Nurse Practitioner Independence, Health Care Utilization, and Health Outcomes*

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Abstract

A number of states permit nurse practitioners (NPs) to practice and prescribe drugs without physician oversight, allowing NPs to fill the traditional primary care provider role long held by physicians. Little is known about the effect of NP independence on population health care utilization rates or long run health outcomes. We estimate the causal impact of NP independence by exploiting variation in the timing of state law passage. We find that in states that allow NPs greater freedom from oversight by doctors, the frequency of routine checkups increases and various measures of care quality improve. We also find less emergency room use by patients with ambulatory care sensitive conditions. These effects come from decreases in the administrative burden of collaboration between physicians and NPs and indirect costs to patients of accessing medical care.

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1 Introduction

Implementation of the Affordable Care Act is expected to increase demand for medical services across the U.S., particularly the demand for primary care services. Primary care providers offer regular preventive medical care, reducing the number of routine medical problems that become emergency room visits and keeping chronic conditions from worsening until a hospital stay is required. With 7 out of 10 deaths in the U.S. every year the result of chronic diseases and nearly half of all adults diagnosed with a chronic illness, increasing the amount of preventive services consumed by the population may have significant impacts on population health outcomes in the long run.[1] As primary care is generally more cost effective than acute care in an emergency room or hospital, more preventive care may also create long run cost reductions in medical care. Towards both these ends, the Affordable Care Act contains a number of provisions designed to increase the amount of primary care consumed in the U.S., including mandating coverage for preventive services, funding community disease prevention measures, and increasing the number of primary care providers.[2]

Traditionally, physicians have been the health care professionals responsible for providing primary care. But with fewer physicians choosing to enter primary care, the approximately 56,000 nurse practitioners (NPs) practicing primary care in 2010 are the largest group of non-physician primary care providers, representing 19% of all primary care providers (Schwartz et al., 2011; AHRQ, 2011). Since the mid-1990s, the number of NPs in primary care has grown at 9.4% per year while the number of physicians in primary care has grown at 1.1% per year, so NPs will likely be an even larger percentage of primary care providers in the future (GAO, 2008). NPs are also more likely than physicians to practice in rural areas (AHRQ, 2012). State scope-of-practice laws regulate the types of medical services that NPs can provide and the necessary level of physician involvement in NP practice. Most

[1] For information on rates of various chronic diseases in the U.S., see the Center for Managing Chronic Disease (`http://cmcd.sph.umich.edu/statistics.html`) and the Center for Disease Control (`http://www.cdc.gov/chronicdisease/`).

[2] See `http://www.healthreform.gov/newsroom/primarycareworkforce.html` for more details on the provisions of the Prevention and Public Health Fund, established as part of the Affordable Care Act.

notably, some states allow NPs to both practice and prescribe drugs without physician supervision, effectively enabling them to be independent providers of primary care services. These laws and regulations represent an important policy tool through which states can influence the total amount of preventive care provided, the geographic distribution of primary care providers, and potentially the overall cost of medical care. In early 2012, over 50 bills were under consideration in state legislatures across the U.S. that would affect scope-of-practice laws for NPs (Cassidy, 2012). However, little is known about the effect of allowing NP independence on the utilization of primary care and population health outcomes.

The implications of NP independence for health care utilization are not immediately clear. NP independence may lead to higher health care utilization rates if independent NPs practice in areas with few doctors, thereby lowering the cost of accessing health care for people in these areas, or by removing administrative burdens of collaboration between NPs and doctors, thereby freeing up more time to spend on patient care rather than reviewing charts and diagnoses. Primary care utilization might show no response or even decrease if fewer doctors provide primary care when NPs do not require physician supervision or if patients believe that NPs provide a lesser quality of care when not supervised by a physician.

The impact of NP independence on health outcomes is also an outcome of significant debate and interest. Physician groups argue that NPs working without physician supervision will lead to a decrease in the quality of primary care, as NPs have less medical training than doctors (American Academy of Family Physicians, 2012). On the other hand, the Institute of Medicine claims that "what nurse practitioners are able to do once they graduate varies widely for reasons that are related not to their ability, education or training, or safety concerns, but to the political decisions of the state in which they work" (Institute of Medicine, 2010, p. 5)). A number of randomized trials have concluded that patients using NPs for primary care have comparable health outcomes to patients who use doctors.[3] NPs managing relatively simple ailments without the supervision of a doctor may also allow doctors to work on cases

[3]See Naylor and Kurtzman (2010) for a summary of these studies.

where advanced training has a larger marginal impact on patient health.

We estimate the causal effect of NP independence on population utilization of care and health outcomes by exploiting plausibly exogenous state level variation in the timing of changes in regulations governing the level of supervision that doctors must provide for NPs. We collect data on scope-of-practice laws and regulations for NPs by state from 1970 to 2010. Identification comes from within state variation in regulations over time. Our findings indicate that the timing of changes in NP regulations is not well-explained by changes in state health care concerns, as argued by Safriet (2002) and Institute of Medicine (2010).

We obtain individual level data on health care utilization and outcomes from the Medical Expenditure Panel Survey and the Behavioral Risk Factor Surveillance System. As states have allowed NPs to practice or prescribe independently for different lengths of time, we use an event study approach to investigate the difference between short and long run effects of NP independence. We also look for heterogeneous effects of NP independence, such as whether women, rural populations, or people without medical insurance have greater changes in utilization or health outcomes.

Several recent papers examine changes in health care utilization or health outcomes in response to changes in the supply of medical providers or changes in occupational licensing. Cook et al. (2012) find that increases in minimum nurse staffing ratios do not lead to better outcomes for patients, while Garthwaite (2012) finds that physicians reduce the amount of time spent with each patient when public insurance programs expand. Both papers show that increasing the number or availability of medical providers does not imply that health care utilization will rise or health outcomes will improve, though neither focuses on NPs or scope-of-practice laws as we do.

Kleiner et al. (2012) and Stange (2012) are most similar in spirit to our paper. Kleiner et al. (2012) analyze responses in NP and physician wages and the prices of primary care services when NPs gain more independence between 2002 to 2007 using a difference-in-difference approach. They find that the wages of NPs and physicians both increase when

NPs have more independence, while the price of well-child visits falls. Our paper has a longer time horizon and focuses on changes in utilization and health outcomes rather than labor market outcomes for primary care providers. Stange (2012) estimates the effect of county-level variation in the number of NPs and PAs on health care expenditures and preventive screenings and finds minimal impact in MEPS data.[4] Our paper has a different source of identification and estimates the direct impact of changes in regulations, allowing for time variation in regulations to impact provider supply as suggested by Kalist and Spurr (2004).[5] This motivates our use of time-varying treatment effects, which allow us to test whether changes in regulations or changes in NP supply drive our results.

We find that states that allow NPs to practice and prescribe without physician supervision see increases in health care utilization and care quality, with utilization increases primarily coming from adults while quality increases impact both adults and children. We find that these increases have positive effects on self-reported health status and body mass index. Patients with conditions that respond to primary care show reductions in emergency room use, suggesting both an improvement in health and cost savings in the provision of care. The response to NP independence shows little heterogeneity across the population, so the gains in health outcomes are widespread. Our evidence suggests that the primary mechanisms for these changes are the elimination of physician and NP time spent on supervision and decreases in indirect costs of receiving medical care such as better appointment availability and lower patient travel costs, rather than changes in provider supply or composition.

2 Background and Related Literature

Advanced practice nurses (APNs) are registered nurses who serve as health care providers in a broad range of primary care, acute care and outpatient settings. APNs include nurse prac-

[4] Stange (2012) also uses a difference-in-difference approach to show that preventive screening frequency does not change when NPs and PAs are allowed to prescribe controlled substances.

[5] Kalist and Spurr (2004) show that NP independence, under a somewhat different definition than ours, increases enrollments in NP training programs.

titioners, certified nurse midwives, certified registered nurse anesthetists, and clinical nurse specialists. In 2010, approximately two thirds of all APNs in the U.S. were NPs (Phillips, 2011). NPs most commonly specialize in primary care areas such as family practice, adult practice, women's health, pediatrics, and gerontology. NPs provide primary and preventive health care services, prescribe medications, diagnose and treat common minor illnesses and injuries, and counsel patients on adopting healthy lifestyles. NPs practice in community clinics, health centers, urgent care centers, hospitals, nurse practitioner practices/offices, retail-based clinics, and walk-in clinics.

Since the first NP program was developed in Colorado in 1965, states set their own laws and regulations governing the scope of NP practice. These laws vary widely by state. States may require physicians to be physically on site to supervise an NP or require a written collaborative agreement between an NP and an offsite physician detailing referral policy and physician review of patient charts. States can also mandate that physicians review or cosign all prescriptions written by an NP and impose restrictions on prescriptions of certain types of medications, limits on private and Medicaid reimbursement, limited hospital privileges, and strict malpractice liability insurance requirements for NPs. For example, Texas requires that an NP must have a collaborating physician spend at least one out of every ten days at the clinic where the NP practices, the NP's practice must be located no more than 75 miles from the physician's office, and a randomly selected 10% of the NP's patient charts must be reviewed each month (Pettypiece, 2013; Traweek and Goodman, 2011). Alabama similarly requires that a collaborating physician must supervise at least 10% of the NP's working hours and review all adverse patient outcomes and 10% of all medical records (Alabama Board of Medical Examiners Administrative Code, 2012).

We choose to focus on the two most significant areas of delivering primary care, practice authority (diagnosing and treating patients) and prescriptive authority (prescribing medications). While any barrier can reduce the willingness of an NP to have a fully independent practice, a requirement for physician involvement in NP practice or prescriptive authority legally constraints an NP's ability to setup primary care facilities in any chosen location and provide patients with prescription medications. We consider NPs in states with laws requiring supervision or collaboration on any aspect of practice to be *dependent* and NPs in states without such laws to be *fully independent*.

Figure 1 shows that following Montana's adoption of full independence for NPs in 1984, the number of states allowing NPs full independence rose steadily between 1985 and 2005. The process of changing state laws on NP practice was often a contentious political fight. According to Safriet (2002, p. 304), legislators are "bombarded by heavily-financed lobbying efforts emanating from state and national professional organizations, individual health care providers (who are also voters), and interested citizens." The federal government has also exerted indirect pressure on states to allow NPs more independence. The Federal Trade Commission held hearings beginning in 2002 on the level of competition between different types of providers of care in medical markets.[6] These hearings indicate federal concern over the rationale behind state laws requiring physician supervision of NP practice and suggest that population health and welfare are not overriding factors for state legislatures and regulators when determining the degree of NP independence. In our empirical work, we examine state-level determinants of the decision to allow NPs full independence.

