or prescriptive authority over the course of the studies were often in the west or northeast. Importantly, seven of the studies used both practice and prescription authority as a measure of full SOP, while three used prescription authority alone, three used prescription authority and direct reimbursement, and one used practice authority and direct reimbursement. Of studies that examined the relationship between NP SOP and our outcomes of interest, ten looked at provider supply, one at access, three at utilization, three at costs, one at quality of care, and three at health outcomes. Notably, one of the highest-quality studies was a National Bureau of Economic Research working paper not currently in a peer-reviewed journal.²⁶ Table 3.1 provides a high-level summary of the results of the studies across each domain, followed by a narrative description. We provide more-detailed results in Appendix E.

Table 3.1. Summary Results of Establishing Full Scope-of-Practice Laws for Nurse Practitioners

Aspect of Care	Overall Effect of Full SOP	Summary of the Evidence
Provider supply	Possible improvement	A plurality of reviewed studies showed positive associations between full NP SOP and provider counts. These studies suggest that full NP SOP possibly contributes to increases in provider supply. However, the vast majority of these studies, although based on national samples, used cross-sectional analyses. Therefore, we cannot conclusively determine that there is a causal relationship between NP SOP regulations and supply. Therefore, we can characterize the positive effect of establishing full NP SOP on provider supply as “possible.” There is also some evidence that NPs may be more likely to work in direct patient care and primary care in states with full SOP relative to states with restricted SOP, but again, the studies are limited and based on cross-sectional studies.
Access to care	Possible improvement	There was only one study examining the relationship between NP SOP regulations and access to care. This study used a very strong design and national data, finding that residents in states with full NP SOP tended to have better access to care. These findings suggest that establishing full state NP SOP would possibly lead to improvements in access to care. However, the evidence remains relatively weak because it is drawn from a single study. More evidence is needed to fully understand the impact of NP SOP on access to care.
Utilization of care	Possible improvement	All three studies that we reviewed found some relationship between NP SOP regulation and utilization. Particularly, two high-quality studies based on national data showed that less-restrictive SOP regulations led to increases in ambulatory utilization. Two studies provide solid, but limited, evidence that establishing a liberal SOP for NPs can possibly lead to a reduction in inpatient utilization, which can be considered an “unfavorable” type of utilization that could reflect inadequate ambulatory care. One study found a reduction in ACS ED visits after states establish full NP SOP; this study was of high quality and based on national data. A second study found reductions in hospitalizations, but it made little attempt to control for bias. Overall, these studies suggest that defining a full SOP could lead to an increase in ambulatory utilization and a reduction in unfavorable utilization. However, the evidence remains relatively limited.
Costs of care	Inconclusive	We found mixed relationships between NP SOP and costs of care. One high-quality, national study found no effect of NP SOP total costs, whereas two other national studies found that some components of costs (e.g., NP wages) were lower in states with less-restrictive SOP rules. One study found that prices of well-child visits were lower in states with less-restrictive SOP rules, while the remaining studies found no effect. Therefore, the effects on costs are largely inconclusive.
Quality of care	Possible improvement (patient-centeredness)	One high-quality national study found significant improvements across multiple patient-experience measures. However, we found no studies that assessed other dimensions of health care quality.
Health outcomes	Inconclusive	Evidence examining the relationship between NP SOP regulations and health outcomes found little effect. One high-quality national study found inconsistent improvements in body mass index and self-reported health status. Two national studies found no relationship between NP SOP regulations and infant mortality. Therefore, the results do not conclusively demonstrate that establishing full NP SOP for NPs will lead to improvements in health outcomes.

Provider Supply

Ten studies examined the relationship between NP SOP and provider supply. In these studies, *provider supply* was operationalized as the number of providers in a given geographic area, hours worked, or provider roles. *Provider roles* referred to the employment of NPs in specific types of practices (e.g., primary care) or the use of NPs as primary care providers.

Number of providers. Five studies examined the relationship between state SOP regulations and provider counts. Graves et al. found that states with full SOP (practice and prescription) had 36 percent more primary care NPs,²⁷ while Reagan and Salsberry found 25 percent more NPs in states that allowed full practice and prescription authority.²⁸ Lin and Burns found no effect on NP counts in states that allow full practice authority and direct reimbursement,²⁹ while Sekscenski et al. found more NPs in states with higher levels of SOP on a 100-point scale but did not report effect sizes.³⁰ Moreover, Graves et al. found that full SOP was also correlated with more primary care physicians and physician assistants in the state.²⁷ Although Perry did not directly investigate provider counts, the study did find that NPs were 46 percent less likely to move out of states that allow full prescription authority and direct reimbursement.³¹ Finally, although not directly applicable to provider counts, Kalist and Spurr found that states with full prescription authority have 12 percent higher enrollment per capita in advanced-practice RN programs.²⁵ However, this study measured the total enrollment of advanced-practice RNs, so we cannot determine the magnitude of the effect on NP enrollment specifically.

Hours worked. Only one study assessed the relationship between NP SOP regulations and number of hours worked. Kleiner et al. found that NPs in states that allowed full prescription authority worked 297 more hours on average per year while physicians worked 187 fewer hours on average.²⁴ However, this study measured NPs as any RN with an advanced degree (master's, PhD, or professional degree). Therefore, it is difficult to determine the magnitude of the effect specifically for NPs.

Provider roles. Finally, three studies examined the relationship between NP SOP and provider roles. Both of these studies measured full SOP as both practice and prescription authority. In a relatively weak study, Kuo et al. found a 250-percent increase in the use of NPs as primary care providers over a ten-year time frame.³² A report by Westat found that NPs were 5.0 percentage points more likely to work in direct patient care and 3.4 percentage points more likely to work in primary care in states with full SOP (both practice and prescription authority) compared to states with restricted SOP (neither practice nor prescription authority).⁷ Ku et al. found that states with full practice and prescription authority had 2 percent more advanced-practice staff (NPs, physician assistants, and certified registered nurse-midwives) in community health centers and 2 percent fewer physicians.³³ We cannot determine the specific effect for NPs because, in this study, NPs were combined with other advanced-practice clinical staff.

