Just What the Nurse Practitioner Ordered: Independent Prescriptive Authority and Population Mental Health *

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Abstract

We examine whether relaxing occupational licensing to allow nurse practitioners (NPs)—registered nurses with advanced degrees—to prescribe medication without physician oversight improves population mental health. Exploiting time-series variation in independent prescriptive authority for NPs from 1990–2014, we find that broadening prescriptive authority leads to improvements in self-reported mental health and decreases in mental-health-related mortality, including suicides. These improvements are concentrated in areas that are underserved by physicians and among populations that have difficulty accessing physician-provided care. Our results demonstrate that extending prescriptive authority to NPs can help mitigate physician shortages and extend care to disadvantaged populations.

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1 Introduction

Limited access to mental health care services in the United States is a major public health concern. While one in five Americans suffers from a mental illness, nearly one third of the U.S. population lives in areas that are underserved by mental health care providers (Bureau of Health Workforce, 2016). As mental health problems tend to develop early in life and persist over the lifecycle, the costs of not receiving treatment can be substantial. In addition to direct medical costs, untreated mental illness is associated with lower human capital accumulation, worse labor market participation and performance, and greater criminal activity (see, for example, Ettner et al., 1997; Currie and Stabile, 2006; Greenberg and Rosenheck, 2008). Recent evidence demonstrates that even increases in all-cause mortality for some groups are being driven by mental-health-related deaths (Case and Deaton, 2015), adding energy and urgency to the search for policies that can be used to improve population mental health.

In this paper, we examine whether allowing nurse practitioners (NPs)—a class of registered nurses with advanced degrees in nursing—to prescribe medication without physician supervision or collaboration is associated with improved mental health outcomes. Leveraging a novel dataset that documents legislative changes granting NPs independent prescriptive authority over 24 years, we find that states that broaden prescriptive authority experience improvements in population mental health. These improvements are concentrated among disadvantaged populations, suggesting that extending independent prescriptive authority to NPs is an important policy tool that can be used to improve health outcomes for populations with limited access to care.

Despite a burgeoning literature demonstrating that NPs can safely and efficiently provide a variety of services, including an endorsement of the skills of NPs by the Institute of Medicine (IOM, 2011), efforts to extend prescriptive authority beyond physicians are controversial. Opponents worry that allowing NPs to prescribe medication will put patients in danger since NPs receive fewer years of training, are held to different legal standards, and go through a different process of licensing than medical doctors.[1] Critics further note that extending prescriptive authority be-

[1]It has been estimated that NPs can safely provide 70-80% of the care provided by physicians in primary care

yond physicians need not expand overall use of pharmacological treatment, as the prescriptions written by non-physician providers may simply crowd out the prescriptions previously written by physicians. The American Medical Association (AMA), a national professional organization representing physicians and medical students in the US, has been particularly vocal in opposing the expansion of state-level scope of practice legislation (AMA, 2010).

To measure the impact of extending independent prescriptive authority to NPs on population mental health, we exploit time-series variation in state-level scope of practice legislation and mental health outcomes from 1990 to 2014 using a difference-in-difference framework. We use two complementary categories of health outcomes: (1) self-reported mental health at the individual-year level from the Behavioral Risk Factor Surveillance System and (2) mental-health-related mortality at the county-quarter level from the U.S. Mortality Files. Our results demonstrate that extending prescriptive authority to NPs leads to signifcant reductions in the number of days spent in poor mental health (0.17 days per month, or 5% of the mean). We further find a negative association between prescriptive authority for NPs and overall mental-health related mortality, although the effect is imprecisely estimated.