Despite claims from physician groups that independent NPs offer a lower quality of care than physicians or physician-led teams, two waves of randomized control trials have concluded that there is no difference in the quality of primary care received by patients using NPs and those using physicians as measured by patient health outcomes. The first set of studies examined the effectiveness of NPs when under physician supervision. Sackett et al. (1974) and Spitzer et al. (1974) study the Burlington randomized trial, a 1971 trial program of NPs as primary care providers in a large suburban Ontario practice. These studies examine physical, emotional, and social factors as well as mortality and care satisfaction of patients and find that patients who received care from physicians had no differences from

[6]See `http://www.ftc.gov/bc/healthcare/research/healthcarehearing.htm` for a summary of the hearings.

patients who received care from NPs. Sox (1979) examines 40 studies of NP or physician assistant-delivered office-based care and finds the quality of NP and physician assistant care to be indistinguishable from physician care.

Recent randomized trials studying health outcomes of patients receiving primary care from NPs without physician supervision reach the same conclusion. Mundinger et al. (2000) randomly assign patients to either an NP-run or physician-run primary care practice over 1995-1997 and find that patients receiving primary care from physicians reported similar levels of health status and satisfaction with care as patients receiving care from NPs practicing without physician supervision six months after the initial primary care visit. They also find that patient utilization of specialists, emergency room visits, and frequency of hospitalization were equivalent across provider types. Letz et al. (2004) confirm these results in a study of the same patients two years after their initial visit to the randomly assigned provider. In a meta-analysis of randomized trials, Brown and Grimes (1995) find that patients who visit NPs "were more likely to be compliant with taking medications, keeping appointments and following recommended behavioral changes than patients" who visit physicians (Pohl et al., 2010, p. 181). These studies show that the quality of primary care provided by NPs practicing independently is comparable to that of physicians.

Independence for NPs is also a potential source of cost savings in medical care. Medicare reimburses independent NPs at 85% of the rate of physicians for services performed, while state Medicaid reimbursement rates for NPs vary. Cost savings may also come from lower salaries and less training time for NPs relative to physicians. In a recent analysis of the Massachusetts health care reform, Eibner et al. (2009) estimate that medical costs would decrease between 0.6 and 1.3% over 10 years if Massachusetts allowed NPs full independence.[7] Given the similarities between Massachusetts' health care law and the provisions of the Affordable Care Act, this estimate of cost savings may be applicable for other states

[7] The estimates here also include cost savings from relaxing scope-of-practice laws for physician assistants. However, NPs outnumbered physician assistants 4 to 1 in Massachusetts in 2007 when the estimates were created and the proposed policy changes for physician assistants did not include some freedoms given to NPs. Thus, the vast majority of this cost savings comes through NP independence.

considering allowing NPs full independence.

Another potential issue in the analysis of health care utilization when NPs are fully independent is that of supplier-induced demand. Many early papers, following the work of Fuchs (1978), find that the suppliers of medical services are able to increase demand beyond the amount that is optimal for patients to consume because providers and patients have asymmetric information about patients' medical conditions.[8] In our analysis, it is possible that allowing NPs full independence might lead to an increase in the utilization of health services that does not improve societal welfare if primary care providers in these states respond to increased competition by inducing more demand for primary care from their patients to increase their incomes. We do not believe that supplier-induced demand is a concern in this case for several reasons. The evidence in favor of supplier-induced demand is strongest for medical providers ordering additional tests when they own the equipment used for the tests (Hillman et al., 1990; Mitchell and Scott, 1992) or in procedures ordered by specialists with less opportunity for repeat business from the same patient than primary care providers have (Gruber and Owings, 1996). Hooker and McCaig (2001) show that there is little difference in the number of diagnostic tests ordered by NPs and physicians. Studies that have focused on primary care providers, such as Grytten et al. (1995), Van De Voorde et al. (2001), Cockx and Brasseur (2003) and Madden et al. (2005), do not find evidence of supplier-induced demand in the number of visits to primary care providers, while Dranove and Wehner (1994) critique the empirical strategies used in some work supportive of supplier-induced demand. The available empirical evidence suggests that there is at most a minimal effect of supplier-induced demand in primary care services.

3 Data

Our main analysis uses data on health care utilization and health outcomes from the Medical Expenditure Panel Survey Full Year Consolidated Data Files over the period 1996-2010. We

[8] See Dranove (1988) for a summary of this literature.

treat this as a repeated cross-section of information about individuals in different states over time. The data contains information on checkups, emergency room visits, and total numbers of visits to a variety of medical providers, as well as self-reported health status and measures of patient ease of access and perceived quality of care. The data also contains a rich set of individual characteristics, including race, gender, education, marital status, income, employment status, and type of health insurance. The confidential version of the MEPS data that we use reveals each individual's state of residence and more detailed information about medical conditions and procedures, neither of which is available in the public use version.

Our primary data sources for laws governing NP practice are state statutes and regulations from state Boards of Nursing from 1970 to present. We cross-reference this data with annual surveys published in the 1995-2011 January issues of *The Nurse Practitioner* for the overlapping years. The survey data in *The Nurse Practitioner* are obtained from representatives of state nursing organizations or from a member of the state Board of Nursing and are based on the interpretation of the state statutes or regulations of the survey responder.

We define independent practice authority for NPs as the absence of statutory or regulatory requirements for physician collaboration or supervision and independent prescriptive authority for NPs as the right to prescribe medications (including controlled substances, if allowed) without physician collaboration or supervision. We consider a state to allow NPs full independence if the state offers NPs both independent practice authority and prescriptive authority. In these states, NPs may establish their own practices without any involvement from a doctor. Under our definition of independence, 17 states and the District of Columbia allowed NPs full independence in 2010. Table 1 lists the years in which states changed their laws to allow NPs independent practice authority, independent prescriptive authority, and full independence from physician supervision.

In order to interpret the parameter estimates of our event study causally, the timing of states' decisions to allow NPs full independence must be exogenous to the outcomes of interest. As discussed above, state laws on NP practice are often the outcome of state board regulatory decisions made by political appointees, attorney general decisions, or other factors related to political bargaining rather than health concerns. We present evidence of the disorganization and unpredictability in law passage by looking for characteristics of states correlated with NPs gaining full independence following the approach of Hoynes and Schanzenbach (2009) and Bailey (2012). We choose variables that reflect both health-related population characteristics as well as proxies for the political power of physician groups motivated by the political discussions of Safriet (2002) and Institute of Medicine (2010). For each state and year, we include the physician to population ratio in the state, the amount of public money spent on medical benefits, the percentage change in public money spent on medical benefits, and the number of inpatient days and outpatient visits in the state per 100,000 residents. Each of these variables captures an aspect of the state's current equilibrium in the market for health care. The physician to population ratio may also reflect the relative political clout of physicians. We include the number of medical schools in a state as well as a dummy for whether the governor is a Democrat to measure the influence of political factors, as doctors may have greater political influence in states with more medical schools and the governor appoints regulators to state Boards of Nursing that can determine NP scope of practice.[9] We also include the share of the population over 65, under 20, living in an urban area, and real personal income to proxy for demand for medical services.[10]

We compare the 1970 characteristics of states that ever allow full NP independence to states that never do so to see if there are pre-treatment systematic differences in the observables of states that ever give NPs full independence. We choose 1970 as the start point for decisions over NP independence as it predates Montana's decision to become the

[9]See American Medical Association (2009) for a list of appointment procedures to state Boards of Nursing.

[10]Data on number of physicians, inpatient and outpatient visits, and number of medical schools from the Area Resource File of the U.S. Department of Health and Human Services. Data on inpatient and outpatient visits is linearly interpolated between 1970 and 1975 and between 1975 and 1980. Data on public medical benefits and real personal income from the BEA Regional Economic Information System. Public medical benefits are defined by the BEA as payments made directly or through intermediaries to vendors for care provided to individuals for medical purposes, consisting of payments from Medicare, Medicaid, and Children's Health Insurance Programs. We adjust personal income data to constant 2010 dollars using the CPI for all urban consumers obtained from the BLS. Share of population over 65, under 20, and urban from Census Bureau.

first state to allow full NP independence in 1984, comes after the founding of the first NP training program in 1965, and is the earliest data point consistently available for many of the covariates we wish to compare. Table 2 presents our results. Though our test for differences among states has large standard errors because we have only 51 observations in 1970, we still find some statistically significant differences between the states that ever permit full NP independence and those that do not. We find that states that allow NPs full independence tend to have lower medical expenditures per person, fewer medical schools, and a younger population.[11] This contradicts the notion that high spending, older states permit NPs to practice without oversight as a means of cutting the cost of providing primary care services or to increase the availability of medical care for an elderly population.[12]

One interpretation of the fact that states that ever allow NPs full independence have many fewer medical schools is that if physicians remain in the state where they attended school to practice, then the number of medical schools proxies for the future supply of medical service providers. However, this does not appear to be true. Only 38.6% of doctors practice in the state where they went to medical school (American Association of Medical Colleges, 2011) and the physician to population ratio is almost exactly the same in the states that ever allow full NP independence and those that never do despite persistent differences in the number of medical schools across the two types of states. We also find no evidence that this difference in the number of medical schools in 1970 leads to a higher physician to population ratio in future years: by 2007, there were 261.41 physicians per 100,000 population in states that ever allow NPs full independence and 264.03 in states that never allow NPs full independence. Instead, we interpret this finding as evidence that the number of medical schools is proxying for the political power of physicians in the state. These observed differences across states and their persistence over time motivate the inclusion of state fixed effects in our empirical

[11] These same differences exist in state data over 1970-1980, so they appear to be persistent rather than an artifact of the small sample.

[12] A young population might have a high utilization of pediatric primary care services, one of the specialty areas of NPs, thereby causing a state to grant NPs full independence to deal with high demand among the young. However, no state allows NPs to practice independently until 1984, so most of those under the age of 20 in 1970 would no longer demand pediatric services.

work, so both observed and unobserved differences across states accounted for by these fixed effects do not affect the internal validity of our estimates.

We now use these covariates to predict the timing of the adoption of NP full independence in the 18 states that ever allow it. We use state panel data over 1970-2008 to regress the covariates described above on the number of years remaining until the state allows full NP independence. We also estimate results on a shortened panel of 1980-2008 to insure that results are not greatly affected by having a long early period before any state allows full NP independence. We present results of these panel regressions in Table 3. Given the correlations between many of our health-related explanatory variables, it is perhaps not surprising that the only variable consistently correlated with the number of years until NPs gain full independence is the party of the governor. We find that states with Democratic governors tend to wait more years before allowing NPs full independence.