Summary. A plurality of reviewed studies showed positive associations between full NP SOP and provider counts. These studies suggest that full NP SOP possibly contributes to increases in

provider supply. However, although based on national samples, the vast majority of these studies used cross-sectional analyses, and we cannot conclusively determine that there is a causal relationship between NP SOP regulations and supply. Therefore, we can characterize the positive effect of establishing full NP 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, but again, the studies are limited and based on cross-sectional designs.

Access to Care

In this section, we review evidence from one study examining the relationship between state NP SOP regulations and access to care as measured by patient self-report. In a strong longitudinal study, Traczynski and Udalova found higher levels of patient-reported access to care associated with states that implemented full practice and prescription authority for NPs relative to states with restricted authority.²⁶ Depending on the observation period after changes to SOP regulations and the population studied (i.e., adults or children), residents in states with full SOP were between 7 and 24 percentage points more likely to report the highest levels of access as 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. There was only one study examining the relationship between NP SOP regulations and access to care. This study, which used a strong design and relatively recent national data, 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 would possibly lead to improvements in access to care. But the evidence remains relatively weak because it is drawn from a single study. More evidence is needed to fully understand the effect of NP SOP on access to care, so we categorize the positive effect of establishing full NP SOP on access to care as possible.

Utilization of Care

We identified three studies examining the relationship between NP SOP regulations and utilization of care. We separated our results into ambulatory and inpatient utilization.

Ambulatory utilization. Two studies (Stange; Traczynski and Udalova) focused on the effect of SOP regulations on the number of ambulatory provider visits.^{26,34} These studies identified higher utilization of ambulatory care in states with full NP SOP. Stange found that individuals in states with less-restrictive NP prescriptive authority regulations had 3 percent more visits conditional on having at least one office-based provider,³⁴ while Traczynski and Udalova found that individuals in states with full SOP (both practice and prescription authority) were between 3.9 and 6.8 percentage points more likely to receive a routine check-up.²⁶

Inpatient utilization. Two studies (Oliver et al.; Traczynski and Udalova) focused on the relationship between state SOP regulations and inpatient utilization measures, such as hospital admissions, readmissions, and ED visits.^{26,35} Traczynski and Udalova 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).²⁶ Oliver et al. found that hospitalization rates for Medicare and Medicaid beneficiaries were 31.3 percent lower in states with full (both practice and prescription) NP SOP than states without.³⁵ Moreover, this study showed that rates of 30-day hospital readmissions from rehabilitation facilities were 11 percent lower and annual hospitalizations of nursing home patients were 30 percent lower in a state with full NP SOP (both practice and prescription). It is important to note, however, that the Oliver et al. study employed very little control for differences across states that could be determining hospital utilization independent of NP SOP regulations.

Summary of the evidence. All three of the studies found some relationship between NP SOP regulation and utilization. Particularly, using strong research designs based on relatively recent national data, two studies showed that less-restrictive SOP regulations led to increases in ambulatory utilization. Two studies showed that establishing liberal SOP for NPs could lead to a reduction in inpatient utilization, which can be considered an “unfavorable” type of utilization. One study found a reduction in ACS ED visits after states established full NP SOP; this study was of high quality and drawn from national data. A second study found reductions in hospitalizations, but it made little attempt to control for bias. Overall, these studies suggest that defining a full SOP could lead to an increase in ambulatory utilization and a reduction in unfavorable utilization. However, the evidence remains relatively limited, so we characterize the positive effect of establishing full NP SOP on utilization of care as possible.

Costs of Care

We identified three studies that examined the relationship between state SOP regulations and costs of care (or components thereof). In line with the conceptual framework (see Figure 2.1), we differentiate between costs associated with NP practice and costs of care. Two studies (Perry; Stange) used strong longitudinal research designs and relatively recent data^{34,36}; one additional study (Kleiner et al.) used a very coarse measure of NPs—essentially any RN who held a graduate or professional degree—but otherwise used a strong research design.²⁴

Costs associated with NP practice. Kleiner et al. and Perry investigated the relationship between SOP regulations and wages of NPs and other providers (such as physicians).^{24,36} These studies showed that NPs practicing in states with full prescription authority earn up to 14 percent more than NPs in more-restrictive states. The relationship between NP SOP and physician salaries is less clear. Perry found that physician wages were 7 percent lower in states with full NP SOP than in states without,³⁶ while Kleiner et al. found no effect in states with full prescription authority.²⁴ Kleiner et al. also examined the relationship between NP SOP and malpractice insurance rates, finding no relationship.²⁴

Costs of care. Two studies (Kleiner et al.; Stange) investigated the effect of SOP regulations on unit prices (or charges) for office visits for either well-child visits or general office visits.^{24,34} Kleiner et al. found that the price for well-child visits was 16 percent lower in states with full

prescription authority than in states without,²⁴ while Stange 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.³⁴

Summary. We found mixed relationships between NP SOP and costs of care. One high-quality, national study found no effect of NP SOP total costs, whereas two other national studies found that some components of costs (e.g., NP wages) were lower in states with less-restrictive SOP rules. One found that prices of well-child visits were lower in states with less-restrictive SOP rules, while the remainder found no effect. Therefore, we characterize the effect of establishing full NP SOP on costs of care as largely inconclusive.

Quality of Care: Patient-Centeredness

We found only one study that focused on any aspect of quality of care. This study focused on patient-centeredness as measured by patient experience of care. However, we found no studies that assessed other dimensions of quality. Traczynski and Udalova investigated the relationship between state NP SOP regulations and patient experience of care.²⁶ This longitudinal national study found that, compared to states that did not expand NP SOP, states that did expand the scope (practice and prescription authority) had higher scores on patient experience measures, including ratings of time spent with a provider, whether the provider listens carefully, and whether the provider explains clearly. Specifically, adults in states with full NP SOP reported higher levels on two of three measures (8.8–8.9 percentage point increase in the probability of reporting that providers listen carefully and 7.4–8.5 percentage point increase in explaining clearly), and caregivers of children reported higher levels on all three measures (12.4–18.9 percentage point increase in reporting providers spending enough time with them, 9.2–15.3 percentage point increase in listening carefully, and 10.2–13.5 percentage point increase in explaining carefully).

Summary. Because there is only one study, we categorize the positive effect of establishing full NP SOP on quality of care (patient-centeredness) as possible. There were, however, no studies examining the effect of NP SOP on other quality domains.

