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RESEARCH ARTICLE

Nurse practitioner scope of practice and patient harm: Evidence from medical malpractice payouts and adverse action reports

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Abstract

Many states have recently changed their scope of practice laws and granted full practice authority to nurse practitioners, allowing them to practice without oversight from physicians. Physician groups have argued against this change, citing patient safety concerns. In this paper, we use a ratio-in-ratio approach to evaluate whether the transition to full practice authority results in harm to patients as proxied by malpractice payouts and adverse action reports against nurse practitioners. We find no evidence of such harm, and instead find that physicians may benefit from the law change in terms of reduced paid malpractice cases against them.

INTRODUCTION

Nurse practitioners (NPs) are a critical part of the U.S. health care workforce. There are over 200,000 licensed NPs in the U.S. who function as primary care providers by examining patients, providing diagnoses, ordering tests, providing treatment, and prescribing medications. They often work in areas where physicians are in short supply, providing care to patients who may otherwise go underserved or have to travel far to access care (McMichael, 2018).

Although nationally certified, the practice environment for NPs located in different states can vary dramatically because of different state scope of practice (SOP) laws. SOP laws delineate what licensed health care professionals may and may not do as part of their practice. These laws define the practitioners' roles, articulate oversight requirements, and govern practice and prescriptive authorities. SOP laws exist for all types of advanced practice providers, including NPs and other advanced practice registered nurses, physician assistants, and dental hygienists. In some states, SOP laws require NPs to practice under physician oversight. This oversight may be supervisory, delegative, or collaborative in nature; however, all require a formal agreement to practice with physicians. These oversight laws effectively tie the NP practice to physicians and can set up significant barriers to NP practice. Other states have moved to "full practice authority" (FPA) where NPs practice without any legal requirement for a formal relationship with physicians.

SOP laws are often controversial, and legislative and regulatory battles frequently ensue over details of the scope of practice requirements. Critics of FPA contend that supervision or collaboration requirements are necessary to protect the public health. Physician groups such as the American Medical Association (AMA) argue that independent NP practice may harm patients because of the shorter length of training and clinical experience required for NP licensure (O'Reilly, 2020). Proponents of FPA argue that NPs provide high-quality, low-cost, and accessible healthcare (American Association of Nurse Practitioners [AANP], 2022). Currently, 34 states have enacted or passed legislation granting FPA to NPs, while the rest of the states still require some degree of physician oversight of NP practice.

The purpose of this paper is to inform the policy debates surrounding SOP reform and evaluate whether eliminating requirements for physician oversight of NPs results in harm to patients. While previous research has evaluated the effects of transitioning to FPA on various proxies for quality of care, most of this research uses measures that are not necessarily attributable to NPs, nor do they directly measure harm. We advance this literature by examining changes in rates of paid medical malpractice claims and adverse license actions against NPs. These outcomes come from the National Practitioner Data Bank (NPDB; Bureau of Health Workforce, 2018).

Every medical malpractice claim we analyze involves the payment of money damages from a defendant healthcare practitioner to a plaintiff-patient resulting from an award at trial or an out-of-court settlement. As we discuss in detail below, the majority of medical liability claims are without merit and are dismissed with no resulting payments. These unpaid claims are not included in our data. However, paid claims like the ones we analyze are highly correlated with adverse patient outcomes and therefore serve as a proxy for the quality of NP care and harm to patients. Adverse license actions are actions taken against a providers' license for reasons related to professional misconduct. Actions include license revocation, probation, and suspension; reprimand and censure; Medicaid and Medicare exclusions; and fines or monetary penalties. We focus on licensure actions for reasons of unsafe practice and substandard care, and improperly prescribing, dispensing, and administering medications/drugs. Again, these actions serve as a proxy for harm to patients. By analyzing outcomes directly attributed to NPs, we can provide a straightforward answer as to whether granting FPA to NPs endangers the public health.

Our empirical models estimate the effect of adopting full practice authority on paid malpractice claims and adverse action reports against NPs. Our empirical strategy uses ratio-in-ratios estimates to detect the effects. We find that allowing NPs to practice without physician supervision leads to no changes in the number of malpractice payouts for NPs. We also observe no harm as measured by counts of adverse actions for reasons of safety violations and prescription drug violations. We further examine spillover effects to physicians and find that physician malpractice payout counts decrease after the passage of FPA, indicating a benefit to the physicians from severing the legal supervisory relationship with NPs.

SCOPE OF PRACTICE, LEGISLATIVE BATTLES, AND QUALITY OF CARE

SOP laws govern the professional activities of NPs, including practice and prescriptive authority. In the states that have granted FPA to NPs, SOP laws allow these nurses to practice to the full extent of their training and under the exclusive authority of the state board of nursing. They practice autonomously but in coordination with other practitioners. In the states with restricted SOP, some form of oversight by physicians is required—usually in the form of a collaborative practice agreement—and there are often limits placed on the types of allowable procedures or prescriptions. The collaborative practice is governed by the state board of nursing, sometimes in conjunction with the state board of medicine.

Legislative battles surrounding SOP are very common. According to the National Conference of State Legislatures (NCSL; 2022), in 2021, 42 bills related to NP practice and prescription authority were introduced in 22 states, with six enacted. The debates surrounding SOP usually pit physician

groups, such as the AMA and American Academy of Family Physicians (AAFP), against nurse groups such as the American Association of Nurse Practitioners (AANP). The physician groups' position against full practice authority focuses on patient safety. For example, when arguing against Kansas's recent senate bill to allow FPA, the AMA wrote, "First, the AMA is concerned S.B. 174 threatens the health and safety of patients in Kansas by allowing APRNs the ability to provide medical care without any physician collaboration or oversight" (AMA, 2021).

In similar letters opposing full practice authority legislation in Pennsylvania, Kentucky, and Massachusetts, the AAFP wrote,

> APRNs are important members of the medical team, but they do not have the medical education and training to provide full coordination of a patient's care. For this reason, a nurse practitioner is not a substitute for a physician when it comes to ensuring patient safety. … Physicians offer an unmatched service to patients and, without their skills, patients' safety would be at risk. (AAFP, 2017a, 2017b, 2017c)

Nurse advocacy groups counter that comparison of educational models is not appropriate and that, "Forty years of patient outcomes and clinical research demonstrates that NPs consistently provide high-quality and safe care" (AANP, 2021).

While there exists a large body of literature comparing the quality of care provided by NPs to physicians (e.g., Newhouse et al., 2011), the more relevant information for the policy debate comes from studies that examine the effects of changing NP scope of practice laws. Such research has proliferated in recent years, with numerous studies examining a variety of outcomes related to access to care, labor markets, health care costs, and quality of care. We refer the reader to papers by Adams and Markowitz (2018), Yang et al. (2021), and McMichael and Markowitz (2022) for reviews of this literature.

The research on the effects of changing NP SOP laws on the quality of care generally finds that health outcomes are similar or better under environments that have eliminated oversight provisions. Specifically, previous literature has measured quality of care through outcomes such as patient-reported assessment of quality of care, medication adherence, opioid treatment admissions, and ambulatory care–sensitive emergency room visits (Grecu & Spector, 2019; Muench et al., 2021; Traczynski & Udalova, 2018). In each case, outcomes are found to be at least as good or better under FPA than under oversight SOP.

However, the bulk of this research measures quality of care through indirect attribution to NPs, with very few studies able to directly measure outcomes of care provided by NPs. Data limitations prevent the researchers from identifying exactly who provided care, so the conclusions represent changes in the average care provided. This is not necessarily uninformative since eliminating oversight requirements may redirect time away from administrative tasks to patient-oriented activities, which would improve outcomes among patients of both NPs and physicians. Changes in SOP rules may also spur competition among providers to the benefit of patients (see Markowitz et al., 2017 for a discussion of this in the context of certified nurse midwives). Nonetheless, this approach of evaluating all patient outcomes cannot directly answer the question of whether oversight of NPs ensures the quality of their care and protects their patients. Our measures of harm from the NPDB relate to NP care much more specifically.

Only a few studies exist that include outcomes that are directly attributed to NP care and use estimation techniques that generate plausible causal estimates. Kurtzman et al. (2017) focused on patients of NPs in community health centers. They used rates of smoking cessation counseling, depression treatment, and statin prescriptions for hyperlipidemia to proxy for quality of care and found no difference in these outcomes based on SOP status. Two other studies also identified NP patients but did not examine quality outcomes per se. McMichael (2020) found that FPA was associated with more opioid prescriptions by NPs and fewer from physicians, resulting in a net reduction. Smith (2022) evaluated the experience of patients treated by NPs in primary care settings. Within this study about NP autonomy, workload, and patient allocation, she found no effects of eliminating oversight requirements

on the NP behaviors of inappropriately prescribed antibiotics and unnecessary imaging ordered. While the outcomes in these studies are all important aspects of treatment, it is not clear that these reflect the sort of harm to patients that the physician oversight requirements are purported to protect against. Our evaluation of malpractice payouts, safety violations, and prescription violations among NPs will reflect more severe harm.

McMichael et al. (2018) is the study most closely related to ours. Using NPDB data for 1999 to 2012, they found that the transition to FPA is associated with a 31% reduction in paid malpractice claims against physicians. They also examined how SOP laws interact with tort reforms and show that states with tort reform experience reductions in paid malpractice cases as well, but to a lesser extent. While they presented a comprehensive analysis for physician malpractice rates, they did not examine NP malpractice claims. Our analyses extend and advance McMichael et al. (2018) by evaluating the effects of FPA on rates of paid NP malpractice claims and on paid physician malpractice claims. We extend the time period under consideration to 2019 in order to capture the more recent wave of states that adopt FPA. We also examine adverse actions against licenses for both NPs and physicians. Lastly, we use rates of paid malpractice claims against RNs as a falsification test.