Since individual statistical significance is likely affected by multicollinearity, we instead look at R^2 as a measure of the overall power of all the variables in the regression when assessing the explanatory power of these covariates. The low R^2 values of these regressions, ranging from 0.36 to 0.54, indicate that these variables capturing important features of the health care markets and political conditions in states explain only a moderate amount of the variance in the timing of passage of NP independence laws. However, since the number of years remaining until law passage is a simple linear trend, these R^2 values are likely inflated by time trends in the explanatory variables. A regression of years until law passage on only year fixed effects shows an R^2 of 0.44 in the panel using data from 1970 and 0.25 using data from 1980.[13] This result is consistent with the presence of common unobserved trends, as we would expect more inflation of the regression R^2 in the longer panel. This suggests that our covariates add minimal explanatory power beyond simple flexible time controls, as the R^2 in columns (2) and (4) only increases by 0.1 and 0.16, respectively, with the inclusion of the additional covariates.[14] Overall, these regressions indicate that a high proportion of

[13]Using a linear trend as the only regressor yields $R^2 = 0.42$ over 1970-2008 and $R^2 = 0.24$ over 1980-2008.

[14]This is somewhat different from the approach of Hoynes and Schanzenbach (2009) and Bailey (2012),

the variance in the timing of the passage of NP full independence laws is unexplained by variables capturing state health care utilization and state demand for health care. We view this as evidence consistent with the assertions of Safriet (2002) and Institute of Medicine (2010) that the law change process is a political one and mostly unresponsive to population health or budgetary issues in a state. In our empirical work below, we therefore treat the timing of state law changes as exogenous to health care utilization and health outcomes.

4 Empirical Approach and Results

We use an event study approach to examine how increasing NP independence affects health care utilization and health outcomes. This research design allows the effects of NP independence to differ in different years and includes effect estimates from before law passage as a falsification test. Our baseline statistical model is

$$y_{ist} = \beta_0 + \sum_{k=-5}^{-1} \tau_k \cdot 1(t - T_s = k) + \sum_{k=1}^{11} \eta_k \cdot 1(t - T_s = k) + \gamma \cdot X_{it} + \alpha_t + \alpha_s + \epsilon_{ist} \qquad (1)$$

where y_{ist} is our outcome of interest for individual i in state s in year t, T_s is the year in which state s first allows NPs full independence, X_{it} are other individual level control variables, and α_t and α_s are year and state fixed effects. We control for age, race, health insurance status, ethnicity, gender, living in an urban area, employment status, marital status, education level, and income. All results use the sampling weights given in the MEPS data. The coefficients τ_k and η_k estimate the evolution of the effects of NP independence over time relative to the year of law passage. We include all observations from states that never allow full NP independence in the control group. We group the event study dummies into

as they use data from one chosen pre-treatment year to predict the length of time between that year and a county program implementation date. Our state level data set has too few observations to use all our covariates in a single meaningful regression. We alternatively estimate separate regressions using data from 1970 only where each covariate is used as the sole explanatory variable. Of these regressions, only medical benefits per 100,000 people has a statistically significant coefficient of 0.003, which suggests that states with higher medical benefits take longer to allow NPs to practice independently. This again contradicts the idea that states implement NP full independence in response to rising costs.

two year intervals to improve the precision of our treatment effect estimates. To estimate long run effects, all available data 11 years or more after the law change is considered part of the "year 11" treatment. Similarly, all data 5 years or more before the law change is part of the "year -5" treatment. When our dependent variable of interest is binary, our regression is a logit model and our reported coefficients are average marginal effects.[15] Reported standard errors are clustered at the state level.

4.1 Preventive Care Utilization and Care Quality

We begin by estimating the effect of NP independence on the probability that an individual has had a routine checkup in the last 12 months. Increased utilization of yearly checkups is an important mechanism for NP independence to affect health outcomes. We split the sample into adults and children based on a cutoff at age 18, and Table 4 reports average marginal effects. For both adults and children, our pre-treatment dummies have small and statistically insignificant effects as desired. We find that the probability that an adult has had a checkup in the last year increases by 3.8 percentage points in the two years immediately after NP full independence. This effect rises to 6.8 percentage points after year 11, though the difference between the initial effect and the long run effect is not statistically significant. We do not find evidence of an increase in the likelihood of a yearly checkup for children.

Table 5 shows the magnitude of the estimated 6.8 percentage point long run effect relative to the baseline rate of adults getting yearly checkups. Over 1996-2010, 66% of adults report having a checkup in the last year. Our long run treatment effect therefore represents a 10.3% increase in the number of adults receiving yearly checkups. As noted above, states requiring NPs to be supervised by physicians often require 10% or more of the physician's and NP's time to be spent on direct supervision, consultations, or reviewing charts. Removing these requirements frees up more time for both physicians and NPs to see additional patients, so we believe that our estimated 10.3% increase in adults receiving yearly checkups is reasonable.

[15] As a robustness check, we also estimate these specifications using a linear probability model. All results are both qualitatively and quantitatively similar under this alternative functional form assumption.

NP independence may increase checkup frequency by reducing indirect costs to the patient through lower travel times or more convenient appointment scheduling. Lower travel costs are consistent with geographic spread of medical providers in response to NP independence, while better availability of appointments is consistent with reduced time spent on supervision and consultations between physicians and NPs. We estimate these effects using patient responses to questions about the availability of an appointment when one is wanted, the availability of appointment when the patient is sick, and whether it is difficult to travel to a provider. We code these responses as 1 if the patient reports "always" being able to get an appointment when wanted or when sick and 0 otherwise, and 1 if travel to a patient's usual source of care is "not at all difficult" and 0 otherwise.[16] Table 6 presents results for both adults and children. We find that all of these measures respond positively to the introduction of NP full independence, with more individuals reporting that they always get an appointment when they want one, always find care when sick, and that it is easy to get to a medical provider. Table 5 shows that the long run effect magnitudes are economically significant, with 16-20% increases in these measures for adults and 17-35% increases for children relative to their baseline values.

NP independence can lead to changes in patient health outcomes through channels other than checkup frequency. If checkups increase in quality, then even individuals who do not receive a greater quantity of primary care in response to NP independence may see greater health benefits. We first use a survey question that explicitly asks patients to rate their health care quality over the past year on a scale of 0-10. Column (1) of Table 7 shows that patients report a higher level of overall health care quality after NP independence, though this effect appears to weaken slightly in the long run. To determine what drives this perceived increase in quality, we look for changes in visit quality using questions on whether the provider spent enough time with the patient, whether the patient felt that the provider listened to their concerns, and whether the provider explained things in a way that the patient understood.

[16] These responses correspond to the most favorable category available for each question.

We again code responses as 1 if the patient answers "always" and 0 otherwise and present results in columns (2)-(7) of Table 7 with magnitudes of long run effects in Table 5. We find that patients consistently report visits to be of higher quality in the years following NP independence, with increases in these metrics ranging from 13-15% for adults to 17-27% for children relative to their baseline values.[17] These results are consistent with the finding of Hooker and McCaig (2001) that NPs spend more time per patient than physicians during office visits. We take this as evidence that patients perceive their interactions with medical service providers to be of higher quality when NPs have full independence, so even individuals who do not consume more primary care after NP independence may show improvement in health outcomes.

We summarize our results in Figures 2 and 3. These graphs report the coefficients of the treatment dummies in the logit regressions of Tables 6 and 7, so effects are measured in percentage point increases in the given dependent variable. The patterns of coefficients in the figures are largely supportive of our research design, as pre-NP independence dummy variables are generally statistically insignificant and have smaller point estimates than post-NP independence dummy variables.[18] Most measures show a sharp increase in the years immediately following NP independence. The patterns also highlight the strength of the event study design, as the pre-treatment years serve as placebo tests of the effect of NP independence and offer further evidence that the timing of NP independence is exogenous to health care concerns.

4.2 Changes in Health Outcomes

Having established that NP independence leads to increases in health care utilization and patient-reported care quality, we now present evidence that these increases lead to improvements in health. We first look at patient self-reported health status on a familiar 1-5 scale,

[17] Parents answer questions about the quality of health care received by their children.

[18] Note that while a few of our pre-treatment dummies are statistically significant, the number of significant point estimates is consistent with expected rates of Type I error.

with 5 being "excellent" health.[19] Our results in column (1) of Table 8 show that adults have a higher self-reported health status after NP independence. However, the coefficient estimates do not exhibit a clear pattern, with some years post-NP independence showing significantly larger effects than others. We interpret this as weak evidence of an improvement in health outcomes.

For a less ambiguous measure of health, we look at changes in adult body mass index. 62.5% of adults in our sample have a BMI over 25, suggesting that weight loss would lead to a reduction in obesity-related health risks.[20] If patients are more likely to follow behavioral changes suggested by NPs than physicians as suggested by Brown and Grimes (1995), then patients may better adhere to diet and exercise routines and lose weight in response to NP independence. We report results in column (2) of Table 8. The pattern of post-NP independence coefficients indicates a slow decrease in BMI in states with NP independence, with a decrease of 0.25 in BMI the first 2 years and 0.54 after 11 years. These effects are modest: a decrease of 0.5 in BMI is a loss of approximately 3 pounds for a person 5' 2" tall and 3.5 pounds for a person 6' 2" tall. We believe that this effect size is consistent with small behavioral changes, and the weight loss represents an improvement in health.

We also test whether the additional preventive care consumed after NP independence leads to better management of chronic conditions using MEPS Medical Conditions data files. The Medical Conditions file reports the number of emergency room visits related to each medical condition an individual has. Of course, for many conditions, we would not expect preventive care to affect the severity of the condition. We instead focus on ambulatory care sensitive conditions, identified by Billings et al. (1993, p. 163) as "diagnoses for which timely and effective outpatient care can help . . . by either preventing the onset of an illness or condition, controlling an acute episodic illness or condition, or managing a chronic disease or

[19] MEPS contains several self-reported health status variables. Since we are treating the data as a repeated cross-section, we use the report in the second and fourth wave of each panel so as to avoid the same individual giving two ratings in a calendar year.