Health Outcomes

Three studies examined the relationship between state NP SOP regulations and other health outcomes, such as infant mortality, health status, and body mass index. Traczynski and Udalova found that self-reported health status of adults improves and body mass index decreases after a state adopts full NP independence, although these associations are not consistently significant across various estimation models.²⁶ Finally, Oliver et al. and Kleiner et al. found no relationship between NP prescription authority regulations and infant mortality rates.^{24,35}

Summary. Evidence examining the relationship between NP SOP regulations and health outcomes was mixed. One national study found inconsistent improvements in body mass index and self-reported health status. Two national studies, one of relatively high quality and another of

low quality, found no relationship between NP SOP regulations and infant mortality. Therefore, the results do not conclusively demonstrate that establishing full NP SOP will lead to improvements in health outcomes.

Overall Summary of Evidence

Overall, evidence of the relationship between NP SOP regulations and any specific aspect of health care delivery is relatively limited (in terms of number and quality of studies). We identified only 14 studies, of which only six used longitudinal research designs with control for confounders. All of the studies were based on national data sets. The cross-sectional studies 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 that changed SOP regulations over a relatively long time horizon. The states with less-restrictive SOP regulations tended to be located in the west and northeast. Furthermore, these studies used various definitions of full SOP. Finally, no study has estimated the effect of NP SOP regulations on dimensions of quality of care other than patient-centeredness. Therefore, it is difficult to assess the extent to which the results are fully generalizable to Michigan currently. Despite the limitations of the available studies, the studies suggest that full SOP can possibly contribute to improvements in provider supply, access to care, utilization of care, and quality of care (patient-centeredness). The effect of full SOP on costs and health outcomes was largely inconclusive.

Chapter Four. Michigan-Specific Impact

In this section, we use the results from the literature review to estimate the potential impact on health care delivery of establishing full NP SOP in Michigan. We first discuss the methods that we used to estimate the effects and then present our results.

Methods

We estimated Michigan-specific results by applying the published effect sizes to publicly available data for Michigan. Importantly, the effect sizes in the literature are generally drawn from national samples, use data from earlier years, and are drawn from studies of variable quality. Therefore, we cannot make exact estimates for Michigan, and caution must be used when interpreting these results. However, if we assume that the effects observed in other states would be similar in Michigan, we can produce reasonable estimates of the effect in Michigan.

Given the high degree of uncertainty about the potential effects in Michigan, we have taken several steps to ensure that we were conservative in our estimates. First, we estimated effects only from studies in which we have the most confidence. These studies are longitudinal and use the highest-quality evaluation methods, adequate approaches to control for confounding, and relatively recent data. Only two studies met these criteria; therefore, the Michigan-specific results are based on just two studies (Traczynski and Udalova; Stange).^{26,34}

Second, we constructed 95-percent confidence intervals around these estimates based on the reported standard errors for effect estimates. To do this, we multiplied the 1.96 test statistic by the reported standard errors corresponding to each significant effect estimate, then subtracted that value from the mean to get the lower limit or added to get the upper limit. This approach assumes the 95-percent confidence area under a normally distributed curve. Therefore, we can include Michigan-specific estimates only for studies that reported standard errors. Third, we calculated Michigan-specific effects only for statistically significant results in the literature with a p -value less than 0.05. Fourth, in cases in which a study used various methods or measures (e.g., 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 Michigan-specific effects only when we were able to access publicly available data sources. We did not calculate effects on health care status and body mass index based on Traczynski and Udalova because the data needed to do so are available only in the restricted-access files from the Medical Expenditure Panel Survey (MEPS). These restrictions limit the number of results we are able to calculate for Michigan but ensure that the results we do calculate are those in which we are most confident.

Due to a lack of state-specific data, many of the Michigan-specific variables had to be estimated. For example, many of the databases used in the studies do not include publicly available data that can be used to make state-level estimates, and we were unable to purchase data and create our own estimates. Therefore, we often used a combination of Michigan-specific and national data to create estimates for Michigan, and using national data assumes that Michigan resembles the rest of the country on average. In the results section, we provide detailed information about how we calculated each variable used in the analysis.

Results

Provider Supply

We identified a single high-quality study that estimated the effect of establishing full NP SOP on provider supply (Perry).³⁶ This study, however, did not report standard errors for its estimates, which prevented us from creating confidence intervals. Therefore, we did not include a Michigan-specific effect estimate of provider supply.

Access to Care

Traczynski and Udalova found improvements on three patient-reported measures of access after states established full SOP (both practice and prescriptive authority). First, they found that the proportion of adults who report that they are able to get an appointment when wanted (i.e., the highest rating on the question) increased by about 7.5 percentage points 1–2 years after establishing full SOP.²⁶ Roughly 52 percent of adults in the United States report that they are able to schedule an appointment when wanted,³⁷ equating to about 4,027,058 adults in Michigan (based on a total adult population of 7,699,919).^{37,38} Applying the estimate from Traczynski and Udalova, this means that roughly 579,804 additional adults will report that they can schedule an appointment when wanted 1–2 years after Michigan establishes full SOP. The estimate for 11 or more years following SOP reform was not statistically significant.

Second, Traczynski and Udalova found that the proportion of adults who report that they are able to get care when they are sick (the highest rating on the question) increased by about 8.87 percentage points 1–2 years after establishing full SOP, but the measure was not statistically significant 11 or more years afterward.²⁶ About 57 percent of adults nationally reported that they are able to get care when sick,³⁷ corresponding to roughly 4,404,354 adults in Michigan.³⁸ Applying the estimates from Traczynski and Udalova, 1–2 years after Michigan establishes full SOP, roughly 682,983 additional adults may report that they can get an appointment when sick. It is worth noting that the confidence interval on the estimate of the effect 1–2 years after establishing full SOP is quite wide, indicating that the effect could be as small as 118,548 or as large as 1,247,418 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 reporting an ability to easily travel to their provider (the highest rating on the question) increased by about 6.37 percentage points 1–2 years after establishing full SOP and 12.8 percentage points 11 or more years afterward.²⁶ National estimates suggest that about 67 percent of adults can easily travel to their provider,³⁷ which is roughly 5,158,946 adults in Michigan.³⁸ Applying the effect estimates from Traczynski and Udalova, there may be 490,485 additional adults who report the ability to easily travel to their provider 1–2 years after establishing full SOP, and 959,590 more adults 11 or more years afterward.