Notably, improvements in mental health outcomes resulting from independent prescriptive authority for NPs are larger and more precisely estimated in areas that are underserved by physicians and among already disadvantaged populations. In particular, areas that are underserved by psychiatrists see statistically significant improvements in self-reported mental health and mental-health-related mortality that are at least twice as large as those experienced on average: respondents in underserved states see an additional reduction of 0.17 days per month in poor mental health (5% of the mean) and underserved counties see additional reductions of over six mental-health-related deaths (12% of the mean) and two suicides (8% of the mean) per quarter. Populations with low levels of education also see strong improvements in both mental health measures, with the largest benefits in percentage terms accruing to individuals with low levels of education residing in unde-

(Scheffler et al., 1996). Furthermore, evidence suggests that there are no differences in health outcomes between patients treated by NPs rather than MDs, and patient satisfaction is, if anything, higher among patients seen by NPs (Mundinger et al., 2000; Horrocks et al., 2002; Lenz et al., 2004; Laurant et al., 2008; Naylor and Kurtzman, 2010).

served areas.

Allowing NPs to prescribe independently should disproportionately affect disadvantaged populations for two reasons. First, since psychiatrists and other physicians are more likely to locate in urban and suburban areas, populations in rural areas have the most limited access to psychotropic treatment (Hartley et al., 2004). Second, psychiatrists are less likely than all other physician specialties to accept insurance, with acceptance rates being lowest for Medicaid beneficiaries (Bishop et al., 2014). Therefore, even in areas with a sufficient number of physicians, access to psychotropic medications may still be limited for certain populations. Since NPs are more likely than physicians to locate in rural and inner-city locations and to accept public insurance (Larson et al., 2003a,b; Everett et al., 2009; Buerhaus et al., 2015), granting independent prescriptive authority to NPs has the potential to address physician shortages and extend care to disadvantaged populations.

Finally, using detailed prescription data from 2006 to 2014, we find evidence that extending independent prescriptive authority to NPs is associated with an increase in prescriptions per capita for antidepressants and antipsychotics. These increases are concentrated among Medicaid beneficiaries—a low-income population for which the predicted impacts of expanded access are the strongest and among whom we find the largest improvements in mental health. Despite having a much shorter time frame—which greatly limits our statistical power over our analyses of mental health outcomes—we nonetheless find evidence that the use of psychotropic medications among low-income populations increases when more providers can prescribe them independently.

In light of rising rates of abuse of prescription pain medication (NSDUH, 2014), one concern with broadening prescriptive authority for NPs is that such legislation could lead to a greater number of opioid analgesics available for misuse. Again using prescription data from 2006–2014, we find that broadening prescriptive authority leads to an increase in opioid prescriptions among Medicaid beneficiaries. However, we do not believe that this influences the interpretation of our main findings. We find that allowing NPs to prescribe independently is associated with fewer mental-health-related deaths, a figure that includes overdoses. Therefore, if anything, our main results actually underestimate the effect of only extending prescriptive authority for non-controlled

substances such as antidepressants and antipsychotics.

Our work contributes to the growing literature in economics that empirically examines the implications of occupational licensing, most of which measures the effects of such legislation on wages, employment, and prices across related occupations and services.[2,3] We depart from this literature by focusing on outcomes of the production process—self-reported mental health and mental-health related mortality—rather than the organization and division of resources across actors in the production process itself.

The two most closely related studies to our work are Stange (2014) and Traczynski and Udalova (2018). Stange (2014) finds that allowing NPs to prescribe controlled substances with or without physician supervision only leads to modest increases in healthcare utilization, whereas Traczynski and Udalova (2018) find that allowing NPs to both practice and prescribe independently leads to increases in utilization of primary care services. Our paper departs from this previous literature in four important dimensions. First, given the well-documented shortages in access to mental health care services in the US, we focus on the impact of broadened scope of practice legislation on the use of psychotropic medications and mental health outcomes.[4] Second, we use a very long time horizon of 23 to 25 years which allows us to include many more law changes than previous papers. Third, we use considerably larger and more representative datasets than previous work, which combined with the long time horizon gives us the power to look for heterogenous effects of broadening scope of practice legislation.[5] We find clear evidence that extending independent

[2]A type of occupational licensing, scope of practice restrictions for NPs are often justified as the state protecting the consumer from receiving substandard care. If consumers are more confident in the services provided as a result of this legal reassurance, restrictive scope of practice legislation will be associated with increased demand. However, given that restrictive scope of practice legislation limits the number of providers who can perform a given service, these increases in demand may be offset by decreases in supply. While restrictive scope of practice legislation should weakly increase the quality of services, the theoretical effect on quantity is ambiguous.