[20] The CDC considers a person with a BMI over 25 to be overweight and a BMI over 30 to be obese. See `http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html` for a discussion of how health risks increase with BMI.

condition." Table 9 reports the list of conditions considered responsive to preventive care in Billings et al. (1993). Because the distribution of emergency room visits for each condition is skewed towards 0, we estimate extensive and intensive margin effects in separate regressions using a dummy variable for any emergency room visit and the natural log of the number of visits as dependent variables. Columns (3) and (4) of Table 8 report results. On the extensive margin, we find consistently negative but imprecisely estimated effects of NP independence. On the intensive margin, we find a 12.8% long run reduction in the number of emergency room visits for ambulatory care sensitive conditions in response to NP independence. The mean number of emergency room visits in a year for conditions with non-zero visits is 1.17, so a 12.8% reduction represents 0.15 fewer emergency room visits per person per ambulatory care sensitive condition per year.

Individuals may go to the emergency room less when NPs have independence because they have ambulatory care sensitive conditions that become less severe or because the greater availability of primary care leads patients with a wide variety of conditions to substitute office-based care for emergency room care. If individuals are substituting, we expect to find a reduction in emergency room visits regardless of condition. We therefore run the same regressions including all conditions in columns (5) and (6). We find that NP independence has at most a small negative effect on emergency room visits for all conditions, suggesting that the degree of substitution of primary care visits for emergency room visits across all medical conditions is likely small. However, we cannot rule out the possibility that individuals with ambulatory care sensitive conditions are themselves substituting primary care for emergency room care. Thus, ambulatory care sensitive conditions generate fewer emergency room visits while the total number of emergency room visits is not affected by NP independence, a result consistent both with individuals having less severe medical conditions due to receiving more primary care and with patients with conditions likely to be affected by primary care switching from emergency room care to primary care. Overall, our results show improvements in health outcomes when NPs have full independence.

4.3 Heterogeneous Effects of NP Independence

The propensity to consume primary care when more becomes available may vary based on a number of individual characteristics, including age, gender, location, or insurance status. We therefore investigate potential heterogeneity in the response to NP independence of the probability that an individual has had a routine checkup in the previous 12 months. We modify equation (1) to include interaction terms between the treatment effects and indicators for the characteristics of interest, and we test for differences in treatment effects across the two groups with F-tests of the difference in estimated coefficients. We consider two groups to show no difference in their responses to NP full independence if no more than one of the post-NP independence treatment dummies shows a significant difference from its counterpart in the other group.

Overall, we find little evidence of heterogeneity in the effect of NP independence. Figure 4 shows that the response to NP independence is similar among those above and below 65 years of age, men and women, and those with and without a 4 year college degree. Figure 5 divides the sample by location, with the city/country results based on whether an individual lives in a county classified as urban or rural in the 1993 USDA Economic Research Service Rural-Urban Continuum Code and the MSA/non-MSA results based on whether an individual lives in a Metropolitan Statistical Area according to MEPS.[21] Both sets of results suffer from large standard errors for the rural estimates, though the point estimates are relatively similar for the two groups in both regressions. This indicates that rural areas do not appear to consume disproportionately more primary care after NP independence and suggests that providers do not move in significant numbers from urban to rural counties or from MSAs to non-MSAs when NP have full independence. This is consistent with our earlier results on travel costs decreasing after NP independence if providers relocate within rural and urban areas.

[21] We classify a county as rural if it is a non-metropolitan county that is not adjacent to a metropolitan area. This corresponds to county codes 5, 7, and 9 in the 1993 USDA ERS Continuum Code.

Figure 6 shows that NP independence has similar effects on checkup frequency for those with and without insurance and those with private insurance compared to those on Medicaid. The comparison between privately insured and Medicaid insured individuals shows that our observed effects are not being driven by possible contemporaneous expansions of SCHIP programs. We also find no difference when comparing the privately insured against those with any form of public insurance. The uniformity of the effect of NP independence across these groups is striking and suggestive of a broad mechanism driving these treatment effects, such as the reduction in the administrative burden of supervision discussed above. We explore potential mechanisms further below.

5 Mechanisms and Sensitivity Analysis

5.1 Changes in NP Supply

Kalist and Spurr (2004) suggest that the supply of NPs should rise when regulations for NPs are more lax. Since the process of becoming an NP can take several years even for current registered nurses, our event study approach suggests a natural test of the importance of an increase in NP supply relative to the removal of the supervision requirements on health care utilization and health outcomes: we look for significant differences in the post-NP independence treatment effect between the first period (1-2 years after law passage) and the last (11+ years after law passage). This test requires the assumption that the required training time is long enough that any increased supply effects are negligible within 1-2 years of NPs gaining independence, while estimates from 11+ years after NP independence allow sufficient time for any transitional effects in the supply of NPs to diminish.[22] For our results in Tables 4, 6, and 7, the only variable for which we find a statistically significant difference between the short and long run effects of NP independence is the availability of appointments

[22] As we estimate the direct impact of changes in NP regulations, we correctly account for any increases in utilization or health outcomes caused by additional NP supply if the supply increase is caused by changes in NP regulations, so this possibility does not affect the internal validity of our estimates.

when wanted for children. We interpret this as evidence that any change in supply of NPs caused by states allowing NPs full independence has small effects on outcomes relative to removing administrative burdens. This is consistent with the finding of Stange (2012) that changes in NP supply have minimal effects on health care markets.

5.2 Changes in Primary Care Physician Supply

One potential unintended consequence of allowing NPs full independence is a change in the percentage of physicians who choose to become primary care providers. If the stock of physicians working as general practitioners changes in response to a state granting NPs full independence, then the observed increases in health care utilization and outcomes must be primarily coming from increased use of NP services. If not, then the effects could arise from more appointments with NPs and physicians, as less time spent on supervision opens up more time for both NPs and physicians to focus on patient care.[23]

To investigate this possibility, we construct the ratio of physician general practitioners to the total number of active physicians for every available state and year from 1995-2008 using data from the Area Resource File of the U.S. Department of Health and Human Services. We focus on the ratio to control for large differences in the size and growth rate of the physician workforce across states. We use this ratio as the dependent variable in a state level event study specification that is identical to equation (1) but includes only the event study dummies and state and year fixed effects. Column (1) of Table 10 shows that the ratio of physicians in general practice does not change in response to NPs gaining full independence, even in the long run. The slightly positive pre-treatment trend is consistent with the results of Table 3, as a low share of physicians in general practice does not precede, and therefore potentially cause, the law change. We interpret this as evidence that granting NPs independence leads to an overall increase in the supply of preventive care available to the population, though

[23] As above, our estimation strategy accounts for a possible change in the mix of primary care physicians and specialists if it occurs because of changes in NP regulations, and so a change in this ratio does not affect the internal validity of our estimates.

it does not lead to a relative reduction in primary care from physicians. This finding is consistent with removal of administrative costs of oversight as an important mechanism for the causal effects identified above.

5.3 Placebo Tests: Utilization of Other Medical Services

To show that our estimated effects of NP independence are not biased by coincident increases in demand for all medical services, we use equation (1) to estimate the effect of NP independence on visits to dentists and optometrists. Results in columns (2)-(5) of Table 10 show no significant impact of NP independence on utilization of these services on either the intensive or extensive margin. This placebo test result provides further evidence that NP independence is not coincident with state Medicaid expansions, as many SCHIP and Medicaid programs cover dental visits for both children and adults to varying degrees.[24]

5.4 State Trends

A weakness of MEPS data for our analysis is that the lack of data before 1996 leaves few years before the policy change to identify preexisting state-specific trends in most states. As pointed out by Wolfers (2006), the inclusion of state-specific trends can therefore lead to upward or downward bias in our treatment effect estimates depending on the nature of the dynamic response of the outcome of interest to the policy change, and so we omit them in equation (1). To check the robustness of our results to the inclusion of state-specific trends, we use data from the Center for Disease Control's Behavioral Risk Factor Surveillance System over 1988-2010. While BRFSS data do not contain information on children or offer the same level of detail on utilization or outcomes as MEPS data, the extra years of data allow for more precise estimates of underlying trends. Columns (6) and (7) of Table 10 show the effect of including state-specific trends on our MEPS estimates of the probability of an adult

[24] See Shulman et al. (2004) and McGinn-Shapiro (2008) for information on Medicaid dental programs for children and adults.

receiving a routine checkup. While the estimated increase in probability is similar in the first 2 years after NP independence, the estimates with state trends are very close to zero in later years. This indicates that the estimated preexisting trend in checkup frequency in states that allow NP independence is upward, a counterintuitive result if health care concerns play any role in states allowing NPs full independence.[25] Columns (8) and (9) show that when using the longer pre-trend in the BRFSS data, the estimated effect of NP independence is smaller but the pattern is consistent with our original estimates, even when extending the dependent variable to include checkups over the past 2 years. Our results are therefore qualitatively robust to the inclusion of state trends, though the direct inclusion of state trends in the MEPS analysis would induce downward bias due to poor estimates of trends in utilization prior to NP independence.

6 Conclusion

Concerns over both health care costs and the current and future supply of primary care providers have sparked growing interest in the effects of relaxing scope-of-practice laws for NPs. We estimate the direct effect of changing these regulations, and our results show that allowing NPs to practice and prescribe drugs without physician oversight leads to increased health care utilization and improvements in health outcomes. We provide evidence that the timing of law changes that give NPs full independence is exogenous to state health care utilization rates, and our event study approach shows that adults obtain routine checkups at a higher frequency in response. We also show that health care quality indicators rise and indirect costs of obtaining care fall for both adults and children. The increase in utilization of care yields improvements in health outcomes for patients, with higher self-reported health status, lower BMI, and fewer emergency room visits for conditions responsive to primary care. We also present evidence that the majority of these positive effects are the result

[25] Our estimates in Table 3 indicate that health care concerns explain 10-16% of the timing of the decision to allow NPs full independence.

of removing the administrative burden of oversight and supervision from both NPs and physicians, as our flexible empirical approach accounts for possible shifts in NP or physician supply in response to the law changes.

Our findings also shed light on current policy debates. The cost-effectiveness of medical care delivered in emergency rooms is well-known to be low, and our analysis indicates that patients with better availability of primary care make fewer emergency room visits.[26] This is an encouraging finding for the coming implementation of the Affordable Care Act, though it also highlights the need to boost provider supply so as to ensure that primary care appointment availability does not fall. The efficacy of the Affordable Care Act in increasing the number of primary care providers may be critical in limiting medical spending by moving care out of emergency rooms and into primary care offices. Our work contributes to this discussion by showing that allowing the current stock of primary care providers more time to focus on patient care by removing administrative burdens can be an effective and low cost way to increase the overall availability of primary care.