Table 4.1 summarizes our effect estimates on these three patient-reported measures of access to care for adults in Michigan.

Table 4.1. Estimated Change in the Number of Michigan Adults Reporting the Highest Ratings on Three Measures of Access to Care

Measure	Get Appointment When Wanted	Get Appointment When Sick	Easily Travel to Provider
Baseline	4,027,058	4,404,354	5,158,946
Difference 1–2 years after SOP reforms	579,804 (271,930 to 887,677)	682,983 (118,548 to 1,247,418)	490,485 (152,428 to 828,542)
Difference 11+ years after SOP reforms	<i>Not significant</i>	<i>Not significant</i>	959,590 (244,580 to 1,726,599)

SOURCE: Traczynski and Udalova, 2014²⁶; proportion of adults reporting each of the three access to care measures from MEPS, 2013³⁷; Michigan population from U.S. Census Bureau, 2015.³⁸

NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

These effects were larger among children (Table 4.2). Traczynski and Udalova estimated that self-reported access measures for children would increase from between 12 and 25 percentage points following establishment of full SOP, or between roughly 267,000 and 553,000 children in Michigan.³⁸ These results are based on the assumption that there are 2,222,657 children under the age of 18 in Michigan,³⁸ and approximately 76 percent can get an appointment when wanted, 84 percent can get an appointment when sick, and 81 percent can easily travel to their provider.³⁷ See Appendix E for specific effect sizes for children.

Table 4.2. Estimated Change in the Number of Michigan Children Reporting the Highest Ratings on Three Measures of Access to Care

Measure	Get Appointment When Wanted	Get Appointment When Sick	Easily Travel to Provider
Baseline	1,689,219	1,864,809	1,800,352
Difference 1–2 years after SOP reforms	268,941 (65,933 to 471,950)	348,957 (73,632 to 624,282)	266,719 (28,859 to 504,579)
Difference 11+ years after SOP reforms	553,442 (342,591 to 764,292)	302,281 (36,105 to 568,458)	368,961 (118,903 to 619,019)

SOURCE: Traczynski and Udalova, 2014²⁶; proportion of children reporting each of the three access to care measures from MEPS, 2013³⁷; Michigan population from U.S. Census Bureau, 2015.³⁸
 NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Utilization of Care

Two studies rated as good quality examined the effect of SOP regulation on utilization. Stange estimated that establishing full prescriptive authority for NPs is associated with a 3.1-percent increase in the number of office-based provider visits.³⁴ The most-recent estimate of office-visit counts in Michigan is from a 2012 National Ambulatory Medicare Care Survey (NAMCS) annual report.³⁹ Based on that report, we estimate that there were approximately 21,245,000 office visits in Michigan in 2012,³⁹ so establishing full NP prescriptive authority might lead to roughly 658,595 more office visits per year (Table 4.3).

Table 4.3. Estimated Change in the Number of Office-Based Provider Visits in Michigan

Measure	Number of Office-Based Provider Visits
Baseline	21,245,000
Difference	658,595 (382,410 to 934,780)

SOURCE: Stange, 2014³⁴; number of office-based provider visits from NAMCS, 2012, Annual Summary Tables.³⁹
 NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Traczynski and Udalova estimated that the likelihood that an adult would receive an annual checkup would increase by about 3.9 percentage points 1–2 years after establishing full SOP and about 6.8 percentage points 11 years afterward.²⁶ The latest national estimate indicates that roughly 63 percent of people receive their annual checkup,³⁷ which would equate to 4,850,949 adults in Michigan.³⁸ Within 1–2 years of establishing full SOP, Michigan might expect that 304,917 additional adults would receive their annual checkup, and 11 years afterward, 523,594 additional adults would receive the checkup (Table 4.4).

Table 4.4. Estimated Change in the Number of Adults in Michigan Who Would Receive an Annual Checkup

Measure	Number of Adults Receiving Annual Checkup
Baseline	4,850,949
Difference 1–2 years after SOP reforms	304,917 (143,434 to 466,399)
Difference 11+ years after SOP reforms	523,594 (242,866 to 804,303)

SOURCE: Traczynski and Udalova, 2014²⁶; proportion of adults receiving checkup from MEPS, 2013³⁷; Michigan population from U.S. Census Bureau, 2015.³⁸

NOTE: Numbers indicate the number of adults in Michigan who would have received a routine checkup in the past 12 months. Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Costs of Care

Only one high-quality study (Perry) found a significant effect of establishing full NP SOP on costs (e.g., NP wages), although that study did not include standard errors for its estimates.³⁶ Therefore, we did not calculate Michigan-specific effect on costs.

Quality of Care: Patient-Centeredness

Traczynski and Udalova found an effect of establishing full SOP (practice and prescriptive authority) on patient-reported experiences.²⁶ They found no significant results related to patients thinking that providers spent enough time with them (i.e., the highest rating on the question).

They found that the proportion of adults reporting that their provider listened carefully (the highest rating on the question) could increase 8.9 percentage points 1–2 years after establishing full SOP and 8.8 percentage points after 11 or more years. National estimates suggest that roughly 64 percent of adults report that their provider listened carefully,³⁷ which equals about 4,897,148 adults in Michigan.³⁸ Applying the estimates from Traczynski and Udalova, we might expect an additional 689,913 adults in Michigan to report that their provider listened carefully 1–2 years after reform and an additional 682,983 adults 11 or more years after reform.

In addition, Traczynski and Udalova found that the proportion of adults who report that their provider explained things clearly (the highest rating on the question) might increase by about 7.4 percentage points 1–2 years after establishing full SOP, but after 11 or more years, the result was not statistically significant.²⁶ Roughly 64 percent of adults report that their provider explained things clearly,³⁷ equating to roughly 4,943,348 adults in Michigan.³⁸ Applying the effect estimates to Michigan, establishing full SOP for NPs might result in an additional 572,874 adults reporting that their provider explained things clearly.

Table 4.5 summarizes our effect estimates on these three measures of quality of care for adults in Michigan.