[3]For example, see Kleiner and Park (2010) and Marier and Wing (2011) for the case of dentists and dental hygienists, and Dueker et al. (2005), Stange (2014), Xue et al. (2016), and Kleiner et al. (2016) for the case of physicians and non-physician providers.

[4]Our focus on mental health motivates the law changes that we consider. Since access to a provider who can prescribe psychotropic medications is a significant barrier to mental health care in the US, we focus on legislation that allows NPs to prescribe medication without the supervision or collaboration of a physician. In contrast to Stange (2014), we do not separately consider legislation that allows NPs to prescribe controlled substances in addition to unscheduled drugs. Since the majority of antidepressants and antipsychotics are not scheduled, we believe that the relevant legislation is whether NPs can prescribe at least non-controlled substances independently.

[5]While Traczynski and Udalova (2018) find no evidence of heterogenous effects, they are likely underpowered

prescriptive authority to NPs has a larger effect on outcomes for low-income and underserved populations, which makes it a particularly attractive policy instrument for reducing inequality. Finally, given our unique prescription data, we are able to document a "first stage" that helps us understand the mechanisms through which broadening scope of practice legislation affects health outcomes.

More broadly, our work contributes to the literature that examines how mental health outcomes can be affected by policy interventions. Previous studies have focused primarily on policy efforts to improve access to physician-provided care—by increasing access to health insurance, mandating parity in reimbursement for mental health care services, or altering incentives for graduating physicians to enter either psychiatry or primary care—and find mixed results (see, for example, Rabinowitz et al., 2008; Cunningham, 2009; Finkelstein et al., 2012). In contrast to this line of work, we focus on a policy that can increase the accessibility of medical care for disadvantaged populations immediately and at a low cost: there are currently over 234,000 NPs already licensed in the US who could prescribe independently if legislation permitted them to do so (AANP, 2017).

Taken together, our results provide strong evidence that relaxing occupational licensing for non-physician providers can help mitigate the negative consequences of limited access to physician-provided health care. In particular, states that are underserved by physicians can grant independent prescriptive authority to NPs to improve the mental health of their residents. The potential for such legislative action remains large: as of January, 2015, only 24 states and the District of Columbia had granted independent prescriptive authority to NPs. Noticeably, no state in the South has yet to allow NPs to independently prescribe.

This paper proceeds as follows. We begin by providing background on NPs and scope of practice legislation in Section 2. We then introduce our data in Section 3. In Section 4, we examine how mental-health-related mortality and self-reported mental health respond when independent prescriptive authority is extended to NPs. In Section 5, we examine how the number of prescriptions

given both the small sample size of the Medical Expenditure Panel Survey (MEPS) and the more limited time period that they consider. We further note that the MEPS is only representative at the national level, whereas the data we use is either representative at the state level (BRFSS) or covers the universe of deaths (U.S. Mortality Files).

for antidepressants, antipsychotics, and opioids change when NPs can prescribe independently. Section 6 concludes.

2 Background

The number of NPs in the US has grown rapidly in recent decades, with the number of licensed NPs more than doubling from 120,000 in 2007 to over 234,000 today (AANP, 2017). To become an NP, registered nurses must complete a master's or doctoral program that provides advanced clinical training beyond their undergraduate nursing education and complete local licensure and national certification requirements. NPs practice in a wide range of settings, including physician practices, hospitals, community health centers, and private NP practices (AANP, 2014).