Our results agree with those of McMichael et al. (2018) and show that FPA is associated with a 21% to 24% reduction in paid physician malpractice cases. More importantly, we show that there is no evidence of an increase in paid NP malpractice cases after the FPA enactment. The results for adverse actions also point to no changes in terms of safety and prescription violations after FPA enactment. Together these results lead to the conclusion that removing physician oversight and granting full practice authority to NPs will not result in harm to patients as detected by paid malpractice claims and license actions.

MEDICAL MALPRACTICE, ADVERSE ACTIONS, AND SCOPE OF PRACTICE

Medical malpractice is "negligence committed by a professional health care provider…whose performance of duties departs from a standard of practice of those with similar training and experience, resulting in harm to a patient or patients" (American Bar Association, 2016). Any type of negligent practitioner can be the subject of a lawsuit, and an individual provider can be held liable for not only their own acts, but the acts of others in their employ or control (McMichael et al., 2018).

The oversight requirements in SOP laws affect the legal nature of the NP–physician relationship and are therefore relevant for malpractice lawsuits. McMichael et al. (2018) provided an extensive discussion on malpractice liability and how malpractice interacts with NP SOP laws. To summarize, when SOP rules require oversight, supervising physicians may be held liable for the mistakes of NPs, even if the physician had no contact with the patient, under the doctrines of agency or negligent supervision. In addition, under the doctrine of respondeat superior, a physician would be liable for the malpractice of an NP if the physician employed the NP and the NP's actions were within the scope of their employment. By contrast, under FPA—and absent any employment relationship—the mistakes of the NP are the NP's alone; there is no supervising physician that can be named as part of a lawsuit. Given these legal relationships, we could expect that switching to FPA generates a reduction in the number of physician malpractice cases simply because physicians can no longer be held liable for the actions of others. Transitioning to FPA may also alter patient–practitioner relationships in a way that could affect the incidence of malpractice or patient litigation incentives. McMichael et al. (2018) found that, overall, moving to FPA reduces the number of successful malpractice claims filed against physicians. Our results show this as well.

The open question is what happens to NP malpractice rates when switching to FPA. If the quality of care remains the same before and after FPA, we might expect to see NP malpractice rates remain unchanged. If the supervision requirements upheld quality and safety, eliminating the oversight requirement might generate an increase in NP malpractice rates. However, if the risk of facing

malpractice lawsuits causes NPs to be more careful with their patients, we may see a decrease in NP malpractice rates. As with physicians, it is also possible that the patient mix or case types change under FPA, and this could also affect malpractice in unpredictable ways. Our empirical estimation reveals the net effect of these possibilities.

Adverse actions are actions taken against a provider's license for a variety of reasons related to professional misconduct. Specific details of how we define adverse actions are below, but broadly stated, the reasons for actions include non-compliance with requirements, misconduct or abuse, unsafe practice, or substandard care, fraud, or criminal conviction. Actions are initiated by state licensing authorities such as the state board of medicine (BOM) or board of nursing (BON), as well as by hospitals, professional societies, the Drug Enforcement Administration, and other state and federal agencies.

Under any type of SOP environment, be it supervisory or full practice authority, NPs and physicians can each have actions taken against their licenses. Unlike for tort liability, doctrines of vicarious liability are generally not applicable for administrative actions. Hence, when a state switches to an FPA environment, it is not clear what would happen to NP and physician rates of adverse actions. Like with malpractice, if supervision requirements uphold quality and safety, we may see more adverse actions taken against NPs' licenses when the oversight is removed. But autonomy may also spur more careful behavior by NPs with the result that adverse actions decrease. An additional possibility is that we may observe an increase in adverse actions as NPs adjust to new rules, particularly in those states where the reporting authorities switch from the BOM and BON to just BON under full practice authority. The oversight agencies themselves may also experience some adjustment period with regard to adjudication and reporting. Again, the net effects of these possibilities are ambiguous, necessitating empirical analyses.

DATA

Medical malpractice and actions against licenses

The outcome data we use come from the NPDB public use file (downloaded February 2023 with reports through December 31, 2022). This source contains information related to the professional conduct and competency of health care providers. The NPDB public use file reports episodes of misconduct committed by health care practitioners in the U.S. Specifically, the NPDB collects information on 1) medical malpractice payments resulting from a written claim or demand; and 2) adverse actions taken by state licensing agencies, hospitals, peer review organizations, and certain state and federal agencies against health care professionals. Federal law requires these entities to disclose any closed proceedings taken against health care practitioners; hence, the NPDB contains the universe of administrative sanctions against health care practitioners. While the NPDB includes thousands of malpractice reports annually, whether this represents the universe of medical malpractice claim payments is unclear. A physician can avoid being reported to the NPDB by exploiting one of several loopholes to the reporting requirement.[1] How frequently this actually occurs in practice is uncertain. In any case, it is unlikely that the use of these exceptions would be correlated with NP SOP laws and therefore any avoidance or underreporting should not pose a threat to the validity of our estimates.

Medical malpractice occurs when a health care practitioner breaches their professional duty of care and a patient is injured as a result. Accordingly, the NPDB defines medical malpractice payments as, "A monetary exchange as a result of a settlement or judgment of a written complaint or claim

[1] For example, because the language of the reporting requirement applies to "entit[ies]," the D.C. Circuit Court of Appeals held that an individual practitioner who pays his or her own malpractice settlement or judgment out of pocket is exempt from the reporting requirement (*Am. Dental Assoc. v. Shalala*, 3 F.3d 445 [D.C. Cir. 1993]). Similarly, under a strategy called the "corporate shield," if a defendant practitioner can convince the plaintiff and a corporate codefendant to dismiss the individual practitioner prior to settlement, then that practitioner need not be reported to the NPDB (Guglielmo, 1996).

demanding payment based on a health care practitioner's provision of or failure to provide health care services" (Bureau of Health Workforce, 2018, p. A-6). The NPDB contains all malpractice payments made by entities on behalf of individual practitioners resulting from written claims or judgements, whether settled out of court or by trial. The set of claims contains payments of any size paid "through an insurance policy or otherwise, for the benefit of a health care practitioner in settlement of, or in satisfaction in whole or in part of, a claim or judgment against the practitioner" (Bureau of Health Workforce, 2018, p. B-9).

The NPDB cautions that malpractice payments should not be construed as a presumption that medical malpractice has occurred. We argue however that the existence of a malpractice payment indicates that, at the very least, a plausible claim for malpractice was put forward. Any frivolous lawsuits are unlikely to be correlated with the state SOP laws and therefore would not be a threat to the validity of our estimates. The converse also holds where medical negligence does not necessarily lead to malpractice claims. Such underreporting is also not a threat to our estimates so long as it is uncorrelated with the state SOP law.

A broader concern is whether a malpractice payout actually represents an occurrence of negligence and harm. The AMA (2023) stated that most liability claims are without merit. There is validity to this argument as researchers have shown that the majority of claims are dismissed and resulted in no payments. For example, Jena et al. (2011) showed that 78% of malpractice claims for all physicians covered by a large professional liability insurer did not result in payments to claimants. Mangalmurti et al. (2014) found a similar result and showed that only a quarter of closed lawsuits against internal medicine physicians in 2009 resulted in claims paid. However, of the paid claims, the vast majority were associated with some form of medical error, with only 4.8% citing no medical error involved. The largest category of error listed is harm caused by failure to diagnose (35.6% of paid claims), and of relevance to this paper, the second highest cause is failure to monitor subordinates such as a nurse (13.5% of paid claims). To be clear, the NDBP database only reports claims with payments.

There is research to support the notion that paid claims are highly correlated with adverse patient outcomes. Studdert et al. (2006) audited a sample of closed malpractice claims from five professional liability insurers. They found that 73% of claimants with injuries due to error received compensation, and 72% of claimants whose injuries were not due to error did not receive compensation. In a recent study, Black et al. (2017) examined the relationship between adverse events and paid malpractice claims at hospitals in Florida and Texas. Using data on adverse patient safety events within hospitals and controlling for patient and hospital characteristics, they found evidence that more medical errors as captured by patient safety indicators led to more malpractice claims.

We use the presence of payments to generate annual state-level malpractice counts rather than rely on information from the payout amount as a measure of harm. The size of a malpractice payment can depend on many factors, several of which do not necessarily scale with the magnitude of the error. The size of settlement may also be driven by litigation dynamics (e.g., the risk-preference of the litigants, the existence of highly prejudicial but tangentially relevant evidence, etc.) that may have little or no relationship whatsoever to the underlying medical error. Hence, our main dependent variable uses the presence of a malpractice payment of any size. In auxiliary models, we analyze severity of malpractice injury in order to provide details on what types of injuries may be altered. Details on the severity outcomes data are discussed in the "Results" section below.