Table 4.5. Estimated Change in Michigan Adults Reporting the Highest Ratings on Three Measures of Quality of Care

Measure	Provider Spent Enough Time	Provider Listened Carefully	Provider Explained Things Clearly
Baseline	4,219,556	4,897,148	4,943,348
Difference 1–2 years after SOP reforms	<i>Not significant</i>	689,913 (513,338 to 866,487)	572,874 (126,155 to 1,019,592)
Difference 11+ years after SOP reforms	<i>Not significant</i>	682,983 (144,204 to 1,221,762)	<i>Not significant</i>

SOURCE: Traczynski and Udalova, 2014²⁶; proportion of adults reporting the three quality of care measures from MEPS, 2013³⁷; Michigan population from U.S. Census Bureau, 2015.³⁸

NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

The results were again larger for children. Traczynski and Udalova estimated that self-reported provider quality measures for children would increase from between 9.2 and 18.9 percentage points after establishing full SOP,²⁶ or between roughly 205,000 and 420,000 children in Michigan.³⁸ Approximately 77 percent report that their provider spent enough time, 81 percent that their provider listened carefully, and 81 percent that their provider explained things clearly.³⁷

Table 4.6. Estimated Change in Michigan Children Reporting the Highest Ratings on Three Measures of Quality of Care

Measure	Provider Spent Enough Time	Provider Listened Carefully	Provider Explained Things Clearly
Baseline	1,711,446	1,809,243	1,804,798
Difference 1–2 years after SOP reforms	275,609 (152,759 to 398,460)	205,151 (72,281 to 338,022)	226,711 (37,207 to 416,215)
Difference 11+ years after SOP reforms	420,082 (225,786 to 614,378)	340,067 (184,543 to 495,590)	300,059 (69,169 to 530,948)

SOURCE: Traczynski and Udalova, 2014²⁶; proportion of children reporting the three quality of care measures from MEPS, 2013³⁷; Michigan population from U.S. Census Bureau, 2015.³⁸

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 unfavorable utilization. Traczynski and Udalova estimated a 14-percent decrease in the number of ACS ED visits 1–2 years after establishing full SOP and a 12.8-percent decrease after 11 or more years. As of 2012, there were roughly 259,773 ACS ED visits in Michigan 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 reported in Fingar et al.⁴⁰ Therefore, applying the estimates from Traczynski

and Udalova, we might expect roughly 36,368 fewer ACS ED visits 1–2 years after establishing full SOP and 33,251 fewer after 11 or more years.

Table 4.7. Estimated Change in the Number of Ambulatory Care-Sensitive Emergency Department Visits in Michigan

Measure	ACS ED Visits
Baseline	259,773
Difference 1–2 years after SOP reforms	-36,368 (-58,771 to -13,965)
Difference 11+ years after SOP reforms	-33,251 (-55,654 to -10,848)

SOURCE: Traczynski and Udalova, 2014²⁶; number of ACS ED visits from Fingar et al., 2015⁴⁰; Michigan population from U.S. Census Bureau, 2015.³⁸
 NOTE: Numbers in parentheses represent the lower and upper confidence intervals calculated using the reported standard errors.

Chapter Five. Discussion

Many policymakers and clinicians have argued that expanding the number and utilization of NPs is an important strategy to meet future growth in the demand for health care services in the United States. As mentioned, restrictive state SOP regulations may limit the supply of NPs and their effectiveness in meeting patients' care needs. NPs in Michigan currently function under the SOP of RNs, limiting their ability to practice and prescribe. Michigan legislators are now considering defining an SOP for NPs. This report has examined the existing literature related to the relationship between state NP SOP regulations and provider supply, access to care, utilization of care, costs of care, quality of care, and health outcomes; in addition, it has estimated the impact on Michigan if the legislature established a full SOP for NPs.

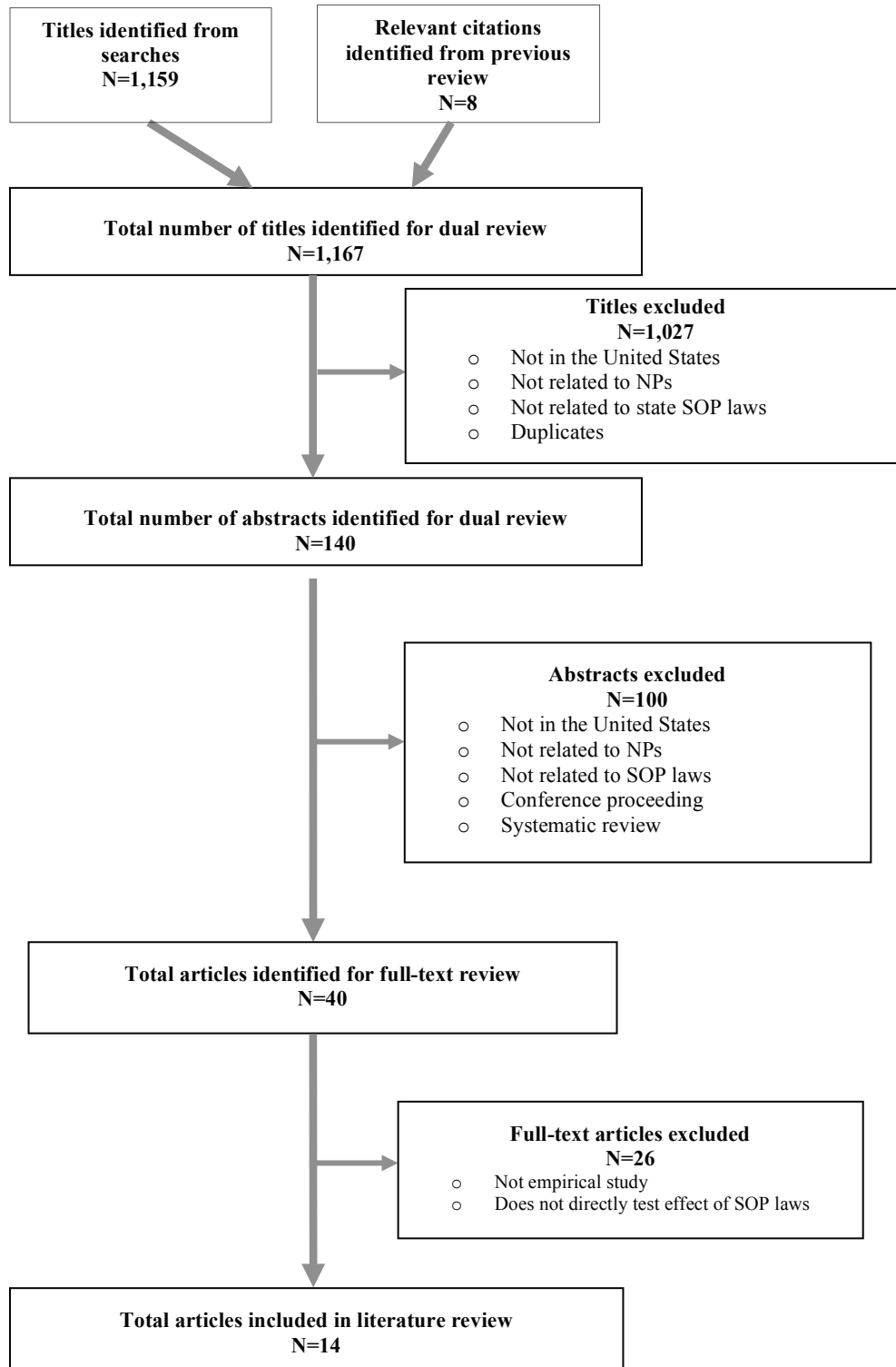
During the literature review, we identified 14 studies examining the relationship between NP SOP regulations and health care delivery domains. As a result of the small number of studies and their quality, overall evidence of the relationship between NP SOP regulations and any specific aspect of health care delivery is relatively limited. Of the 14 studies we identified, only six used longitudinal research designs with adequate control for confounding. However, all of the studies were based on national data sets. The cross-sectional studies were based on comparisons of a large number of states with different levels of SOP regulations. The longitudinal studies, on the other hand, were based on a relatively small number of states that changed SOP regulations over a relatively long time horizon. The states with less-restrictive SOP regulations tended to be located in the western and northeastern United States, and these studies used various definitions of full SOP. Therefore, it is difficult to assess the extent to which the results are fully generalizable to Michigan currently. Despite the limitations of the available studies, our findings suggest that full SOP can potentially contribute to improvements in provider supply, access to care, utilization of care, and quality of care (patient-centeredness). No study has estimated the effect of NP SOP regulations on other dimensions of quality of care. The effects of full SOP on costs and health outcomes were largely inconclusive.