While the training requirements for NPs are similar across the US, individual states have the authority to dictate what NPs are able to do. In states with liberal scope of practice legislation, NPs have the authority to evaluate, diagnose, and treat patients—which includes ordering and interpreting diagnostic tests, initiating and managing treatments, and prescribing medication—under the licensure authority of the state board of nursing. In states with more restrictive scope of practice legislation, NPs may be required to undergo career-long supervision, delegation, or team-management by another health provider in order to provide patient care. Such legislation can be very costly for NPs: anecdotal evidence suggests that NPs often have difficulty finding or affording physicians who are willing to supervise or work in collaboration, and it is not uncommon for NPs to have to move or close when the physician with whom they contract has moved, retired, or died (Sadeghi, 2017). Broadening scope of practice legislation therefore lowers the cost of practice and may increase access by increasing both the number of providers and the effective labor supply of each provider.

We focus specifically on scope of practice legislation that grants NPs the authority to prescribe medication independently. Extending prescriptive authority may be particularly relevant for improving the provision of mental health care in the US, as past work has documented signifi-

cant disparities in access to providers who can prescribe psychotropic medications (Hartley et al., 2004; Bishop et al., 2014). Broadly speaking, there are two types of treatment for mental illness: psychotherapy and psychotropic medication. A complementarity between the two has been well documented, and in most cases it is recommended that a patient receive a combination of both treatments (SAMHSA, 2015). Despite this ideal of psychotherapy in conjunction with psychotropic medication, it is often much easier to find consistent access to therapy than to medication. While all mental health professionals can offer some degree of counseling services, traditionally only psychiatrists and other medical doctors have the legislative authority to prescribe medications.[6]

Although some NPs specialize in psychiatric and mental health, these providers make up less than four percent of the total NP workforce (AANP, 2014). Rather, the vast majority of NPs are trained in primary care programs and focus on adult, family, and pediatric health, gerontology, and women's health. Despite their generalist training, most primary care NPs diagnose and treat mental illness on a regular basis. According to a recent survey, 66 (63) percent of general practice NPs report treating anxiety (depression) in their practice, with the numbers being even more pronounced among NPs in family practice (76 and 74 percent, respectively) (AANP, 2012). This pattern is similar among physicians: while psychiatrists are the only MDs that specifically focus on mental health, many general practitioners also provide mental health services (Kessler and Stafford, 2008). Therefore, we would expect increased access to NPs in general—rather than just those specializing in psychiatric medicine—to have the potential to improve population mental health.

3 Data

We use information from seven sources to document how extending prescriptive authority to NPs affects population mental health. In particular, we combine a new dataset detailing independent prescriptive authority for NPs with mental health outcomes from both the U.S. Mortality Files and the Behavioral Risk Factor Surveillance System survey and prescription data from QuintilesIMS's

[6]Thomas et al. (2009) documents that shortages in providers who prescribe psychotropic medications are much more widespread than shortages in providers who provide non-medication mental health care services.

Xponent database. These data are supplemented with information on the provision of local medical resources and population demographics from the Area Resource Files, the American Community Survey, and the U.S. Census. Each dataset is described in detail below.