Adverse actions reflect a broader array of misdeeds. The NPDB lists adverse actions in the following categories: non-compliance with requirements; criminal conviction or adjudication; confidentiality, consent, or disclosure violations; misconduct or abuse; fraud, deception, or misrepresentation; unsafe practice or substandard care; improper supervision or allowing unlicensed practice; and improper prescribing, dispensing, administering of a medication or drug (Bureau of Health Workforce, 2018). If a health care professional commits any of these violations, the responsible regulatory agency can take an adverse action against them and must report that adverse action to the NPDB. Results of adverse actions include license revocation, probation, and suspension; reprimand and censure; Medicaid or Medicare exclusions; and fines or monetary penalties. It should be noted that acts or omissions that

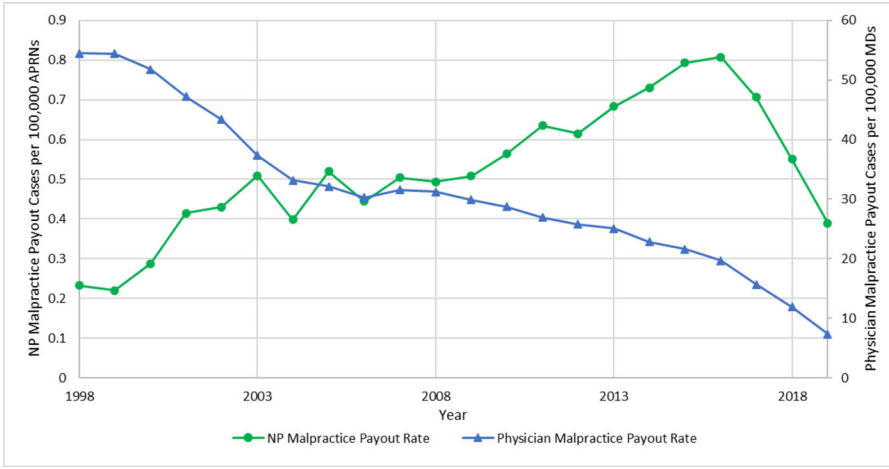

FIGURE 1 National malpractice payout case rates, 1998–2019.
[Color figure can be viewed at wileyonlinelibrary.com]
Sources: National Practitioner Data Bank and Area Health Resource File.

give rise to malpractice liability may also be the subject of an adverse action taken by a licensing board.

We generate four different dependent variables that reflect the reason for adverse actions against a license. The first indicates the presence of any action taken against the license. This encompasses all of the misdeeds listed in the paragraph above. However, this definition is very general and combines actions that are plausibly related to SOP laws and to patient care with those that are not (for example, default on education loans). We therefore also examine violations in the categories of unsafe practice or substandard care and improper prescribing, dispensing, administering medications or drugs. We refer to these as safety violations and prescription violations, respectively. The exact infractions for these two dependent variables as defined by the NPDB are listed in Appendix A.[2] Lastly, we analyze regulatory violations in order to directly measure violations most closely related to the scope of practice and practice-management provisions within the statutes. These include practicing beyond the scope of practice, failure to maintain adequate or accurate records, and other unspecified violations of federal or state statutes, regulations, or rules.

Rates of medical malpractice payouts and adverse actions by practitioner type, state, and year are calculated by summing the counts and dividing by the relevant number of licensed practitioners in the state. Trends in these rates are shown in Figures 1, 2, and 3. However, using licensed practitioners as a denominator in the empirical models is potentially problematic as this can vary along with the SOP laws when the law change alters labor market incentives. For example, McMichael (2018) and Reagan and Salsberry (2013) found that full practice authority is associated with an increased supply of NPs, although a more recent analysis by Kandrack et al. (2021) did not confirm this finding and found no change in supply. We therefore alternatively use the state population as a denominator in the empirical models. As we show below, it turns out the choice of denominator matters little to the magnitudes and statistical significance of the estimated effects. We generate rates separately for NPs and physicians. Physicians include MDs and DOs.[3]

[2] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's website and use the search engine to locate the article at http://onlinelibrary.wiley.com.

[3] Ideally, we would like to identify the case rates of physicians who would be most likely to supervise NPs. One way to do this might be by examining rates for primary care physicians and specialists separately, but unfortunately, the NPDB does not provide information on provider specialty. In addition, although many NPs identify primary care as their specialty, other clinical specialty fields are popular as well. Spetz et al.

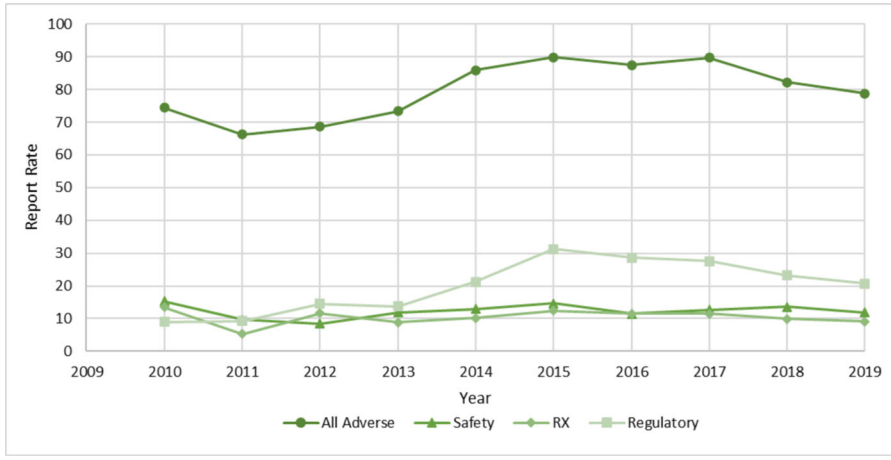

FIGURE 2 National NP adverse action reports per 100,000 APRNs.
[Color figure can be viewed at wileyonlinelibrary.com]
Sources: National Practitioner Data Bank and Area Health Resource File.

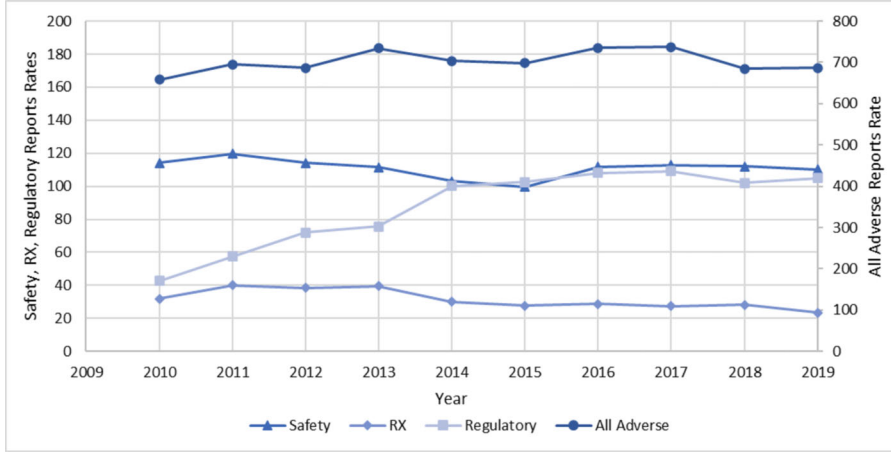

FIGURE 3 National physician adverse action reports per 100,000 MDs.
[Color figure can be viewed at wileyonlinelibrary.com]
Notes: FPA coefficients and confidence intervals transformed to semi-elasticities (exp(b)-1). 95% confidence intervals shown.
Sources: National Practitioner Data Bank and Area Health Resource File.

Figure 1 shows rates of NP and physician malpractice cases over time using the NPDB data. The denominators used here are the number of licensed Advanced Practice Registered Nurses (APRNs) from the *Nurse Practitioner Annual APRN Legislative Update* (NPAALU) and the total number of active non-federal MDs from the AMA master file as reported in the Area Health Resource File (AHRF). The AHRF does not report workforce statistics for APRNs nor NPs until 2010, so we rely on data from the *Nurse Practitioner* to provide a consistent series over the 1998 to 2019 time period. Since around 70% of APRNs are NPs, the use of APRNs should well reflect trends in NPs over time.

One issue with the NPDB data regards the timing of reporting. The years shown in Figure 1 reflect the date of the occurrence of the act that gave rise to the malpractice payment. This is the relevant

(2015) estimated that only half of NPs are in primary care as determined by employment setting. Our inability to identify supervising physicians remains a limitation.

year for matching with the state SOP laws. However, there can be a large difference between the time the act occurred and the time the payment is made and reported to the NPDB. Both the reporting date and the date of occurrence are available within the NPDB. Comparing these dates shows the mean, median, and mode lags are all 4 years for NPs and for physicians. Our main results use data through 2019 which captures observations with a 3-year reporting lag. At the time of writing of this paper, far fewer malpractice cases are reported as occurring in 2020, 2021, and 2022.[4] The year 2020 also coincides with the pandemic and emergency executive orders that temporarily changed SOP rules for many NPs. Our main models therefore end in 2019. We will also show results that exclude the 2019 data and end in 2018 to avoid the average 4-year reporting drop-off. As we will show, this exclusion matters little, and this is likely because the drop-off occurs regardless of SOP status.

Figure 1 shows a clear downward trend in physician malpractice rates over time. The rates were highest in the first year of our data at a rate of 1,972 cases per 100,000 MDs, and fell consistently over time to a low rate of 214 cases per 100,000 MDs in 2019, although part of the drop-off at the end of the series reflects the lag in reporting. The trends for NPs are not as clear. There is an initial rise from a low of 45 cases per 100,000 APRNs in 1999 to a peak in 2005 at 88 cases per 100,000 APRNs, followed by a leveling-off. The lag in reporting probably explains the part of the drop-off at the end of the series.

Figures 2 and 3 show rates of adverse action reports against NPs and physicians, respectively. These reports appear in the NPDB beginning in 2010 for NPs so this is the first year shown. The denominators are the same as for Figure 1 with the number of licensed APRNs used for the NP rate and the number of active MDs for the physician rates. For both sets of providers, rates of adverse actions are fairly constant over time with no clear trends present in the data. This statement holds for safety and prescription violations as well. The regulatory violations show a large increase starting in 2014 for both NPs and physicians, although the NP rate falls after 2015 while the physician rate levels off.