Following the literature review, we used the estimates from the highest-quality studies and applied them to create Michigan-specific effect estimates. We used only the most-convincing and complete results from the highest-quality studies to create conservative estimates and attempt to limit bias. Our exclusion criteria resulted in only two studies being included in the estimates of Michigan-specific impacts. Using these restrictions, we were able to calculate expected effects on access and quality. Our estimates suggest that establishing full SOP for NPs could lead to potentially meaningful improvements in access and quality (patient-centeredness) in Michigan.

Taken together, our findings suggest that there may be possible improvements in provider supply, access to care, utilization of care, and quality of care (patient-centeredness) as a result of establishing a full SOP for NPs in Michigan. Further research is needed to assess the effects of expanding NP SOP on costs and other dimensions of health care quality.

Appendix A. Literature Review Flow Diagram

Figure A.1. Literature Review Flow Diagram



Appendix B. Detailed Study Summaries

Table B.1 summarizes each included study's characteristics, including definition of NP, SOP measure, data and study design, and relevant outcomes.

Table B.1. Summary of 14 Included Studies

Reference	Definition of Nurse Practitioner	SOP Measure	Data and Study Design	Relevant Outcomes
Graves et al., 2016 ²⁷	Counts of NPs with National Provider Identifier from administrative data	Categorized states as either full (both prescriptive and practice authority), reduced (one of two), or restricted (none) practice, comparing states with reduced and restricted practice to 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 ²⁵	Combined all advanced-practice RNs (NPs, certified nurse-midwives, certified nurse anesthetists, and clinical nurse specialists)	Levels of prescriptive and practice authority (high and low prescriptive or practice authority). The study includes a term for contrasts between high and low prescriptive authority, a term for contrasts between high and low practice authority, and an interaction term for both high practice and high prescriptive authority.	Longitudinal national study using data on SOP laws and master's degree nursing program enrollment in each state from 1989 to 1995	Enrollment in advanced-practice RN programs
Kleiner et al., 2014 ²⁴	All RNs with an advanced degree (master's, PhD, or professional degree)	Independent prescription authority and whether NPs can prescribe controlled substances. Compared supervised prescription authority and limited prescription authority to 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 through 2009	Hours worked, infant mortality, and costs of well-child visits
Ku et al., 2015 ³³	Combined all advanced-practice staff (NPs, physician assistants, and certified registered nurse-midwives)	Categorized states as either full (both prescriptive and practice authority), partial (one of two), or restricted (none) practice. Compared full and partial to restricted practice authority.	Cross-sectional national analysis using 2012 data on characteristics of all community health centers and data on state-level NP SOP laws	Employment in community health centers
Kuo et al., 2013 ³²	Identified NPs based on Unique Provider Identification or National Provider Identifier	Categorized states as either full (both prescriptive and practice authority), reduced (one of two), or restricted (none) practice.	Longitudinal national study using Medicare claims data on care provided by NPs and data on state-level SOP laws from 1998 to 2010	Use of NPs as primary care physicians