Further research is necessary to assess other supply side effects of changes in NP scope-of-practice laws, including potential changes in the quality of NPs that may be caused by higher ability workers choosing to become NPs when NPs have greater freedoms. Increases in NP ability may allay some concerns of physician groups about allowing NPs a wider scope-of-practice and increase the overall productivity of the health care sector, generating further cost savings. As Kleiner et al. (2012) point out, NPs and physicians are both complements and substitutes in the production of medical services, so changes in NP quality may have implications for physician quality as well. Overall, the results of this paper indicate that NPs can serve an important role in improving population health by providing necessary primary care.

[26]MEPS data shows that in 2010, the median cost of an office visit was $91, while the median cost of an emergency room visit was $391.

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Figure 1: Number of States with Independent NP Practice by Year

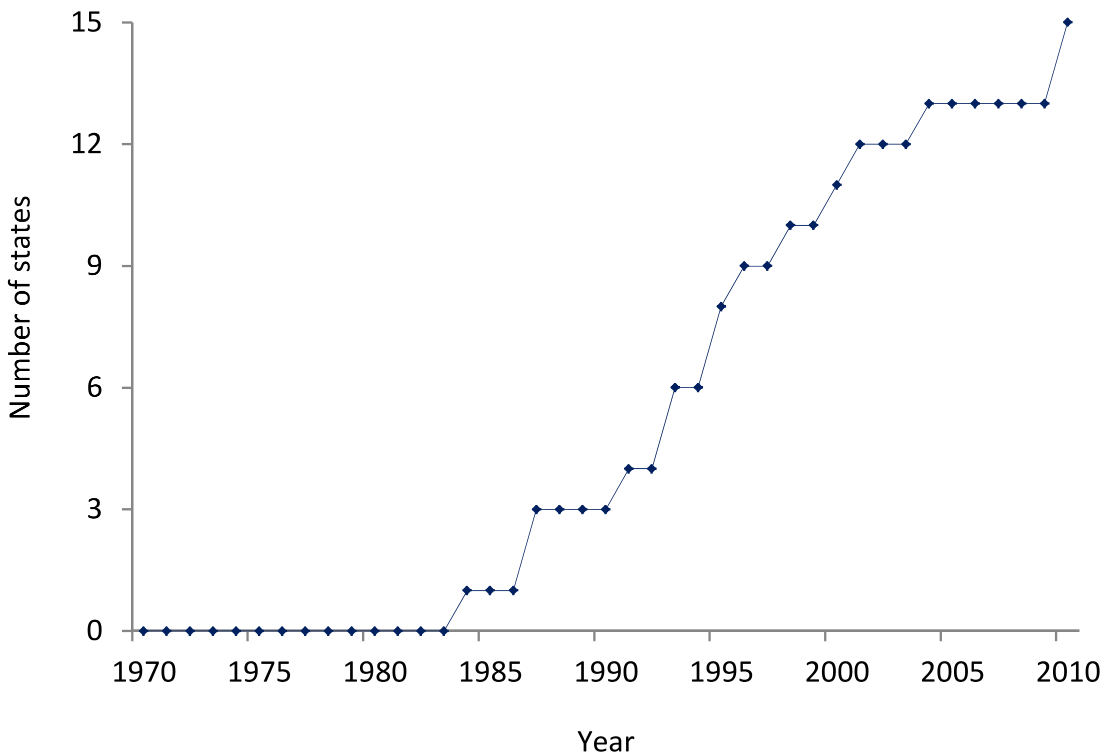


Table 1: NP Practice and Prescriptive Authority by State and Year

Independent practice authority	AK (1984), AR (1995), AZ (2000), CO (1980), CT (1989 - repealed in 1997 by attorney general decision), DC (1995), HI (1994), IA (1983), ID (2004), KY (2000), MD (2010), ME (1996), MI (1978), MT (1984), ND (1980), NH (1991), NJ (1996), NM (1993), OK (1972), OR (1987), RI (1975), TX (1989 - repealed in 2005), UT (1993), VT (2011), WA (1973), WV (1991), WY (1993)
Independent prescriptive authority	AK (1987), AZ (1984), CO (2010), DC (1995), HI (2011), IA (1995), ID (2004), MD (2010), ME (1996), MT (1984), ND (2011), NH (1991), NM (1993), OR (1979), UT (1998), VT (2011), WA (2001), WI (1995), WY (1993)
Independent practice and prescriptive authority	AK (1987), AZ (2000), CO (2010), DC (1995), HI (2011), IA (1995), ID (2004), MD (2010), ME (1996), MT (1984), ND (2011), NH (1991), NM (1993), OR (1987), UT (1998), VT (2011), WA (2001), WY (1993)

Data collected by authors from state statutes and Board of Nursing rules and regulations, cross-referenced with January issues of *The Nurse Practitioner* from 1995-2011. Year in parentheses is the year that state allows NPs the form of independence listed at left.

Table 2: 1970 Characteristics of States by NP Independence

State Characteristics	Ever have full NP indep. Mean	Never have full NP indep. Mean	Difference (Ever-Never)
Physicians per 100,000	137.54	137.11	0.43
Medical Benefits per 100,000	5,128.30	6,660.61	-1532.31*
Change in Medical Benefits per 100,000	10.67%	15.07%	-4.4%
Inpatient Days per 100,000	123,751.10	129,941.60	-6,190.5
Outpatient Visits per 100,000	96,718.63	83,999.98	12,718.65
# of Medical Schools	1.18	4.91	-3.73***
Democrat Governor	0.36	0.27	0.09
Share over 65	0.09	0.10	-0.01
Share under 20	0.39	0.37	0.02**
Share urban	0.69	0.74	-0.05
Real Personal Income	4,027.38	4,091.57	-64.19
Observations	18	33	

*, **, *** denote statistical significance at the 10%, 5%, and 1% levels respectively. Variables as defined in text. All means calculated using state level population weighted data from 1970 only, except for "Change in Medical Benefits per 100,000," which is calculated using data from 1970 and 1971.

Table 3: Determinants of Timing of NP Full Independence

	(1)	(2)	(3)	(4)
Physicians per 100,000	-0.00748	-0.0122	-0.0110	0.00172
	(0.0434)	(0.0458)	(0.0345)	(0.0379)
Medical Benefits per 100,000	-3.00e-05	-5.16e-05	-1.51e-05	-9.69e-05
	(5.06e-05)	(7.32e-05)	(4.69e-05)	(6.19e-05)
Change in Medical Benefits per 100,000	-3.928	-13.17**	4.834	-1.490
	(4.978)	(5.499)	(6.666)	(5.247)
Inpatient Days per 100,000	3.56e-05	8.34e-06	1.69e-05	1.04e-05
	(5.43e-05)	(7.66e-05)	(5.18e-05)	(6.65e-05)
Outpatient Visits per 100,000	-1.32e-05	-9.18e-06	-1.36e-05	-7.96e-06
	(2.31e-05)	(2.62e-05)	(1.80e-05)	(2.24e-05)
# of Medical Schools	3.903	3.642	2.501	2.688
	(2.348)	(2.333)	(2.241)	(2.372)
Democrat Governor	4.172*	4.779**	4.503**	5.418**
	(2.236)	(2.169)	(2.058)	(2.050)
Share over 65	-65.83	-134.7	-106.1	-75.05
	(130.1)	(152.9)	(108.6)	(149.2)
Share under 20	34.18	-99.67	-80.58	-82.61
	(72.54)	(86.05)	(67.99)	(79.26)
Share urban	-8.314	-7.578	-6.045	-8.504
	(13.39)	(12.06)	(9.173)	(8.857)
Real Personal Income	-0.00136	-0.00329	-0.00268	-0.00284
	(0.00240)	(0.00286)	(0.00230)	(0.00307)
Constant	19.93	94.62	65.76	67.79
	(43.69)	(55.00)	(40.93)	(52.12)
Observations	443	443	285	285
R^2	0.436	0.539	0.362	0.412
R^2 with only Year FE		0.436		0.250
Start Year	1970	1970	1980	1980
Year FE	No	Yes	No	Yes

Observations are state-years from 1970-2008 in column 1 and 1980-2008 in columns 2 and 3. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors are Huber-White robust estimates clustered at the state level.

Table 4: NP Independence Effect on Probability of Routine Checkup in Last 12 Months

Years relative to full independence	(1) Adults	(2) Children
5+ years before	-0.00158	0.0283
	(0.0360)	(0.0654)
3-4 years before	0.000432	-0.00674
	(0.0175)	(0.0471)
1-2 years before	0.00954	-0.0188
	(0.0276)	(0.0479)
1-2 years after	0.0396***	-0.0289
	(0.0107)	(0.0250)
3-4 years after	0.0553***	-0.0199
	(0.0130)	(0.0233)
5-6 years after	0.0410***	-0.0527
	(0.0125)	(0.0449)
7-8 years after	0.0554***	-0.0130
	(0.0186)	(0.0483)
9-10 years after	0.0581***	-0.0390
	(0.0164)	(0.0362)
11+ years after	0.0680***	0.00545
	(0.0186)	(0.0510)
Observations	219,276	102,012

Regressions are weighted estimates of equation (1) using sampling weights provided in MEPS data. All columns are logit regressions are reported coefficients are average marginal effects. Dependent variable is listed at top and described in text. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors in parentheses are Huber-White robust estimates clustered at the state level.

Table 5: Treatment Effects Relative to Baseline

Dependent Variable	Baseline	LR Treatment	LR Treatment/Baseline
Adult Checkup	0.66	0.068	10.30%
Adult Appt. When Wanted	0.48	0.0811	16.90%
Adult Care When Sick	0.58	0.116	20.00%
Adult Easy to Get to Provider	0.67	0.128	19.10%
Adult Enough Time	0.49	0.0648	13.22%
Adult Listen Carefully	0.58	0.0887	15.29%
Adult Explained Clearly	0.59	0.0859	14.56%
Child Checkup	0.68	0.00545	0.80%
Child Appt. When Wanted	0.70	0.249	35.57%
Child Care When Sick	0.77	0.136	17.66%
Child Easy to Get to Provider	0.70	0.166	23.71%
Child Enough Time	0.70	0.189	27.00%
Child Listen Carefully	0.75	0.153	20.40%
Child Explained Clearly	0.77	0.135	17.53%

Dependent variables as defined in text. Baseline is the weighted sample mean of each dependent variable for pooled MEPS data from 1996-2010. LR Treatment is the coefficient on the dummy for 11+ years since the law change.