Table 1 shows summary statistics for malpractice cases and adverse action reports. Looking at the data for all states, the first thing to note is that malpractice cases against NPs are relatively rare. On average there are around 3 cases per state and year as compared to 181 for physicians. Thirty percent of the state-year observations have zero reported NP malpractice cases, while there are only two cases of a zero for physicians. These zeros for physicians are in small states in the most recent years, likely reflecting the reporting lag. Adverse actions are also rare events for NPs. While there is an average of 4.8 events per state-year for any type of action, 33% of the observations have no reports. Narrowing the definition of an adverse event to safety violations, prescription violations, and regulatory violations yields even more zeros with 67%, 74%, and 53% of observations with zero actions, respectively.

Full practice authority

Information on states' SOP laws for NPs comes from each state's statutory and administrative codes as provided by McMichael and Markowitz (2022). This information is used to classify NP SOP as FPA or physician oversight required. FPA means that NPs have practice and prescription authority without a requirement for documented physician collaboration, delegation, or supervision. This definition includes the ability to prescribe controlled substances. Note that some states require a transition to practice before granting FPA, but this dimension of the law is ignored since new NPs make up only a small percentage of the overall NP workforce. Table 2 lists the 20 states that switch from oversight to FPA between 1998 and 2019 along with the SOP status of all other states. Note that 16 states change between 2010 and 2019, corresponding to the timing of the adverse action reports.

[4] The data we use contain reports received through December 31, 2022. The total number of reported malpractice payout cases against physicians falls from 2,414 in 2019 to 843 in 2020, 270 in 2021, and 36 in 2022.

TABLE 1 Summary statistics.

Variable	All states				Excluding always FPA states			
	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max
NP counts								
Malpractice payouts	3.14	4.60	0	43	3.53	4.91	0	43
All adverse actions	4.80	7.35	0	44	5.33	7.87	0	44
Safety violations	0.73	1.74	0	16	0.83	1.90	0	16
RX violations	0.62	1.55	0	14	0.68	1.68	0	14
Regulatory violations	1.25	2.54	0	27	1.38	2.80	0	27
Physician counts								
Malpractice payouts	180.73	271.84	0	1820	209.89	291.04	0	1820
All adverse actions	142.46	157.58	6	894	170.17	170.23	10	894
Safety violations	22.47	28.80	0	188	26.58	31.24	0	188
RX violations	6.34	8.82	0	63	7.93	9.66	0	63
Regulatory violations	17.97	31.73	0	250	21.97	35.50	0	250
State population in millions	5.96	6.70	0.48	39.60	6.90	7.02	0.59	39.60
Total licensed APRNs (NPAALU 1998–2019)	4,507	4,964	159	32,978	5,151	5,231	388	32,978
Total NPs (AHRF 2010–2019)	3,612	3,707	201	22,307	4,350	3,973	314	22,307
Total MDs (AHRF 1998–2019)	18,221	21,722	943	140,148	21,106	22,882	1,501	140,148
Total physicians (AHRF 2010–2019)	4,709	5,293	369	31,852	5,648	5,765	518	31,852
Full practice authority	0.30	0.46	0	1	0.16	0.36	0	1
Joint and several liability reform	0.79	0.41	0	1	0.79	0.40	0	1
Punitive damages cap	0.58	0.49	0	1	0.56	0.50	0	1
Non-economic damages cap	0.44	0.50	0	1	0.46	0.50	0	1
Apology law	0.52	0.50	0	1	0.51	0.50	0	1
Percent of state in poverty	13.14	3.26	5.6	23.9	13.21	3.18	6.9	23.9
State unemployment rate	5.41	1.97	2.2	14.9	5.41	2.01	2.2	14.9
State real income per capita	18.62	3.41	12.30	33.08	18.42	3.07	12.30	29.64

Notes: Number of observations for variables with values from 1998–2019 is 1,122 for all states and 924 when the sample excludes always FPA states. Number of observations for variables with values from 2010–2019 is 510 for all states and 380 when the sample excludes always FPA states. Data for malpractice payouts and adverse actions come from the National Practitioner Data Bank. Data on licensed practitioners come from the Nurse Practitioner Annual APRN Legislative Update (NPAALU) and the Area Health Resource File (AHRF).

The switch to FPA primarily involves eliminating physician oversight requirements. Legislated changes to procedures or prescriptions allowed often had been made prior to FPA. States tend to follow a sequence of first allowing the prescription of controlled substances with oversight, followed by the elimination of prescription and practice oversight requirements. All states that currently maintain oversight allow NPs to prescribe controlled substances, and they began doing so in the early 2000s (see McMichael & Markowitz, 2022). One caveat to this discussion is that some individual NPs may see a large change in allowable services when they transition from a protocol-based regime to FPA. Protocols require supervising physicians to specify exactly what an NP can and cannot do under their direction, so it is possible that the switch to FPA did allow for more types of prescriptions and more leeway for diagnoses and procedures for these NPs. The degree of such expansion of scope of practice would vary on a case-by-case basis. In general, the results below can be interpreted as the effects of eliminating oversight requirements without much else changing in the NPs legal scope of practice.

TABLE 2 Dates of full practice authority and tort reforms, by state.

State	Full practice authority[a]	Joint and several liability reform[b]	Punitive damages cap[b]	Non-economic damages cap[b]	Apology law[c]
Alabama			2000		
Alaska	Pre 1998	1986	1998	1998	2015
Arizona	Dec 1999	1988			2005
Arkansas	*(July 2021)*	2003	2003–2011		
California	*(Effective 2023)*	1986		1976	2000
Colorado	July 2010	1987	1987	1987	2003
Connecticut	July 2014	1987			2006
Delaware	Sept. 2015				2006
District of Columbia	Pre 1998		1988		2007
Florida	*(July 2020)*	1986	1987	2003–2019	2001
Georgia		1988	1988	2005–2009	2011
Hawaii	July 2009	1987		1987	2007
Idaho	July 2004	1988	2004	1988	2006
Illinois	June 2019	1997	1986	2006–2009	2005
Indiana		1985	1995		2006
Iowa	Pre 1998	1985			2006
Kansas	*(Passed 2022)*	1975	1988	1987–2018	
Kentucky		1989			
Louisiana		1981	1932		2005
Maine	Pre 1998		2000	2000	2005
Maryland	Oct 2010			1987	2004
Massachusetts	*(Jan 2021)*			1987	1986
Michigan		1987	1850	1987	2011
Minnesota	Jan 2015	1987			
Mississippi		1990	2004	2003–2012	
Missouri		1986	2006–2014	1986–2012	2005
Montana	Pre 1998	1988	1985	1996	2005
Nebraska	March 2015	1992	1878		2007
Nevada	July 2013	1973	1989	2003	
New Hampshire	Pre 1998	1990	1987		2005
New Jersey		1988	1996		
New Mexico	Pre 1998	1982			
New York	Jan 2015	1987			
North Carolina			1996	2012	2004
North Dakota	Oct 2011	1988	1993	1996	2007
Ohio		2003	2005	2003	2004
Oklahoma		1973	1996	2004–2018	2004
Oregon	Pre 1998	1976	1988	1988–1999	2003
Pennsylvania		2002–2005	1997		2013
Rhode Island	June 2013				

(Continues)

TABLE 2 (Continued)

State	Full practice authority[a]	Joint and several liability reform[b]	Punitive damages cap[b]	Non-economic damages cap[b]	Apology law[c]
South Carolina		2006	2012	2006	2006
South Dakota	July 2017	1945		1996	2005
Tennessee		1992	2012–2018	2012	2003
Texas		1986	1973	2004	1999
Utah	May 2016	1986		1988–2015	2006
Vermont	June 2011	1971			2006
Virginia	April 2018		1989		2005
Washington	Jan 2006	1986	1891		2002
West Virginia	June 2016	1986		1986	2005
Wisconsin		1995	1996	1995	2014
Wyoming	Pre 1998	1986			2004

[a]Source: McMichael and Markowitz (2022). For laws passed in July or later, FPA is assigned to the next calendar year. Dates in italics are beyond the data range of the analyses and are shown for informational purpose only. Emergency orders related to Covid-19 are excluded.
[b]Source: Avraham (2021).
[c]Sources: McMichael et al. (2019) and Morton (2021).

Tort reforms

Torts are breaches of noncontractual duties that result in injury or harm to another individual. Tort laws provide relief to the injured parties and are the basis for medical malpractice lawsuits. In response to periodic spikes in medical malpractice insurance premia, many states have enacted tort reform measures (Black et al., 2021). These reforms are designed to reduce litigation risk, lower malpractice insurance premiums, and reduce the pressure for practitioners to practice defensive medicine (Agarwal et al., 2019). Tort reforms are therefore relevant determinants of malpractice lawsuits. A concern for our analyses arises if states pass a package of reforms related to both NP SOP and tort reform at the same time, making the evaluation of SOP laws difficult to disentangle from that of tort reforms. Tort reforms may not be directly related to adverse actions against licenses; however, to the extent that they alter provider behavior, especially towards safety, they are relevant for these outcomes.

We include in the empirical models three relevant tort laws: joint and several liability (JSL) reform, caps on non-economic damages, and caps on punitive damages. Joint and several liability is also known as the "deep-pockets" rule and allows plaintiffs to collect damages from any defendant regardless of the proportion of fault. Reforms to this law assign liability based on percentage of fault. Caps on damages set maximum dollar amounts allowed on awards. Damage caps change incentives by making it less attractive for plaintiffs to sue and lowering the expected malpractice costs for providers (McMichael, 2018).

Apology laws are a relatively new set of tort-related law designed to reduce malpractice lawsuit pressure. Apology laws are reforms to evidence rules and make statements of apology, sympathy, and condolence inadmissible in trials (McMichael et al., 2019). The idea behind these laws is that by encouraging apology, the apology itself may reduce medical malpractice litigation by assuaging anger. In practice, however, an apology may instead alert the patient to an issue and foster a malpractice claim. Ho and Liu (2011) found that apology laws expedited resolution but did not reduce the number of cases, and McMichael et al. (2019) found apology laws are associated with more lawsuits among non-surgeon physicians. Given the relevance of apology laws to malpractice cases, we include an indicator for the presence of this law in the models along with the tort reforms.