Reference	Definition of Nurse Practitioner	SOP Measure	Data and Study Design	Relevant Outcomes
Lin et al., 1997 ²⁹	Indicated by state Boards of Nursing as certified or registered NP	Compared states that allowed independent practice and/or direct reimbursement for NPs with states that did not.	Cross-sectional, national county-level study using state nursing board licensing data, data on SOP laws, and county characteristics from the Area Health Resource File in 1994	NP supply
Oliver et al., 2014 ³⁵	Combined all advanced-practice RNs (NPs, certified nurse-midwives, certified nurse anesthetists, and clinical nurse specialists)	Categorized states as either full (both prescriptive and practice authority), reduced (one of two), or restricted (none) practice. Compared full with reduced and restricted, and compared reduced with restricted.	Cross-sectional national analysis using data on state SOP laws in 2013 and public reports on state-level outcomes	Hospitalizations and readmissions
Perry, 2009 ³⁶	Little detail on how NPs were defined other than they were identified from the National Sample Survey of Registered Nurses	Measured whether states allowed prescription authority and/or direct reimbursement for NPs. Compared states that did with those that did not.	Longitudinal national study using individual-level data on NP wages and data on state SOP laws in 1992, 1996, 2000, and 2004	NP wages
Perry, 2012 ³¹	Little detail on how NPs were defined other than they were identified from the National Sample Survey of Registered Nurses	Measured whether states allowed prescription authority and/or direct reimbursement for NPs. Compared states that did with those that did not.	Longitudinal national study using individual-level data on NP location and demographics and data on state SOP laws in 1992, 1996, 2000, and 2004	The likelihood of NPs moving from a state with more-restrictive SOP laws to a state with less-restrictive laws
Reagan and Salsberry, 2013 ²⁸	No definition given	Categorized states as either 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 using data on state SOP laws, county-level counts of NPs, and other county characteristics in 2008	NP supply per 100,000 population
Sekscenski et al., 1994 ³⁰	Estimated number of NPs based on a previous study	Created a 100-point scoring mechanism for state practice environment; a higher score indicated more authority and legal status.	Cross-sectional national study using state regulatory data and data that appeared in previously published studies in 1992	NP supply
Stange, 2014 ³⁴	Created a unique data set of licensed NPs using state licensing records	Categorized states based on whether they grant prescriptive authority to NPs for controlled substances.	Longitudinal national study using individual-level patient data from multiple waves of the MEPS, data on state SOP laws, and county-level NP counts from 1996 to 2008	Number of office-based provider visits, charges, and total costs

Reference	Definition of Nurse Practitioner	SOP Measure	Data and Study Design	Relevant Outcomes
Traczynski and Udalova, 2014 ²⁶	Study does not include data on NP supply	Categorized states as having full or limited SOP and compared the two.	Longitudinal national study using rich, individual-level patient data from multiple waves of the MEPS; data on state SOP laws; and data on other state-level control variables from 1996 to 2010	Self-reported access measures, patient experience, and utilization
Westat, 2015 ⁷	Identified NPs through the National Sample Survey of Nurse Practitioners	Categorized states based on whether they granted full practice or prescriptive authority to NPs, or neither.	Cross-sectional national study using individual-level patient data from the Medicare Claims file, data on 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	Risk of Bias
Graves et al., 2016 ²⁷	2013	National cross-sectional study. Eighteen states were categorized as full practice (AK, AZ, CO, DC, HI, ID, IA, ME, MT, NV, NH, NM, ND, OR, RI, VT, WA, WY) and 12 were categorized as restricted practice (CA, FL, GA, MA, MI, MO, NC, OK, SC, TN, TX, VA).	Cross-sectional analysis with regression adjustment does not allow for causal inferences.
Kalist and Spurr, 2004 ²⁵	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 six 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 extremely coarse measure of NP enrollment. Combining all advanced-practice RNs makes it impossible to isolate the effect for NPs.
Kleiner et al., 2014 ²⁴	2002–2009	National longitudinal study. During the study period, six states went from restricted to supervised/delegated prescription authority (KY, LA, MS, MO, NV, TX), and five states went from supervised/delegated to independent prescription authority (CO, HI, ID, MD, WI).	Strong longitudinal research design with regression adjustment, but extremely coarse measure of NPs (all RNs with any advanced degree).
Ku et al., 2015 ³³	2012	Cross-sectional national analysis limited to staffing in community health centers (1,191 of the 1,198 centers in the United States in 2012 were included in the analyses). Study does not list or enumerate states with full SOP.	Cross-sectional analysis with regression adjustment and coarse measure of NPs.
Kuo et al., 2013 ³²	1998–2010	National longitudinal study. In 2010, there were 17 states with full authority (AK, AZ, CO, DC, HI, ID, IA, ME, MD, MT, NH, NM, ND, OR, VT, WA, WY) and 23 states with restricted authority (AL, CA, CT, DE, FL, GA, IL, KS, LA, MN, MS, MO, NE, NV, NY, NC, OH, PA, SC, SD, TX, VA, WI). In 1998, there were nine states with full authority (AK, DC, IA, ME, MT, NH, NM, OR, WA) and 28 states with restricted authority (AL, CA, CT, DE, FL, GA, ID, IL, KY, LA, MD, MA, MN, MS, MO, NE, NV, NY, NC, OH, PA, SC, SD, TN, VT, VA, WI, WY).	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, the effects measured in this study are very likely biased.
Lin et al., 1997 ²⁹	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.
Oliver et al., 2014 ³⁵	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).

Reference	Recency	Generalizability	Risk of Bias
Perry, 2009 ³⁶	1992, 1996, 2000, and 2004	National study. In 1992, roughly 37 percent of states authorized NPs to prescribe controlled substances, increasing to 90 percent in 2005. In 1992, 43 percent of states authorized NPs to receive direct reimbursement, increasing to 63 percent in 2005. The study does not list specific states.	Strong longitudinal research design with regression adjustment.
Perry, 2012 ³¹	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 ²⁸	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. In the study, there were ten states with full authority (AZ, ID, IA, ME, MT, NM, OR, RI, UT, WA) 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).	Cross-sectional analysis with regression adjustment.
Sekscenski et al., 1994 ³⁰	1992	Cross-sectional national study. Created a 100-point scale to describe the continuum of practice authority for NPs. The study lists the overall score only 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 ³⁴	1996–2008	Longitudinal national study. The study does not specify which states have different levels of prescription authority, but it does mention that roughly 79 percent of NPs live in states with full prescription authority for controlled substances.	Strong longitudinal research design with regression adjustment.
Traczynski and Udalova, 2013 ²⁶	1996–2010	Longitudinal national study. Ten states expanded (practice and prescriptive) authority during the study period (AZ, CO, HI, ID, ME, MD, ND, UT, VT, and WA).	Strong longitudinal research design with regression adjustment.
Westat, 2015 ⁷	2012	Cross-sectional national study. In 2012, 19 states had full SOP, eight had practice authority only, and 24 had restricted practice and prescription authority.	Cross-sectional research design with regression adjustment.