Table 6: NP Independence Effect on Appointment Availability and Travel Costs

	Adults			Children		
Years relative to	(1)	(2)	(3)	(4)	(5)	(6)
full independence	Appt. when wanted	Care when sick	Travel	Appt. when wanted	Care when sick	Travel
5+ years before	-0.0393	-0.0173	0.0394	0.00256	0.0832	0.0687
	(0.0362)	(0.0235)	(0.0453)	(0.109)	(0.117)	(0.0871)
3-4 years before	-0.0144	-0.00619	0.0116	-0.0132	0.106	0.0229
	(0.0336)	(0.0343)	(0.0573)	(0.135)	(0.117)	(0.0743)
1-2 years before	-0.0495**	0.0203	-0.0127	-0.0182	0.0662	0.0632*
	(0.0179)	(0.0249)	(0.0202)	(0.0937)	(0.0868)	(0.0374)
1-2 years after	0.0753***	0.0887**	0.0637***	0.121***	0.157**	0.120**
	(0.0204)	(0.0374)	(0.0224)	(0.0466)	(0.0632)	(0.0546)
3-4 years after	0.0611**	0.0807**	0.0957***	0.154***	0.0933	0.0952
	(0.0279)	(0.0403)	(0.0301)	(0.0513)	(0.0722)	(0.0624)
5-6 years after	0.0905***	0.107***	0.0408*	0.151**	0.127	0.0817
	(0.0256)	(0.0412)	(0.0241)	(0.0638)	(0.0773)	(0.0562)
7-8 years after	0.0684*	0.116***	0.0337	0.136***	0.0569	0.0524
	(0.0396)	(0.0256)	(0.0261)	(0.0390)	(0.0407)	(0.0496)
9-10 years after	0.118**	0.110**	0.129***	0.197***	0.0964*	0.154**
	(0.0491)	(0.0475)	(0.0445)	(0.0453)	(0.0580)	(0.0602)
11+ years after	0.0811	0.116*	0.128***	0.249***	0.136**	0.166***
	(0.0534)	(0.0599)	(0.0491)	(0.0484)	(0.0611)	(0.0574)
Observations	134,131	63,713	208,247	64,110	22,076	87,386

Regressions are weighted estimates of equation (1) using sampling weights provided in MEPS data. All columns are logit regressions and reported coefficients are average marginal effects. Dependent variable is listed at top and described in text. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors in parentheses are Huber-White robust estimates clustered at the state level.

Table 7: NP Independence Effect on Patient-Reported Visit Quality

Years relative to full independence	Adults (1) Health Care Rating	Adults (2) Enough Time	Adults (3) Listen Carefully	Adults (4) Explained Clearly	Children (5) Enough Time	Children (6) Listen Carefully	Children (7) Explained Clearly
5+ years before	-0.0193	0.0111	0.0216	0.0249	0.0676	0.0802	0.0702
	(0.0841)	(0.0296)	(0.0147)	(0.0179)	(0.0663)	(0.0583)	(0.0701)
3-4 years before	-0.0107	0.0167	0.0291*	0.0198	-0.0162	0.0179	0.00716
	(0.0449)	(0.0329)	(0.0175)	(0.0185)	(0.0690)	(0.0756)	(0.0812)
1-2 years before	-0.0589	0.00206	0.0122	-0.00879	0.0463	0.0483	0.0225
	(0.0823)	(0.0280)	(0.0169)	(0.0212)	(0.0569)	(0.0793)	(0.0781)
1-2 years after	0.191***	0.0691	0.0896***	0.0744**	0.124***	0.0923***	0.102**
	(0.0295)	(0.0434)	(0.0117)	(0.0296)	(0.0282)	(0.0305)	(0.0435)
3-4 years after	0.164***	0.0899***	0.102***	0.0690**	0.138***	0.109***	0.104***
	(0.0382)	(0.0244)	(0.00706)	(0.0285)	(0.0376)	(0.0360)	(0.0364)
5-6 years after	0.198***	0.0975***	0.0861***	0.0753**	0.0852**	0.0814**	0.0709*
	(0.0630)	(0.0377)	(0.0207)	(0.0371)	(0.0406)	(0.0413)	(0.0366)
7-8 years after	0.229**	0.0623	0.0677**	0.0755	0.0544*	0.0488*	0.0439
	(0.0961)	(0.0464)	(0.0285)	(0.0472)	(0.0281)	(0.0269)	(0.0403)
9-10 years after	0.261**	0.0903	0.0894**	0.0856	0.148***	0.108***	0.138***
	(0.108)	(0.0588)	(0.0432)	(0.0576)	(0.0383)	(0.0286)	(0.0416)
11+ years after	0.114	0.0648	0.0887**	0.0859*	0.189***	0.153***	0.135**
	(0.119)	(0.0555)	(0.0357)	(0.0520)	(0.0446)	(0.0357)	(0.0530)
Observations	151,402	151,526	151,164	151,695	74,072	74,002	74,070

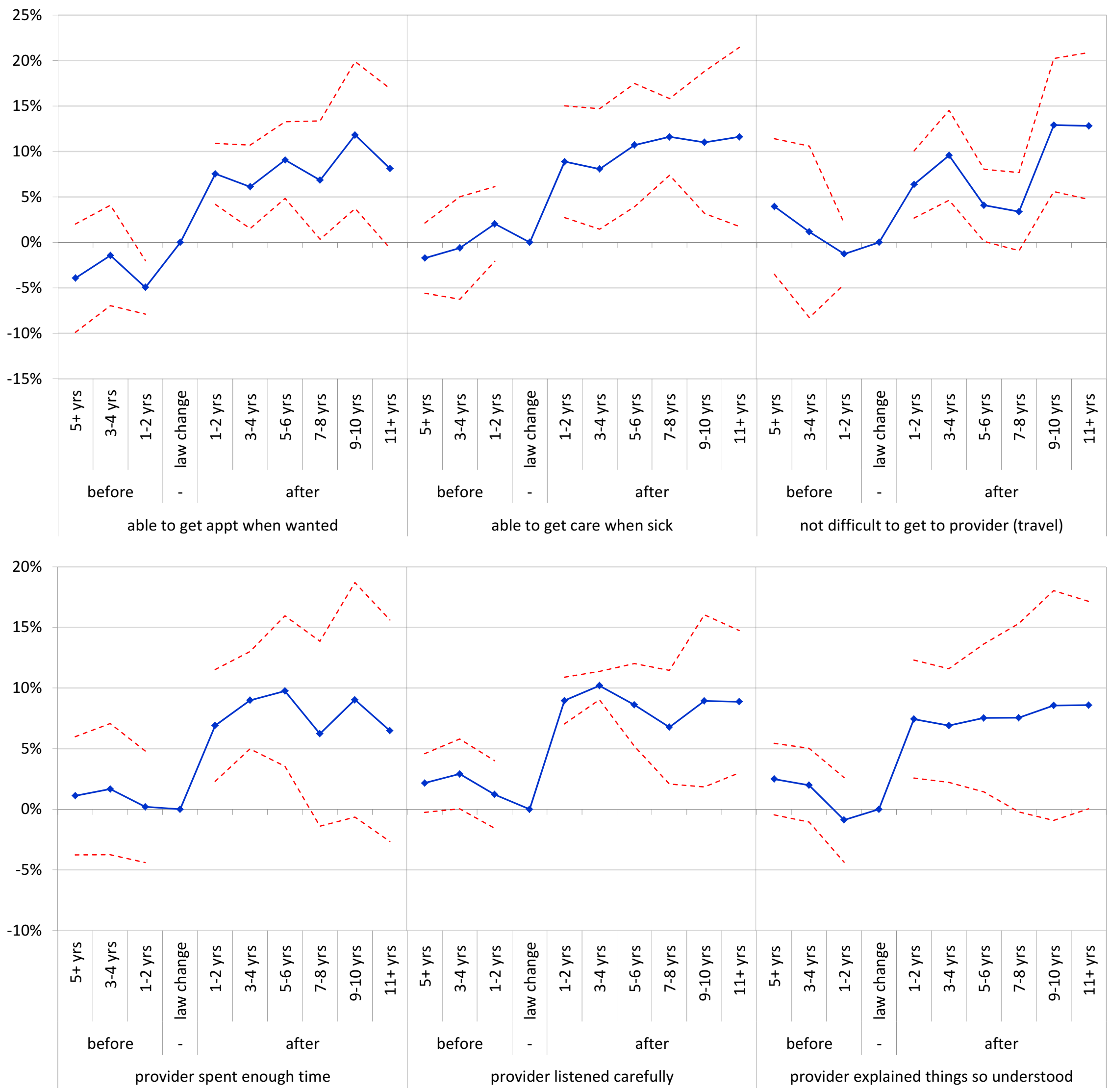
Regressions are weighted estimates of equation (1) using sampling weights provided in MEPS data. Column (1) is an OLS regression. All other columns are logit regressions and reported coefficients are average marginal effects. Dependent variable is listed at top and described in text. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors in parentheses are Huber-White robust estimates clustered at the state level.

Table 8: NP Independence Effect on Health Outcomes

Years relative to full independence	Adults (1) Health Status	Adults (2) BMI	Medical Conditions (3) Any ER Visit, ACS cond.	Medical Conditions (4) ln(ER visits), ACS cond.	Medical Conditions (5) Any ER Visit, all cond.	Medical Conditions (6) ln(ER visits), all cond.
5+ years before	-0.0416	0.0991	-0.00320	-0.0146	-0.00091	-0.0378**
	(0.0574)	(0.462)	(0.00681)	(0.0599)	(0.00306)	(0.0142)
3-4 years before	0.0564	0.0651	-0.0131	-0.0727	-0.00490	-0.00498
	(0.0357)	(0.271)	(0.0103)	(0.0456)	(0.00346)	(0.0252)
1-2 years before	0.00679	0.0673	-0.00234	-0.0701	-0.00479*	-0.0253
	(0.0494)	(0.227)	(0.00606)	(0.0474)	(0.00282)	(0.0176)
1-2 years after	0.0726*	-0.246**	-0.0102	-0.140***	-0.000928	-0.0255**
	(0.0425)	(0.109)	(0.0103)	(0.0440)	(0.00243)	(0.00975)
3-4 years after	0.0467	-0.501***	-0.0148	-0.121***	0.00640*	0.00366
	(0.0365)	(0.107)	(0.0104)	(0.0359)	(0.00325)	(0.0124)
5-6 years after	0.0403	-0.328*	-0.0107	-0.100**	0.00598**	-0.00507
	(0.0371)	(0.167)	(0.0104)	(0.0470)	(0.00250)	(0.0270)
7-8 years after	0.105***	-0.360	-0.0122	-0.181***	0.00632	-0.0204*
	(0.0370)	(0.291)	(0.00963)	(0.0420)	(0.00517)	(0.0111)
9-10 years after	0.0448	-0.418*	-0.0142*	-0.150***	0.00363	-0.0167
	(0.0474)	(0.213)	(0.00794)	(0.0428)	(0.00356)	(0.0182)
11+ years after	0.108**	-0.540*	-0.0124	-0.128**	0.00310	0.00686
	(0.0495)	(0.290)	(0.0112)	(0.0503)	(0.00612)	(0.0220)
Observations	327,489	220,280	178,502	11,105	1,411,644	76,131