Our source for the JSL reform and damage cap laws is the database on tort reforms provided by Avraham (2021). McMichael et al. (2019) and Morton (2021) have provided information on the

apology laws. The dates for these law changes are listed in Table 2 by state along with the effective date of FPA. During the years of our sample of malpractice claims, 1998 to 2019, four states reformed JSL laws, nine states changed punitive damage caps, and 14 states changed non-economic damages. These counts include the few states that reversed the laws' status during this time period. Note that these reforms mostly predate the 2010 to 2019 adverse action data. No JSL reform changes are made after 2010, only four states change punitive caps after 2010 and seven states change non-economic caps. JSL reform therefore will necessarily be excluded from the models evaluating adverse actions. Between 1998 and 2019, 39 states (including DC) passed apology laws, although only five states added apology laws after 2010. Table 2 also shows that the dates of these law changes almost never overlap with the passage of FPA. The only overlap is in Idaho where FPA was passed in the same year as caps on punitive damages. This alleviates the concern that states pass a package of medical care–related reforms simultaneously.

EMPIRICAL ESTIMATION

Given the presence of zeros for NP malpractice and adverse action reports, we use a Poisson Quasi-MLE to estimate the models. Estimates are consistent regardless of whether the counts actually have a Poisson distribution (Wooldridge, 2001). To permit overdispersion, standard errors are adjusted for heteroskedasticity of unknown form that includes a within-state cluster correlation. Each model includes the natural log of the annual state population as a right-hand side variable to normalize for exposure with this coefficient constrained to equal one. Alternative models use the number of practitioners rather than the state population, however these are not the preferred specification since the number of practitioners may be influenced by the scope of practice environment.

The basic estimating equation takes the following form:

$$Case\ count_{st} = exp\left(\beta_1 FPA_{st} + \beta_2 Torts_{st} + \beta_3 X_{st} + \gamma_s + \tau_t + \ln(pop_{st}\right) + \varepsilon_{st} \quad (1)$$

Where *Case count* represents paid malpractice counts or one of the four measures of adverse actions against practitioners in state s in year t; *FPA* is an indicator variable for states that have adopted full practice authority scope of practice; *Torts* are indicator variables for states that have adopted the above-mentioned tort reforms; and X contains state-level variables to reflect the economic conditions and population characteristics of the state. These include the state unemployment rate, real income per capita, and the percentage of the state in poverty. All models also include state (γ) and year (τ) indicator variables. Equation 1 is estimated separately for NPs and physicians.

The coefficient of interest, β_1, is not directly interpretable. However, the semi-elasticity, calculated as $\exp(\beta_1)$-1, is the proportional effect on the treated in the post treatment period. This semi-elasticity is a ratio-in-ratios (RR) estimate, which can be thought of as a difference-in-differences (DD) type of estimate for the Poisson count model. Lee and Lee (2021) described the estimator in detail. In DD models, the time and group effects are cancelled by double differencing; in the RR model, they are cancelled by double division. These authors also showed that an interaction between time and the indicator for the treatment group allows for a test of the identification condition (comparable to the DD parallel trends assumption). This test was conducted for all models. Event study models were also shown to visually display the validity of the identification condition as well as to show the evolution of trends around the enactment of the law.

We exclude states that have always had FPA as the SOP environment from the main models. This is done so that the comparison is conducted only among states that start without FPA and have the potential to switch. This helps alleviate some concerns about variation in treatment timing (Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021). As further checks, we run two auxiliary models. First, we show results from a stacked Poisson regression (Baker et al., 2022; Cengiz et al., 2019). The stacked regression addresses staggered treatment timing and treatment effect heterogeneity but trades off bias

for efficiency. Second, as a more direct way to check for treatment heterogeneity, we show results for different cohorts of states that enact FPA around the same date. This shows how the effects may vary for different time-based cohorts. The results for the event studies, cohort analyses, and stacked regressions all point to the same conclusions.

It is possible that states pass a package of medical-related reforms at the same time, making the evaluation of SOP laws indistinguishable from that of other laws. As stated above, the most likely candidate, tort reforms, do not occur at the same time as SOP reforms, so this should not contaminate the interpretation of the coefficient on FPA. Another possibility is the passage of prescription drug monitoring programs (PDMPs). Comparing dates of PDMP enactment from Horwitz et al. (2021) to the effective dates of FPA reveals that no state changes these two laws in the same year. In fact, the average difference in timing is over 11 years. Nevertheless, in results not shown but available upon request, we include an indicator variable for the presence of PDMP in the state. The inclusion of this variable has very little effect on the magnitudes of the FPA semi-elasticities, nor does it alter the statistical significance. The PDMP indicator itself is for the most part small in magnitude and statistically insignificant with one notable exception. The PDMP is associated with a 36% reduction in adverse actions against physicians for prescription violations.

We also test models that include alternatively 1-, 2-, and 3-year lags of the FPA indicator to account for new pharmacology training that may be required upon adoption of FPA. More generally, longer lags allow time for NPs to respond to the new incentives in terms of their career choices.

It is possible that there remain unidentified state-specific laws that may have passed simultaneously and affected health care practitioners' behaviors or quality of care. As a final check on this, we provide results for a falsification test where we evaluate the malpractice and adverse action counts of registered nurses instead of NPs. Since scope of practice laws do not pertain to this group of practitioners, results showing any significant effects may point to a confounding variable and cast doubt on our results. Lack of effects will provide further evidence for the validity of our estimates.

Our main models are chosen to control for possible confounding variables, avoid issues of endogeneity, and provide the 'cleanest' experiment possible. Our main models therefore include the above-mentioned variables for tort reforms, state and year fixed effects, and the state population as the exposure variable. We exclude states that have always had FPA as the SOP environment from the main models. Summary statistics for this sample are shown in Table 1 along with the statistics for all states. Note that the states that have always had FPA tend to have smaller populations and can be characterized as more rural. In alternative models, we check whether the results are sensitive to these modeling choices. These variations include using the full sample of states including those that are always classified as FPA; using select samples of states that pass FPA at similar times; using total numbers of licensed practitioners in the state (APRNs, NPs, MDs, or physicians) as the exposure variables; and excluding the tort reform variables to see how much influence these variables have on the estimates. For the malpractice models we also test ending the sample in 2018 to check if the 4-year lag in reports affects the estimates. Lastly, we run all models using malpractice and adverse action counts among registered nurses as a falsification test. Registered nurses are not subject to the NP SOP laws and should not be affected by changes in the NP practice environment. Overall, our results are robust to these sensitivity tests.

RESULTS

Malpractice results

Table 3 shows the effects of FPA on malpractice payouts for NPs in columns 1 through 4 and for physicians in columns 5 through 8. Coefficients and standard errors are shown just for the FPA indicator. Semi-elasticities and marginal effects for FPA are also shown for ease of interpretation. All models also include the four tort-related laws, the state unemployment rate, real income per capita, the percent of the state living in poverty, state fixed effects, and year fixed effects. The coefficients for the

TABLE 3 Malpractice payouts.

	Nurse practitioners				Physicians			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Full practice authority	−0.247	−0.222	−0.206	−0.171	−0.268***	−0.252***	−0.257***	−0.241***
	(0.184)	(0.196)	(0.172)	(0.183)	(0.095)	(0.091)	(0.094)	(0.090)
Pre-FPA mean	1.96	1.96	1.96	1.96	174.35	174.35	174.35	174.35
FPA semi-elasticity	−0.22	−0.20	−0.19	−0.16	−0.24	−0.22	−0.23	−0.21
FPA marginal effect	−0.43	−0.39	−0.36	−0.31	−40.95	−37.78	−39.56	−37.38
Exposure variable	State pop	State pop	APRNs	APRNs	State pop	State pop	MDs	MDs
Years	1998–2019	1998–2018	1998–2019	1998–2018	1998–2019	1998–2018	1998–2019	1998–2018
Observations	924	882	924	882	924	882	924	882

Notes: State clustered standard errors in parentheses. Means shown pertain to the eventually treated states in the pre-period. Models also include tort-related laws, state unemployment rate, real income per capita, the percent of the state living in poverty, state fixed effects, and year fixed effects. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

four tort-related laws and other control variables are shown in full models in Appendix B. The state population is used as the relevant exposure variable in columns 1, 2, 5, and 6, and the relevant number of practitioners are included in the other columns. Odd numbered columns include data through 2019 and the even numbered columns end the sample in 2018 to account for the average 4-year lag in reporting.

The results show that switching from an oversight environment to FPA has a negative but statistically insignificant effect on malpractice cases against NPs, and a negative and significant effect on physician cases. However, the magnitude in terms of the semi-elasticity is similar for both types of providers with the reduction in cases in the range from 16% to 22% for NPs and 21% to 24% for physicians. The result for physicians is slightly smaller than that found by McMichael et al. (2018), who found a 31% reduction in physician malpractice cases. Regardless of the magnitudes, we also fail to reject the null hypotheses of the coefficients less than or equal to zero against an alternative of positive effects. This indicates that eliminating oversight requirements does not result in an increase in malpractice cases against NPs and therefore is not indicative of increased harm to patients.

The marginal effects shown at the bottom of Table 3 are calculated by applying the semi-elasticity to the mean case count in the pre-FPA period among only the states that eventually change FPA status. In other words, the marginal effect represents the average effect among the treated. The reduction in cases among NPs is less than one per state and year, while the reduction for physicians ranges from 36 to 41 per state and year.