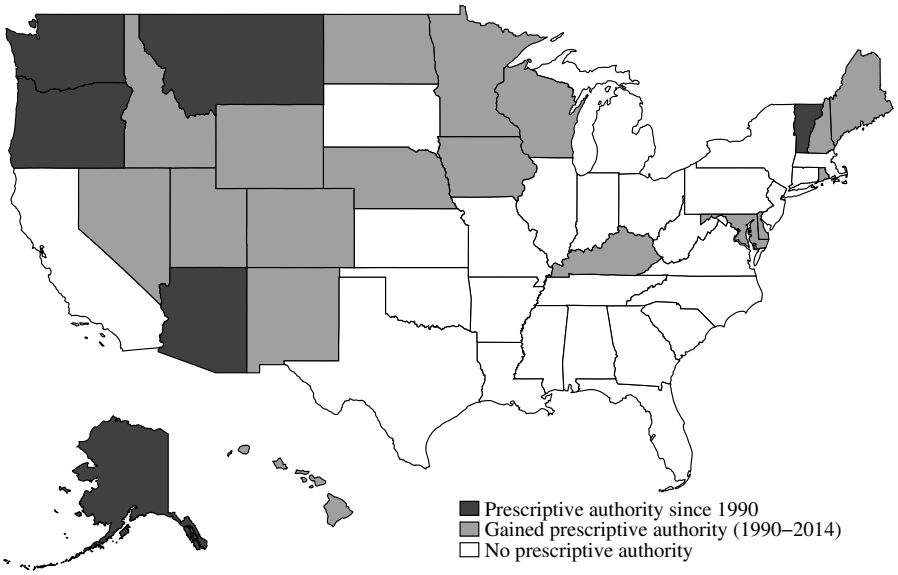
3.1 Independent Prescriptive Authority

Our first dataset documents whether NPs had the legislative authority to independently prescribe medication in each month from 1990 to 2014 in each state and the District of Columbia. This dataset was constructed by the authors and combines information from the *The Nurse Practitioner's* "Annual Legislative Update," correspondences with state nursing boards, and readings of primary source legislation.[7]

As discussed in Section 2, the language of scope of practice legislation is particular to each state. We define independent prescriptive authority as the ability to prescribe medication without physician collaboration or supervision. As of January 1^{st}, 1990, six states and the District of Columbia had already granted NPs statutory authority to independently prescribe medication. Between 1990 and 2014, 18 states changed their scope of practice legislation to allow NPs to prescribe without physician involvement. This geographic and temporal variation in scope of practice legislation is displayed in Figure 1.

[7] *The Nurse Practitioner* is a journal addressing clinical issues relevant to NPs and other primary care providers. Every January since 1989, the journal has published the "Annual Legislative Update" which summarizes both the practice environment and the level of prescriptive authority for NPs in each state. While informative, these overviews do not consistently include dates of legislative action nor comprehensive coverage of the precise changes made to a state's legislation. Therefore, the information provided by the journal alone is not sufficient for a quantitative analysis of independent prescriptive authority.

Figure 1: Changes in Independent Prescriptive Authority for NPs: 1990–2014



Notes: We define a state as having independent prescriptive authority if NPs registered in the state have the statutory authority to prescribe medications without physician collaboration or supervision.

While it is difficult to say why states decide to grant NPs independent prescriptive authority, we believe that the timing of state-level changes in scope of practice legislation are exogenous to population mental health. Anecdotal evidence from those involved in the process suggests that changes in scope of practice legislation are driven largely by idiosyncrasies of local politics. Furthermore, we find no evidence that the law changes are driven by measures of local economic conditions or the availability of medical providers (see Table A.1). Therefore, we believe that these law changes are exogenous to baseline levels and trends of mental health.

3.2 Health Resources

Increasing the supply of providers who can prescribe medication should have greater impacts among populations living in areas with an insufficient supply of such providers. According to the Health Resources and Services Administration (HRSA), an area is "underserved" for mental health care services if there is fewer than one psychiatrist for every 30,000 people. Using this definition, we identify underserved counties by combining county-level psychiatrist counts from the HRSA's