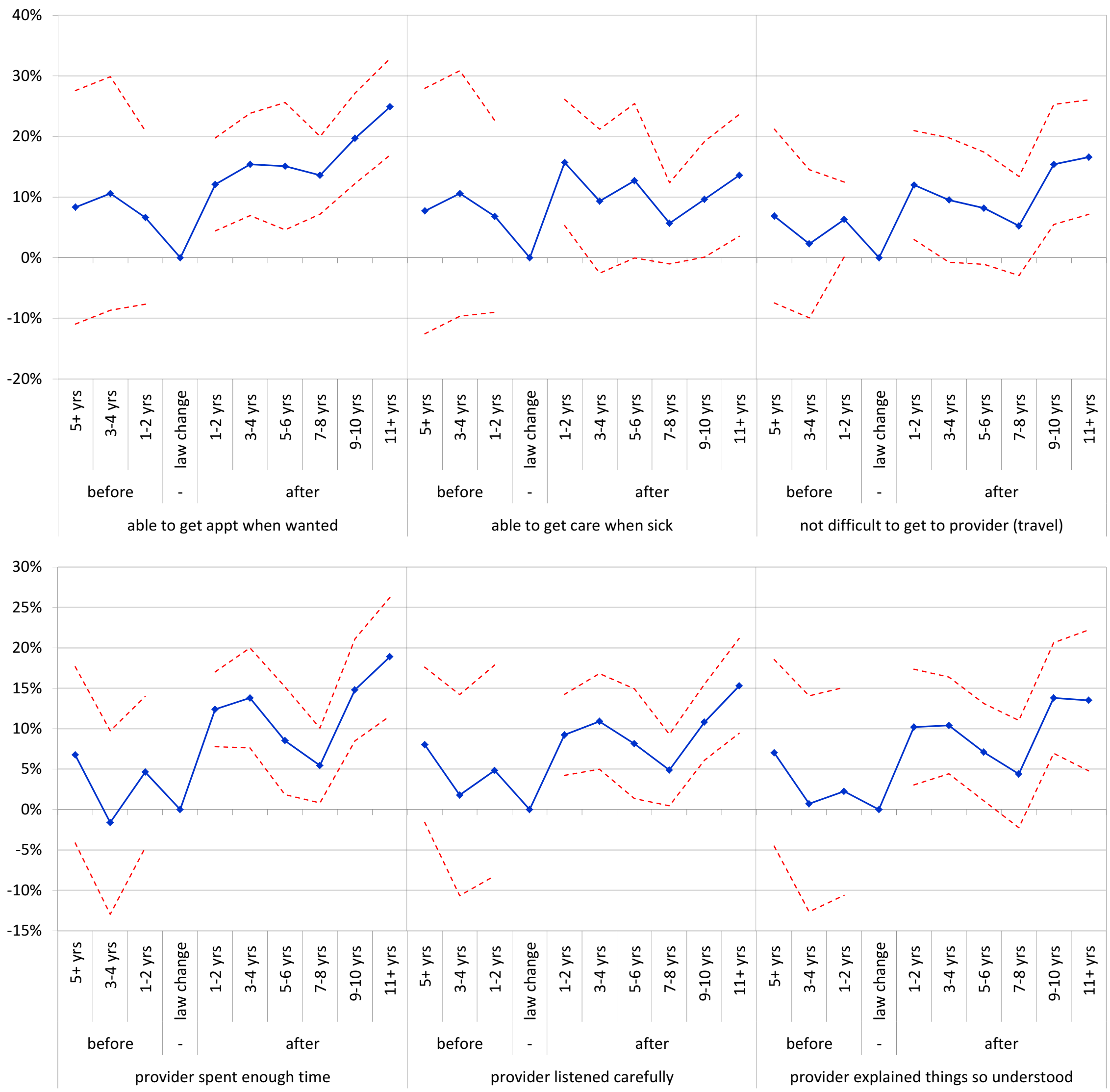
Regressions are weighted estimates of equation (1) using sampling weights provided in MEPS data. Columns (1), (2), (4), and (6) are OLS regressions. Columns (3) and (5) are logit regressions and reported coefficients are average marginal effects. Dependent variable is listed at top and described in text. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors in parentheses are Huber-White robust estimates clustered at the state level.

Figure 2: Event Study Results: Adults



Graphs plot average marginal effects from event study logit regressions with dependent variable listed at bottom of graph. First panel depicts results from columns (1)-(3) of Table6; second panel depicts results from columns (2)-(4) of Table 7. Blue lines indicate point estimates of coefficients, and red dashed lines indicate 90% confidence intervals of estimates.

Figure 3: Event Study Results: Children



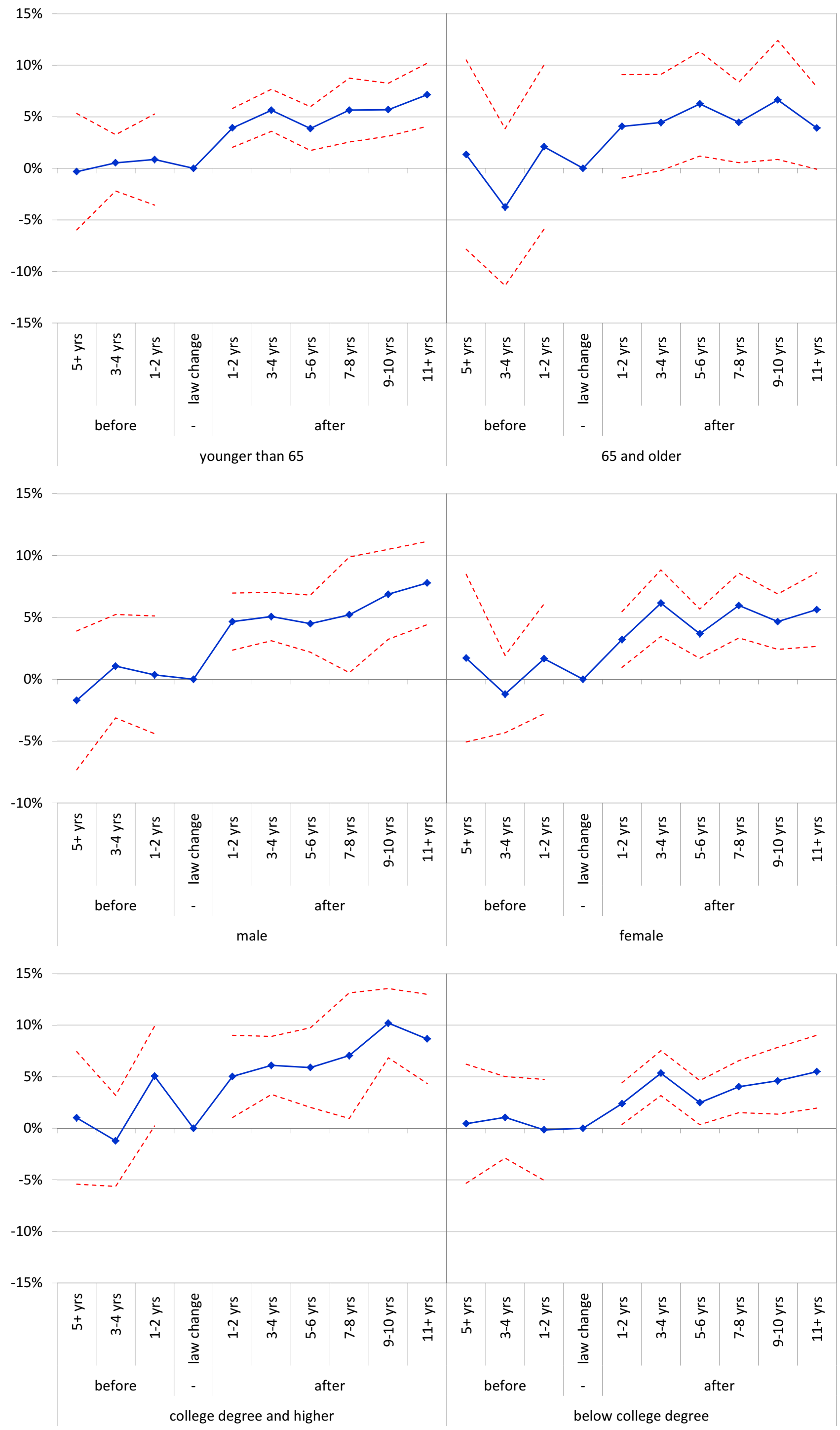
Graphs plot average marginal effects from event study logit regressions with dependent variable listed at bottom of graph. First panel depicts results from columns (4)-(6) of Table6; second panel depicts results from columns (5)-(7) of Table 7. Blue lines indicate point estimates of coefficients, and red dashed lines indicate 90% confidence intervals of estimates.