Appendix D. Method Details

Selecting the Highest-Quality Results

One study (Stange) used multiple methods to examine the effect of implementing full SOP for NPs.³⁴ Specifically, the author 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 (Kleiner et al.) also used multiple methods.²⁴ The authors use two sequential models. The first model regressed individual-level outcomes on covariates with a state by year difference-in-differences framework. The second model used the regression-adjusted covariate means and regressed on SOP, state, and year fixed effects. The results were generally robust across models, but we report results from the second, which included 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. However, in one study, the coefficients were difficult to interpret or not directly usable, so we performed additional calculations. Graves et al. reported adjusted mean differences in the geographic accessibility of providers from a nonparametric gravity model.²⁷ These numbers were difficult to interpret, so we calculated a percentage change as the difference between the predicted number of NPs in states with restricted practice authority and the predicted number of NPs in states with full practice authority. For example, we calculated the percent effect on the number of NPs per 100,000 as $5.36 / 14.88 = 36\%$ increase, where 5.36 is the effect of full-practice states relative to restricted-practice states, and 14.88 represents the restricted-practice baseline.

Appendix E. Summary of Effect Estimates

Tables E.1 through E.6 in this appendix summarize the effect estimates from the final set of included studies. Those estimates include provider supply, access to care, utilization of care, costs of care, quality of care (patient-centeredness), and health outcomes.

Table E.1. Summary of Effect Estimates for Provider Supply

Construct	Reference	Overall Effect of Expanded SOP
Number of providers	Lin and Burns, 1997 ²⁹	No effect*
	Graves et al., 2016 ²⁷	36% more primary care NPs*
		7% more primary care doctors*
		23% more primary care physicians assistants*
	Perry, 2012 ³¹	NPs 46% less likely to move out of state^
	Sekenscenski, 1994 ³⁰	More NPs (no effect sizes reported)*
	Reagan, 2013 ²⁸	25% more NPs*
Kalist and Spurr, 2004 ²⁵	12% higher enrollment per capita in advanced-practice RN programs^	
Hours worked	Kleiner et al., 2014 ²⁴	297 additional hours worked per year for NPs, 187 fewer hours for physicians^
Provider roles	Kuo et al., 2015 ³²	250% increase in the use of NPs as primary care physicians*
	Westat, 2015 ⁷	NPs 5 percentage points more likely to work in patient care*
		NPs 3.4 percentage points more likely to work in primary care*
	Ku et al., 2015 ³³	2% more advanced-practice staff and 2% fewer physicians in community health centers*

* Prescription and practice authority.

^ Prescription authority only.

Table E.2. Summary of Effect Estimates for Access to Care

Construct	Reference	Overall Effect of Expanded SOP
Patient-reported access	Traczynski and Udalova, 2014 ²⁶	Appointment when wanted, 1–2 years after expansion: 7.5 percentage points higher for adults; 12 percentage points higher for children* Appointment when wanted, 11+ years after expansion: no difference for adults; 24.9 percentage points higher for children*
		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* Able to get care when needed, 11+ years after expansion: 11.6 percentage points higher for adults; 13.6 percentage points higher for children*
		Acceptable travel time, 1–2 years after expansion: 6.37 percentage points higher for adults; 12 percentage points for children* Acceptable travel time, 11+ years after expansion: 12.8 percentage points higher for adults; 16.6 percentage points higher for children*

* Prescription and practice authority.

Table E.3. Summary of Effect Estimates for Utilization of Care

Construct	Reference	Overall Effect of Expanded SOP
Ambulatory utilization	Stange, 2014 ³⁴	3.1% increase in office-based provider visits [^]
	Traczynski and Udalova, 2014 ²⁶	3.9–6.8 percentage point increase in probability of adults receiving annual checkup*
Inpatient utilization	Oliver et al., 2014 ³⁵	31% lower rates of avoidable hospital admissions
		30% lower rates of hospital admissions among nursing home residents
		11% lower rates of readmissions
	Traczynski and Udalova, 2014 ²⁶	No differences in all ED visits* ACS ED visits, 1–2 years after expansion: 14% lower* ACS ED visits, 11+years after expansion: 12.8% lower*

* Prescription and practice authority.

[^] Prescription authority only.

Table E.4. Summary of Effect Estimates for Costs of Care

Construct	Reference	Overall Effect of Expanded SOP
Unit costs and prices	Kleiner, 2014 ²⁴	16% lower prices for well-child visits [^]
	Stange, 2014 ³⁴	No difference on charges or amount paid [^]
Total costs	Stange, 2014 ³⁴	No difference in total costs [^]
Malpractice premiums	Kleiner, 2014 ²⁴	No effect [^]
Provider wages	Kleiner, 2014 ²⁴	14% higher NP wages [^]
		No effect on medical doctor wages [^]
	Perry, 2009 ³⁶	1.6% increase in NP wages per year [^]
		1.4% reduction in physician assistant wages per year [^]
	7.6% reduction in medical doctor wages [^]	

* Prescription and practice authority.

[^] Prescription authority only.

Table E.5. Summary of Effect Estimates for Quality of Care (Patient-Centeredness)

Construct	Reference	Overall Effect of Expanded SOP
Patient experience	Traczynski and Udalova, 2014 ²⁶	Enough time with provider, 1–2 years after expansion: no difference for adults; 12.4 percentage points higher for children*
		Enough time with provider, 11+ years after expansion: no difference for adults; 18.9 percentage points higher for children*
		Provider listens carefully, 1–2 years after expansion: 8.9 percentage points higher for adults; 9.2 percentage points higher for children*
		Provider listens carefully, 11+ years after expansion: 8.8 percentage points higher for adults; 15.3 percentage points higher for children*
		Provider explains clearly, 1–2 years after expansion: 7.4 percentage points higher for adults; 10.2 percentage points higher for children*
		Provider explains clearly, 11+ years after expansion: 8.5 percentage points higher for adults; 13.5 percentage points higher for children*

* Prescription and practice authority.

Table E.6. Summary of Effect Estimates for Health Outcome

Construct	Reference	Overall Effect of Expanded SOP
Infant mortality	Kleiner et al., 2014 ²⁴	No effect
Health status	Traczynski and Udalova, 2014 ²⁶	No consistent difference in self-reported health status*
Body mass index	Traczynski and Udalova, 2014 ²⁶	No consistent difference in body mass index*

* Prescription and practice authority.

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