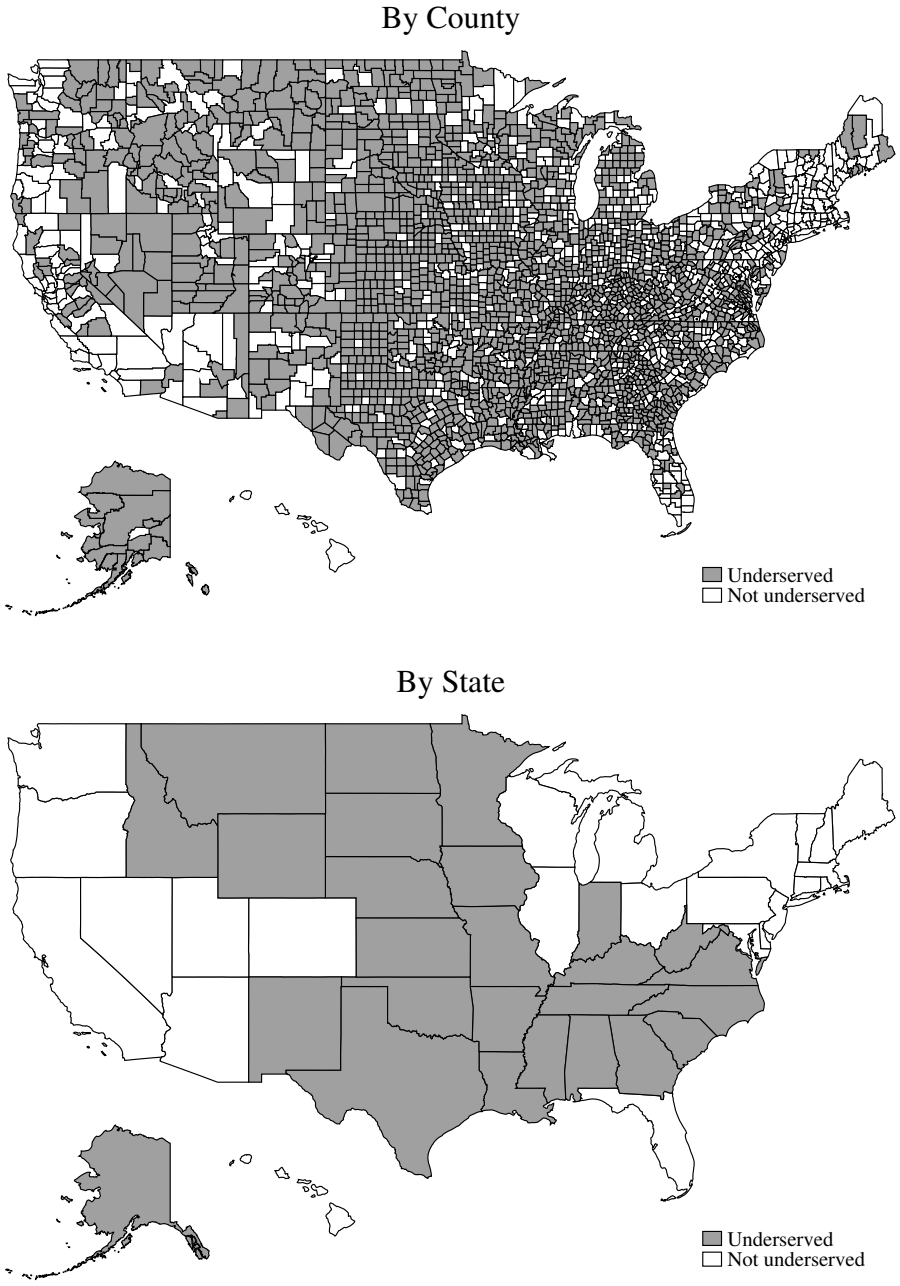
Area Resource File in 1990 with county population estimates from the 1990 Census. While we can construct this underserved measure at the county-year level, we use the measure from the beginning of our sample to avoid introducing bias from changes to the supply of medical providers driven by changing scope of practice legislation.[8] Over our sample period, approximately 20% of the U.S. population lived in counties that were underserved for mental health care.