Figures 4 and 5 show the event studies corresponding to the preferred models in columns 1 and 5 of Table 3. Details of the construction of the event studies are in Appendix C. In this figure and in all subsequent figures, the coefficients have been transformed to semi-elasticities, as have been the upper and lower values of the confidence intervals. The results in these figures support the results presented in Table 3. Figure 4 for NPs shows coefficients in the pre and post periods that are negative but statistically insignificant, with no apparent trends on either side of the law. By contrast, Figure 5 for physicians shows coefficients in the pre period that are positive and statistically insignificant, and coefficients in the post period that are all negative and many are significant. The immediate reduction in malpractice cases is apparent right after the law changes. This supports the negative effect shown in Table 3 and supports the conclusion that FPA for NPs may have benefits for physicians in terms of fewer paid malpractice cases against them.

As mentioned above, Lee and Lee (2021) stated that the identification condition of the ratios-in-ratios estimator can be tested with the inclusion of an interaction between time and the indicator for the treatment group. Following Lee and Lee, we re-estimate the models in Table 3 to include

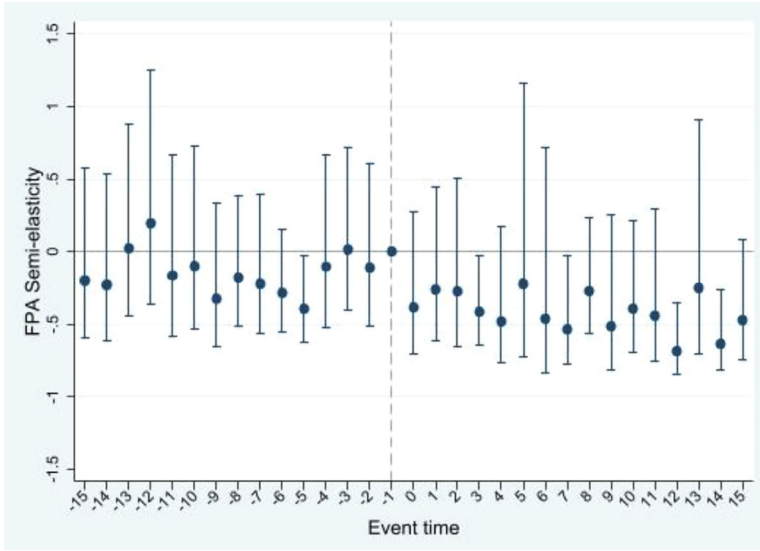

FIGURE 4 Event study for nurse practitioner malpractice payout count.
[Color figure can be viewed at wileyonlinelibrary.com]
Notes: FPA coefficients and confidence intervals transformed to semi-elasticities (exp(b)-1). 95% confidence intervals shown.

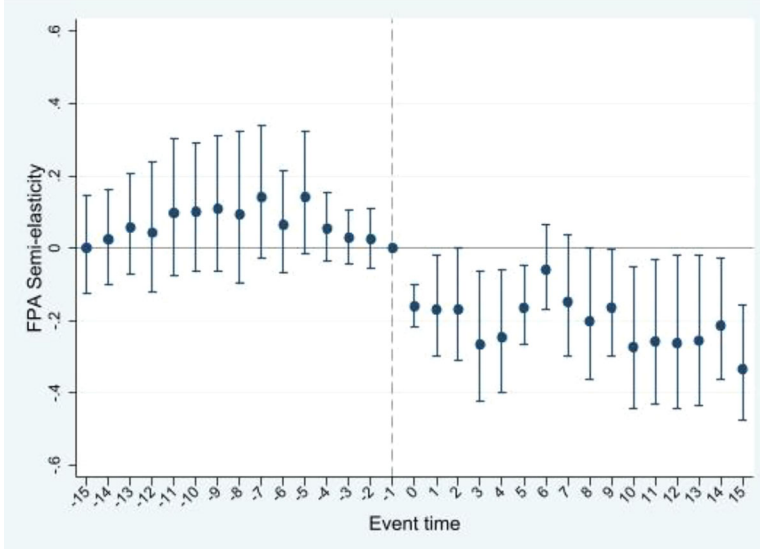

FIGURE 5 Event study for physician malpractice payout count.
[Color figure can be viewed at wileyonlinelibrary.com]
Notes: FPA coefficients and confidence intervals transformed to semi-elasticities (exp(b)-1). 95% confidence intervals shown.

a time*treatment group interaction. Results are shown in Appendix Figure D1. In all models, the coefficients on the interaction terms are very close to 0 and statistically insignificant indicating that the identification condition holds. The inclusion of this term also does not alter the magnitudes of the effects.

We estimate stacked Poisson regression models to address staggered treatment timing and potential treatment heterogeneity. These models are specified both as an average treatment effect on the treated

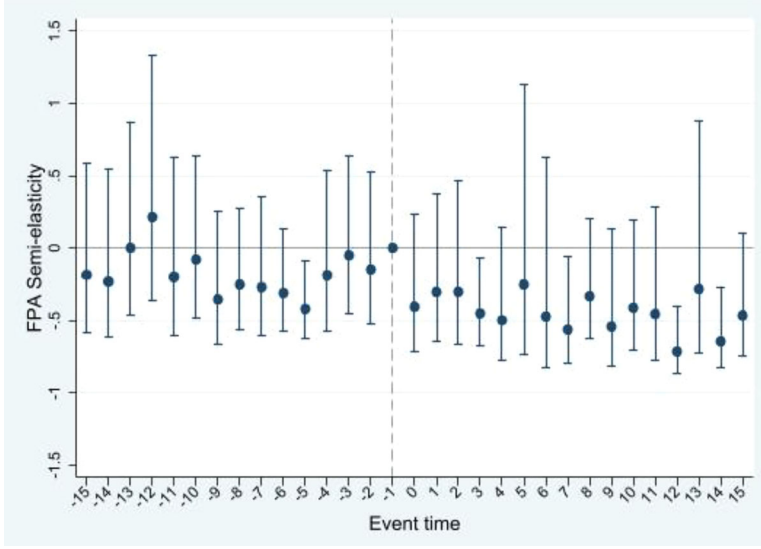

FIGURE 6 Stacked event study for nurse practitioner malpractice payout count.
[Color figure can be viewed at wileyonlinelibrary.com]
Notes: FPA coefficients and confidence intervals transformed to semi-elasticities (exp(b)-1). 95% confidence intervals shown.

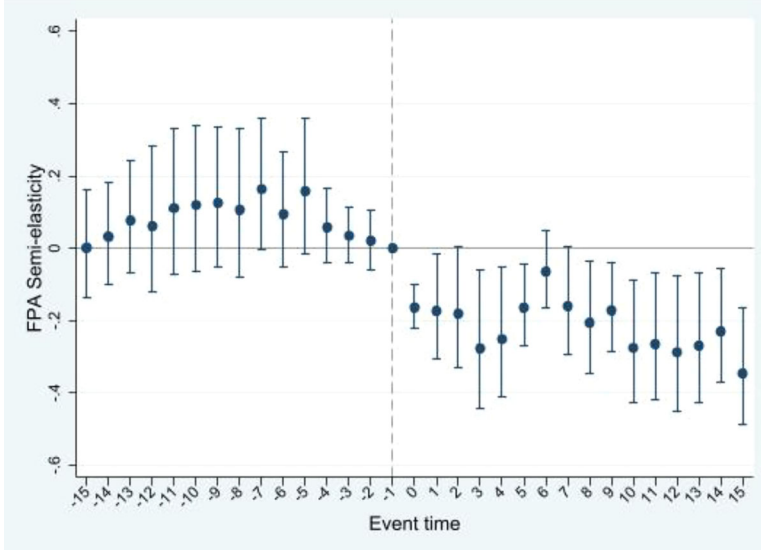

FIGURE 7 Stacked event study for physician malpractice payout count.
[Color figure can be viewed at wileyonlinelibrary.com]
Notes: FPA coefficients and confidence intervals transformed to semi-elasticities (exp(b)-1). 95% confidence intervals shown.

(not shown) and in an event study framework (shown in Figures 6 and 7). The models correspond to our preferred specification in Columns 1 and 5 of Table 3. The results for the average treatment effect are all very similar to those of our main models in both magnitude and statistical significance. The semi-elasticities in the event studies figures are also very similar to those of the standard event study models.

As a further check for treatment effect heterogeneity, Appendix Figure D2 contains models that evaluate the experience of states that switch to FPA at similar times. The top row shows the semi-elasticity on FPA for states with the first full year of change occurring in 2011 and 2012 (Colorado, Maryland, Vermont, and North Dakota). The control group includes only the states that never have FPA. Other states are excluded. The second row shows the effect among states with the first full year of change occurring in 2015 and 2016, compared to the never-FPA states. These states are Connecticut, Minnesota, Nebraska, New York, Delaware, Utah, and West Virginia. These time periods are chosen because they allow for sufficient pre and post periods, and because the number of states with changes is large relative to the numbers in other years.

The results in Appendix Figure D2 confirm the main results in Table 3. For NPs, the coefficients on FPA are statistically insignificant and the magnitudes are small. For physicians, the coefficients are negative and significant with a magnitude that is larger for the states in the later period. While there may exist treatment heterogeneity, the results still point to the conclusion that the transition to FPA does not result in any harm to patients of NPs as measured by the incidence of paid malpractice cases and may provide the benefit of fewer malpractice cases against physicians.

Other robustness checks appear in Appendix D as well. In Appendix Figure D3 we show variations on the Table 3 models. These variations include using the number of practitioners as the exposure variable rather than the state population, excluding the tort-related variables, and using all states in the models. The malpractice results shown in these figures for both NPs and physicians are very similar to that shown in the models in Table 3. Appendix Figure D4 shows models that include a 1-year lag of FPA in order to allow for adoption time. Comparing the lagged FPA to the current year FPA yields very few differences. Two- and three-year lags also yield the same conclusions (available upon request).