Table 9: ICD-9 Codes for Ambulatory Care Sensitive Conditions

ACS Condition and ICD-9-CM Code(s)	Comments
Congenital syphilis [090]	Secondary diagnosis for newborns only
Immunization-related and preventable conditions [033, 037, 045, 320.0, 390, 391]	Hemophilus meningitis [320.0] age 1-5 only
Grand mal status and other epileptic convulsions [345]	
Convulsions "A" [780.3]	Age 0-5
Convulsions "B" [780.3]	Age >5
Severe ENT infections [382, 462, 463, 465, 472.1]	Exclude otitis media cases [382] with myringotomy with insertion of tube [20.01]
Pulmonary tuberculosis [011]	
Other tuberculosis [012-018]	
Chronic obstructive pulmonary disease [491, 492, 494, 496, 466.0]	Acute bronchitis [466.0] only with secondary diagnosis of 491, 492, 494, 496
Bacterial pneumonia [481, 482.2, 482.3, 482.9, 483, 485, 486]	Exclude case with secondary diagnosis of sickle cell [282.6] and patients $<$ 2 months
Asthma [493]	
Congestive heart failure [428, 402.01, 402.11, 402.91, 518.4]	Exclude cases with the following surgical procedures: 36.01, 36.02, 36.05, 36.1, 37.5, or 37.7
Hypertension [401.0, 401.9, 402.00, 402.10, 402.90]	Exclude cases with the following procedures: 36.01, 36.02, 36.05, 36.1, 37.5, or 37.7
Angina [411.1, 411.8, 413]	Exclude cases with a surgical procedure [01-86.99]
Cellulitis [681, 682, 683, 686]	Exclude cases with a surgical procedure [01-86.99], except incision of skin and subcutaneous tissue [86.0] where it is the only listed surgical procedure
Diabetes "A" [250.1, 250.2, 250.3]	
Diabetes "B" [250.8, 250.9]	
Diabetes "C" [250.0]	
Hypoglycemia [251.2]	
Gastroenteritis [558.9]	
Kidney/urinary infection [590, 599.0, 599.9]	
Dehydration - volume depletion [276.5]	
Iron deficiency anemia [280.1, 280.8, 280.9]	Age 0-5
Nutritional deficiencies [260, 261, 262, 268.0, 268.1]	
Failure to thrive [783.4]	Age $<$ 1 only
Pelvic inflammatory disease [614]	Exclude cases with a surgical procedure of hysterectomy [68.3-68.8]
Dental Conditions [521, 522, 523, 525, 528]	

List of conditions and notes from appendix of Billings et al. (1993). We omit “skin grafts with cellulitis” as an ambulatory care sensitive condition from the list in Billings et al. (1993) because no ICD-9 code is provided to identify it.

Figure 4: Heterogeneous Effects of NP Independence on Checkup Frequency: Demographics

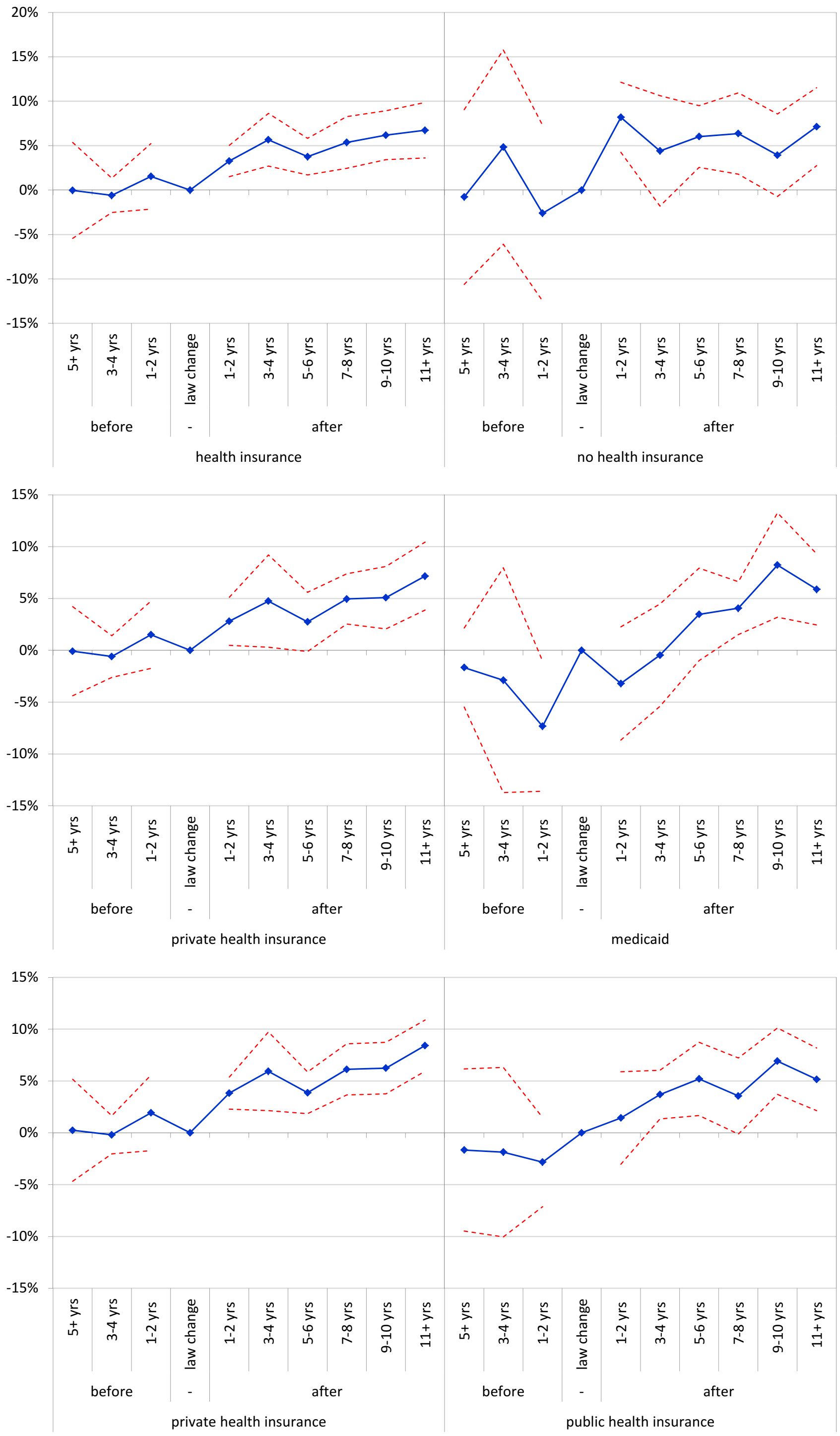


Graphs plot average marginal effects from event study logit regressions with dependent variable indicating if individual has had a routine checkup in past 12 months. Regression shown in first panel includes interactions of treatment effect dummies with indicators for whether individual is under/over age of 65; second panel, indicators for male/female; third panel, indicators for more/less than 16 years of education. Blue lines indicate point estimates of coefficients, and red dashed lines indicate 90% confidence intervals of estimates.

Figure 5: Heterogeneous Effects of NP Independence on Checkup Frequency: Geography

Graphs plot average marginal effects from event study logit regressions with dependent variable indicating if individual has had a routine checkup in past 12 months. Regression shown in first panel includes interactions of treatment effect dummies with indicators for whether individual lives in an urban/rural county according to USDA Economic Research Service 1993 Rural-Urban Continuum Code; second panel, indicators for whether individual lives in a metropolitan statistical area or not. Blue lines indicate point estimates of coefficients, and red dashed lines indicate 90% confidence intervals of estimates.

Figure 6: Heterogeneous Effects of NP Independence on Checkup Frequency: Insurance Status



Graphs plot average marginal effects from event study logit regressions with dependent variable indicating if individual has had a routine checkup in past 12 months. Regression shown in first panel includes interactions of treatment effect dummies with indicators for whether individual has any form of health insurance/no health insurance; second panel, indicators for private health insurance/Medicaid; third panel, indicators for private health insurance/Medicaid or Medicare. Blue lines indicate point estimates of coefficients, and red dashed lines indicate 90% confidence intervals of estimates.

Table 10: Mechanisms and Sensitivity Analysis

	Physician Supply	Placebo Tests				State Trends			
Years relative to	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
full independence	GP Ratio	Any Dental visit	ln(Dental visits)	Any Opto. visit	ln(Opto. visits)	Checkup last year	Checkup last year	Checkup last year	Checkup last 2 years
5+ years before	0.00444*	0.00808	-0.00935	0.00521	-0.0784	-0.00158	0.0187	-0.00300	0.000832
	(0.00265)	(0.0333)	(0.0300)	(0.0163)	(0.0485)	(0.036)	(0.0235)	(0.0208)	(0.0177)
3-4 years before	0.00448*	0.00108	-0.00301	-0.00648	-0.0566	0.000432	0.00860	-0.00782	0.00386
	(0.00241)	(0.0297)	(0.0517)	(0.00991)	(0.0387)	(0.0175)	(0.0208)	(0.0168)	(0.0158)
1-2 years before	0.00156	0.0285	0.0360	0.00479	-0.0846**	0.00954	0.00866	-0.0229	0.000149
	(0.00204)	(0.0231)	(0.0241)	(0.0118)	(0.0421)	(0.0276)	(0.0257)	(0.0161)	(0.0102)
1-2 years after	0.000299	0.0129	0.0129	-0.00121	-0.0525	0.0396***	0.0216**	-0.0161	-0.00612
	(0.00112)	(0.0288)	(0.0606)	(0.0153)	(0.0473)	(0.0107)	(0.00953)	(0.0179)	(0.0112)
3-4 years after	-0.00131	0.0327	0.00191	0.0115	-0.0960**	0.0553***	0.0233	0.0122	0.0138
	(0.00163)	(0.0273)	(0.0384)	(0.0144)	(0.0430)	(0.013)	(0.0177)	(0.0216)	(0.0140)
5-6 years after	-0.00122	0.0495**	0.0524	0.00589	-0.0740	0.0410***	-0.00339	0.000381	0.00870
	(0.00182)	(0.0251)	(0.0363)	(0.0154)	(0.0454)	(0.0125)	(0.0236)	(0.0193)	(0.0135)
7-8 years after	-0.00262	0.0198	0.0580	0.000981	-0.0126	0.0554***	-0.00394	0.00475	0.00665
	(0.00258)	(0.0237)	(0.0348)	(0.0152)	(0.0509)	(0.0186)	(0.0359)	(0.0232)	(0.0175)
9-10 years after	-0.00189	0.0154	0.0135	0.0170	-0.0182	0.0581***	-0.00755	0.0170	0.0182
	(0.00293)	(0.0320)	(0.0388)	(0.0196)	(0.0474)	(0.0164)	(0.0399)	(0.0332)	(0.0237)
11+ years after	0.00250	0.0318	0.0342	0.00626	-0.0310	0.0680***	-0.00265	0.0265	0.0273
	(0.00317)	(0.0286)	(0.0393)	(0.0193)	(0.0599)	(0.0186)	(0.0553)	(0.0327)	(0.0233)
Observations	722	447,502	170,241	447,502	21,545	219,276	219,276	2,935,971	2,935,971
State Trends	No	No	No	No	No	No	Yes	Yes	Yes
Data Source	ARF	MEPS	MEPS	MEPS	MEPS	MEPS	MEPS	BRFSS	BRFSS

Regressions are estimates of equation (1) using data source listed at bottom. For MEPS and BRFSS data, regressions are weighted using provided sample weights. Columns (1), (3), and (5) are OLS regressions. Columns (2), (4), (6), (7), (8), and (9) are logit regressions and reported coefficients are average marginal effects. Dependent variable is listed at top and described in text. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels respectively. Standard errors in parentheses are Huber-White robust estimates clustered at the state level.