As the survey data outlined in Section 3.3.2 is at the state level, we also need a measure of how well-equipped each state is for mental health care services. To take into account the geographic distribution of resources within a state, we analogously define a state as being "underserved" for mental health services if the population-weighted average of binary, underserved categorizations across all counties in the state is less than the median across all states in 1990. Figure 2 shows the geographic variation in underserved states and counties. Perhaps unsurprisingly, underserved counties and states are on average less densely populated, less educated, and are more white than counties with adequate mental health resources (see Tables A.2 and A.3, respectively).

While we define an area as being underserved for mental health care services by whether they have enough psychiatrists to serve the population, this characterization is an over-simplification of how mental health care is actually delivered in the US. While psychiatrists are the only MDs specifically trained to treat mental illness, in practice many general practitioners also provide treatment for mental illness (Kessler and Stafford, 2008). Despite this overlap in the services provided by psychiatrists and general practitioners, we define areas as underserved for mental health care using the psychiatrist-to-population ratio for two reasons. First, the HRSA only defines mental health care shortage areas using the number of psychiatrists, so it is not clear which threshold would be appropriate to use if we were to consider counts of both psychiatrists and general practitioners. Second, in practice, defining shortage areas based on psychiatrist-to-population ratios also captures areas that are underserved by general practitioners; that is, areas defined as underserved by psychiatrists also have fewer general practitioners per capita. Therefore, we believe that we are identifying the relevant variation in the availability of mental health care providers by focusing on

[8]Despite this concern, all of our results are robust to instead using a time-varying measure of the provision of mental health care services.

Figure 2: Areas Underserved for Mental Health Care Services: 1990



Notes: Following the definition provided by the HRSA, a county is "underserved" for mental health care services if the county has fewer than one psychiatrist per 30,000 residents. We identify underserved counties by combining information on the number of psychiatrists per county from the HRSA's 1990 Area Resource File with county population estimates from the 1990 Census. A state is "underserved" for mental health services if the population-weighted average of binary, underserved categorizations across all counties in that state is less than the median across all states in 1990.

areas underserved by psychiatrists.

3.3 Mental Health Outcomes

We identify the impact of independent prescriptive authority for NPs on population mental health using two complementary outcomes: mental-health-related mortality and self-reported days in "poor mental health." For each outcome, we consider how extending prescriptive authority to NPs impacts both the local population as a whole and disadvantaged subpopulations who may find it particularly difficult to access physician-provided care.

3.3.1 Mental-Health-Related Mortality

Our first outcome is mental-health-related mortality from the U.S. Mortality Files at the county-quarter level from 1990–2014. Here, we consider both suicides and a broader measure of "mental-health-related deaths," which combines suicides, deaths of unknown intent, and accidental death categories that are closely related to mental health: those involving firearms, trains, drownings, and poisonings.

We believe that the broad measure of mental-health-related mortality provides a more accurate picture of mortality caused by poor mental health rather than suicides alone for two reasons. First, geographic variation in reported suicides may reflect both systematic differences in true suicides as well as systematic differences in cause-of-death reporting (Hilkevitch, 2005; Rockett et al., 2006; Bjorkenstam et al., 2014). When someone dies from an overdose of oxycodone, for example, the local coroner decides whether to label the death as a suicide or as an accidental poisoning. Our broad measure of mental-health-related deaths captures both causes of death, whereas "suicides" only captures the former. Second, drug and alcohol addiction is an increasingly important category of mental illness, and thus we are interested in drug-related deaths even if suicide was not the individual's intent.[9]

[9]There is an extensive body of literature in medicine and psychiatry discussing the feedback between substance abuse disorders and other types of mental illness. Most prominently, the self-medication hypothesis posits that substance abuse is often related to other underlying mental illness via self-medication (Khantzian, 1985; Regier et al.,

The mortality files contain demographic information for the deceased individual. In particular, the deceased's county of residence, sex, race, age, and level of education are recorded. We use this information to determine both the total number of deaths at the county level as well as the number of deaths among subpopulations of interest. As the mortality files contain no information on the deceased's income, we use education as a proxy for socioeconomic status.