Severity of injury

The results above indicate that there are no increases in the rates of malpractice payouts associated with FPA, but a question remains as to whether the severity of the injury may be affected. In other words, by removing oversight, do we observe minor mistakes changing into major mistakes, or vice versa? Severity can be measured with the NPDB variable describing the severity of the alleged malpractice injury. The severity classifications are as follows: 1) Emotional Injury Only; 2) Insignificant Injury; 3) Minor Temporary Injury; 4) Major Temporary Injury; 5) Minor Permanent Injury; 6) Significant Permanent Injury; 7) Major Permanent Injury; 8) Quadriplegic, Brain Damage, Lifelong Care; 9) Death. We generate nine new dependent variables reflecting the counts of each of these injury types by practitioner, state, and year. We analyze these counts using the same specifications and estimation technique as the total malpractice counts. These estimates allow us to answer the question of whether the count of injuries of a certain type changes after the passage of FPA. Alternative approaches might be to examine changes in the average severity, or to use the individual-level malpractice data to examine changes in the probability of each type of injury occurring. However, these types of analyses are conditional on malpractice occurring and are therefore less informative. Indeed, ordered probit models using the individual records show no effects of FPA on the probabilities of the injury severity types.

The results for injury severity are shown in Table 4 for NPs and physicians. The models are similar to those in columns 1 and 5 of Table 3 and use all available years of data with the state population as the exposure variable. The results show no statistically significant positive effects of FPA on the case counts of any injury type for any provider. These results again indicate that there is no evidence that full practice authority for NPs results in harm to patients. The results in Table 4 also help illuminate where the negative effects are coming from in the total counts. For NPs, FPA is associated with statistically significant reductions in the categories of significant permanent injuries and major permanent injuries. For physicians, FPA is associated with statistically significant reductions in the categories of minor temporary, major temporary, minor permanent injury, and significant permanent injury. In 2019, the average payment associated with physician malpractices cases for these four categories was $111,313;

TABLE 4 Severity of malpractice payout cases.

	Emotional injury only	Insignificant injury	Minor temporaryinjury	Major temporaryinjury	Minor permanentinjury	Significant permanent injury	Major permanent injury	Quadriplegic, brain damage, lifelong care	Death
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Nurse practitioners									
Full practice authority	−1.485	−1.195	−0.136	0.231	0.393	−0.416*	−0.521**	−0.577	−0.150
	(1.077)	(1.116)	(0.291)	(0.374)	(0.296)	(0.232)	(0.258)	(0.398)	(0.160)
Pre-FPA mean	0.08	0.01	0.22	0.10	0.19	0.22	0.26	0.08	0.67
FPA semi-elasticity	−0.77	−0.70	−0.13	0.26	0.48	−0.34	−0.41	−0.44	−0.14
FPA marginal effect	−0.06	−0.01	−0.03	0.03	0.09	−0.08	−0.10	−0.04	−0.09
Physicians									
Full practice authority	−0.119	−0.359	−0.309**	−0.272**	−0.357***	−0.262**	−0.102	−0.284	−0.197
	(0.212)	(0.244)	(0.152)	(0.125)	(0.091)	(0.124)	(0.129)	(0.173)	(0.138)
Pre-FPA mean	2.07	2.55	16.48	17.97	21.46	23.50	14.41	6.15	43.63
FPA semi-elasticity	−0.11	−0.30	−0.27	−0.24	−0.30	−0.23	−0.10	−0.25	−0.18
FPA marginal effect	−0.23	−0.77	−4.38	−4.28	−6.45	−5.42	−1.40	−1.52	−7.81

Notes: $N = 924$. State clustered standard errors in parentheses. State population used as exposure variable. Means shown pertain to the eventually treated states in the pre-period. Models also include tort-related laws, state unemployment rate, real income per capita, the percent of the state living in poverty, state fixed effects, and year fixed effects. $^{*}p < 0.10$,** $p < 0.05$, $^{***}p < 0.01$

TABLE 5 Adverse action reports.

	Nurse practitioners				Physicians			
	All adverse actions	Safety violations	Rx violations	Regulatory violations	All adverse actions	Safety violations	Rx violations	Regulatory violations
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Full practice authority	0.165	0.060	0.179	0.443*	−0.070	−0.071	−0.259	−0.287**
	(0.164)	(0.322)	(0.400)	(0.249)	(0.070)	(0.130)	(0.210)	(0.127)
Pre-FPA mean	3.28	0.69	0.49	0.68	128.61	19.67	7.41	14.44
FPA semi-elasticity	0.18	0.06	0.20	0.56	−0.07	−0.07	−0.23	−0.25
FPA marginal effect	0.59	0.04	0.10	0.38	−8.66	−1.35	−1.69	−3.60

Notes: $N = 380$. State clustered standard errors in parentheses. State population used as exposure variable. Means shown pertain to the eventually treated states in the pre-period. Models also include tort-related laws, state unemployment rate, real income per capita, the percent of the state living in poverty, state fixed effects, and year fixed effects. $^{*}p < 0.10$, $^{**}< 0.05$, $^{***}< 0.01$

$237,255; $238,705; and $506,320, respectively, with the caveat that the range of payouts is very large. Nevertheless, reductions in these malpractice cases could translate into substantial savings.

Adverse actions results

Table 5 shows the effects of FPA on adverse actions for NPs and physicians. As with the previous table, the coefficients, standard errors, semi-elasticities, and marginal effects are shown for the FPA

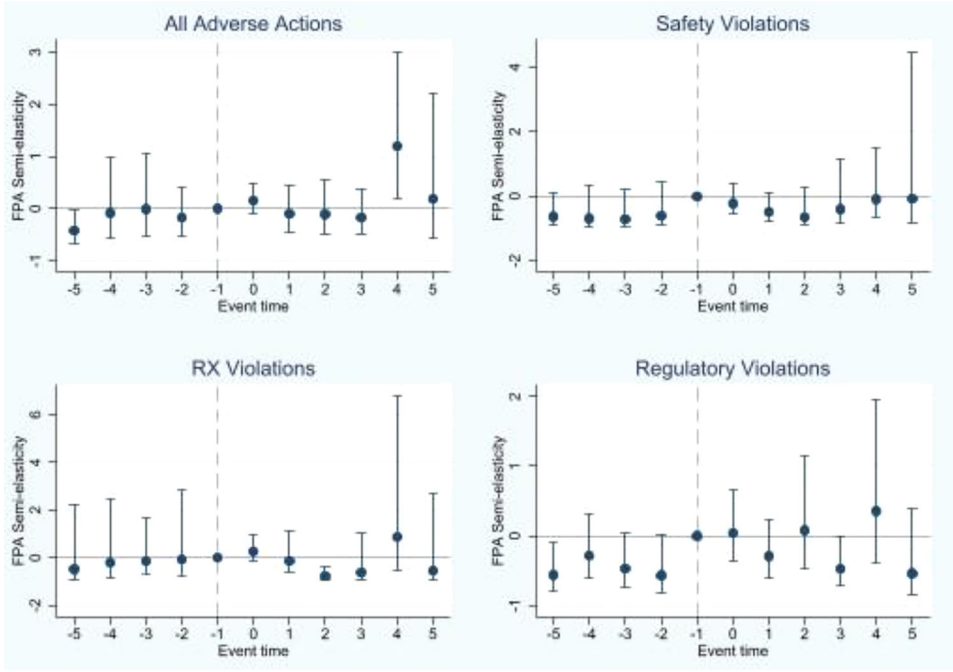

FIGURE 8 Event study for nurse practitioner adverse actions.
[Color figure can be viewed at wileyonlinelibrary.com]
Notes: FPA coefficients and confidence intervals transformed to semi-elasticities (exp(b)-1). 95% confidence intervals shown.

indicator. The state population is used as the relevant exposure variable and the samples exclude states that have always had FPA. The coefficients on the tort reform laws and other included variables are shown in Appendix Tables B1 and B2.

The first four columns of Table 5 show results for NPs. The coefficients on FPA for all adverse action reports, reports of safety violations, and reports of prescription violations are all positive but are statically insignificant. Importantly, the magnitude of the safety violations is small at a statistically insignificant 6% or 0.04 cases per state/year. Even if a one-tailed test is conducted to test for positive effects, the null hypotheses cannot be rejected for safety and prescription violations. These results provide evidence that the transition to FPA does not result in increased reports of unsafe practices nor prescription violations by NPs. In other words, the claim that physician oversight is needed to protect the public health is not substantiated by adverse action reports regarding safety. The results for adverse actions against physicians are also small and statistically insignificant for all adverse actions, safety violations, and prescription violations, although the signs here are negative instead of positive.

The event studies that correspond to the models in Table 5 are shown in Figures 8 and 9 for NPs and physicians, respectively. For the most part, the semi-elasticities shown are all small, statistically insignificant, and display no obvious trends. There are a few outliers with large confidence intervals in the years furthest from the event date. This volatility likely reflects the small number of states in these years. Stacked event studies yield similar null results, as do the cohort-specific analyses. These are not shown for brevity but are available upon request.

One interesting result that appears in Table 5 regards regulatory violations. For NPs, the coefficient on regulatory violations is positive, significant at the 10% level in a two-tailed test (and at the 5% level in a one-tailed test), and relatively large in magnitude at 56% (with a marginal effect of 0.38 cases). For physicians, the coefficient on regulatory violations is negative and statistically significant, indicating a 25% decrease in regulatory violations associated with the transition to FPA. One explanation might be

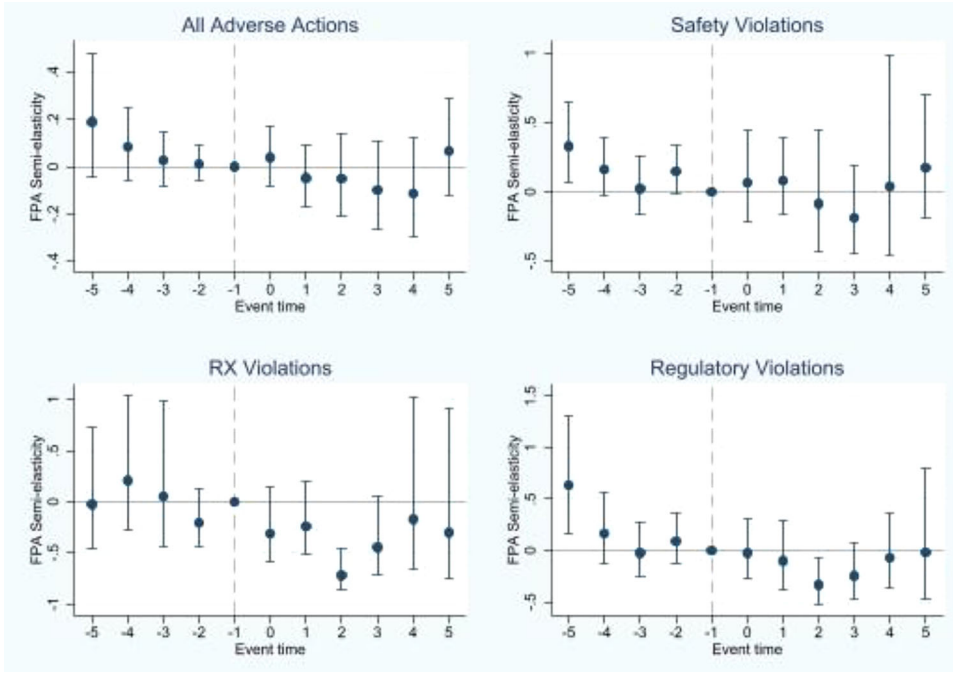

FIGURE 9 Event study for physician adverse actions.
[Color figure can be viewed at wileyonlinelibrary.com]
Notes: FPA coefficients and confidence intervals transformed to semi-elasticities (exp(b)-1). 95% confidence intervals shown.

that the practitioners are responding to an adjustment period with regard to newly implemented SOP rules. However, these effects largely disappear in the corresponding event studies, and cast doubt on the explanation of an adjustment effect. The majority of the regulatory violations are in the category of "violation of federal or state statutes, regulations or rules," but unfortunately, the NPDB does not provide details of the specific infractions that lead to these reports, so we are unable to explore these results further.

Appendix Figure D5 tests the identification condition with the time*treatment group interaction. The coefficients on the interaction term are statically insignificant in the models for safety violations, prescription violations and regulatory violations, indicating that the identification condition holds. The results for the model variations (using the number of practitioners as the exposure variable, using all states in the models, and excluding the tort-related variables) are shown in Appendix Figures D6 and D7. Models lagging FPA are shown in Appendix Figure D8. Results in all of these figures are very similar to the corresponding models in Table 5, and show no effects of FPA on actions against licenses for safety violations and prescription violations.

Registered nurse results

Table 6 shows results for the falsification test where we evaluate the malpractice and adverse action counts of registered nurses. As stated earlier, since scope of practice laws do not pertain to this group of practitioners, results showing any significant effects may point to a confounding variable and cast doubt on our results. However, Table 6 shows small and statistically insignificant coefficients on FPA across all outcomes, providing further evidence for the validity of our estimates.

TABLE 6 Malpractice payouts and adverse actions reports, registered nurses.

	Malpractice payouts	All adverse actions	Safety violations	Rx violations	Regulatory violations
	(1)	(2)	(3)	(4)	(5)
Full practice authority	−0.085	0.012	−0.093	0.009	−0.114
	(0.109)	(0.076)	(0.059)	(0.129)	(0.213)
Pre-FPA mean	3.94	179.52	36.68	22.08	10.59
FPA semi-elasticity	−0.08	0.01	−0.09	0.01	−0.11
FPA marginal effect	−0.32	2.08	−3.25	0.21	−1.14
Observations	923	380	380	380	380

Notes: State clustered standard errors in parentheses. State population used as exposure variable. Models also include tort-related laws, state unemployment rate, real income per capita, the percent of the state living in poverty, state fixed effects, and year fixed effects. $*p < 0.10$, $** p < 0.05$, $*** p < 0.0$

Tort-related law results

The results for the tort-related laws are presented in Appendix Tables B1 and B2. First, as expected, JSL reform has differential effects on NPs and physicians, with the reform associated with an increase in NP malpractice cases and a decrease in physician cases. This type of switching may occur as the reform removes the "deep-pockets" rule that allowed plaintiffs to collect damages from any defendant regardless of the proportion of fault. When NPs are at fault, we would expect to see fewer physicians (with deep pockets) and more NPs being sued under JSL reform. The results in these tables also show reductions in both NP and physician malpractice cases in states that have instituted caps on non-economic damages. However, caps on punitive damages and apology laws have small and statistically insignificant effects.

Regarding the adverse actions, the damage cap and apology laws have little to no effect on adverse actions against physicians, overall or of any kind. Apology laws similarly appear to have no effect on adverse actions against NPs. The punitive and non-economic damage caps have opposing effects in regard to safety violations for NPs, and non-economic damage caps seem to reduce the rate of regulatory actions against NPs. We caution that these coefficients are based off of small numbers of state changes, with some states adding the caps and others removing the caps.

CONCLUSIONS

In this paper, we answer the question of whether removing physician oversight of nurse practitioners results in harms as proxied by malpractice payouts, license actions for reasons of unsafe practices or substandard care, and license actions for reasons of improper prescribing, dispensing, or administering of drugs. This research question stems from the legislative debates over changing scope of practice rules that occur frequently in states. Critics of granting FPA to NPs contend that oversight requirements are required to protect the public health. But is the opposition to FPA based on safety concerns warranted?

Currently, 17 states mandate some form of physician oversight of NPs. Previous research has shown that this oversight can distort nurse labor markets, reduce patient access, and raise costs. There is also evidence that the transition to FPA results in no changes in certain types of health outcomes related to the care that NPs provide. Rather than focus on specific outcomes, such as depression treatment or prescriptions written, we analyze broader measures of harm to patients that result in medical malpractice payouts and adverse actions against licenses. These outcomes have not been previously analyzed

and reflect medical mistakes and misdeeds that have the potential for severe and long-lasting harm to patients.

We use Poisson Quasi-MLE to estimate ratio-in-ratios count models. Our models focus on the effects of the switch to full practice authority and include measures of tort reform, state fixed effects, and year fixed effects to control for possible confounding variables. We check for violations of the identification condition and for treatment heterogeneity. We also check whether the results are sensitive to our modeling choices. Lastly, we run all models using malpractice and adverse action counts among registered nurses as a falsification test. The results are robust to these variation and checks.

We find no evidence that switching from an oversight environment to FPA increases rates of paid malpractice claims against NPs. We also find no evidence that this switch results in increased adverse license actions against NPs for safety- or prescription-related reasons. As the legislation eliminating physician oversight often involves no other substantial changes to NP practice, the insignificant coefficients likely reflect a true null effect. There is, however, a possibility that when an NP's practice environment switches from oversight to FPA, there is a corresponding change in the types of cases or patients seen by the NP that may confound the estimates in unpredictable ways. For example, there is some evidence that NP labor supply grows in underserved areas after FPA (McMichael, 2018), implying that NPs who move may serve a patient population with more comorbidities or chronic conditions. In this case, we might expect to see more mistakes if complex cases are less familiar to the NP. Luo et al. (2021) showed that FPA is associated with changes in employment setting towards ambulatory care centers away from community health centers, and Markowitz and Adams (2022) showed that NPs are more likely to be self-employed after FPA. These employment setting changes may reflect NP preference towards selecting the types of patients with whom they are most experienced and could result in fewer medical errors. Selection effects on the patients' side could also explain why we see no increase in patient harm after states switch to FPA. Following the transition to FPA, patients with complex cases may elect to visit practices where they know they can see a physician and take their more routine cases to NP practices. The degree to which FPA is associated with patient population or case mix changes is currently understudied and presents a direction for future research.

Despite the fact that physician groups often oppose FPA for NPs, we confirm a benefit of FPA for physicians. Our results indicate that FPA is associated with a 21% to 24% reduction in the number of paid malpractice claims against physicians. McMichael et al. (2018) were the first to detect this benefit and find a slightly larger magnitude of a 31% reduction using data ending in 2012. Under FPA, collaborative agreements are terminated and the legal concepts surrounding shared responsibility no longer apply, absent a formal employment relationship. The severing of these legal ties likely explains some of the observed reduction. Also, as with NPs, it is possible that when faced with new competition, physicians may face a new patient case mix, or they may change behaviors or practice style. For example, Markowitz et al. (2017) found a reduction in cesarean sections after FPA for certified nurse midwives. Since these nurses cannot legally perform cesarean sections, a logical explanation is that obstetricians are reacting to competitive concerns. In a working paper, Currie et al. (2023) showed evidence that general practice physicians change prescribing behaviors in response to FPA. Further testing of this supposition is a direction for future research.

Patient safety is a primary concern in the debate surrounding the movement towards FPA for NPs. The results of this paper indicate no evidence of harm severe enough to result in medical malpractice payouts and adverse actions against licenses. These results add to the growing literature showing that removing physician oversight requirements from the NP SOP results in health outcomes that are either no different or slightly better under NP care, with lower costs and more patient access, and with no evidence of harm or other downsides to patients.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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