While the mortality files tell us the number of people who died, they provide us with no information about the size of the population base. When one area reports having more deaths than another, for example, we cannot determine from the mortality files alone whether this is because the population is larger and the death rates are the same, or whether the location experienced a disproportionate number of deaths. To take into account the size of the relevant population, we combine the number of deaths at the county-quarter level with linearly interpolated county-year population estimates from the 1990, 2000, and 2010 Censuses.[10]

In addition to population estimates, we also use county-level demographics from both the census and the American Community Survey (ACS) to control for underlying differences across counties and to identify disadvantaged subpopulations. As with total population, we linearly interpolate subpopulation estimates at the county-year level between the 1990 Census, the 2000 Census, and either the 2010 Census or the 5-year pooled (2008–2012) ACS. As shown in Table 1, counties in states that allow NPs to prescribe independently at some point during our sample period tend to be less densely populated and less racially diverse. However, both groups of counties have very similar employment, education, and age profiles.

1990; Khantzian, 1997; Barkus and Murray, 2010; Nock et al., 2010).

[10]Results are robust to using intercensal population estimates from the Census.

Table 1: Summary Statistics: County-Level Mortality and Controls, 1990–2014

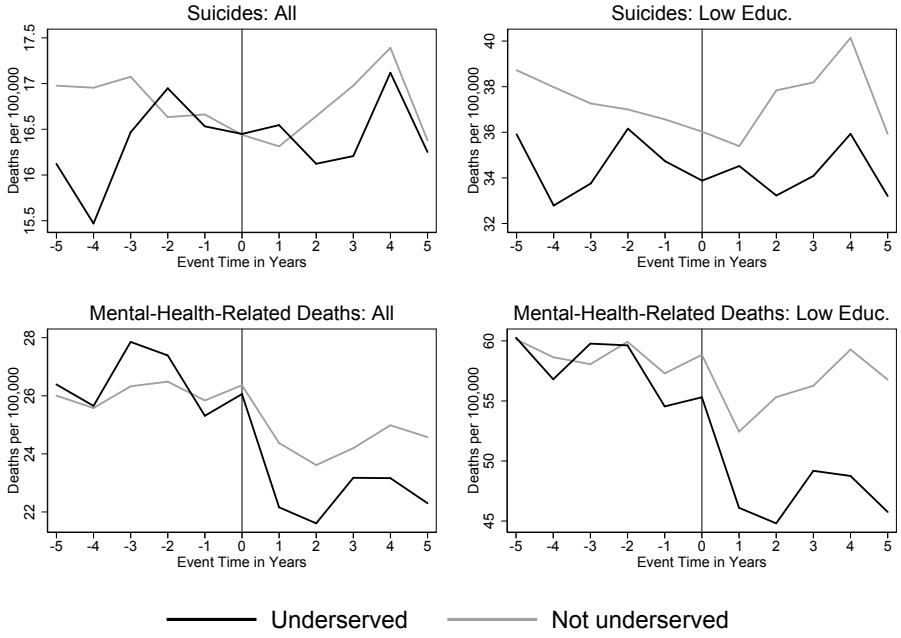
	All	Never Indep. Rx Authority	Ever Indep. Rx Authority
Deaths per 100,000:			
Suicides	3.32	3.10	4.15
Mental-health-related deaths	5.54	5.32	6.34
Indep. prescriptive authority	0.13	0.00	0.62
Low psychiatrist-to-pop. ratio (underserved)	0.23	0.23	0.25
Total population	1,039,119	1,172,967	549,985
Population density (per mile^2)	2,095	2,469	728
Median household income	54,016	53,882	54,504
Percent unemployed	0.06	0.06	0.06
Percent male	0.49	0.49	0.49
Percent black	0.12	0.14	0.06
Percent middle aged	0.13	0.13	0.13
Percent 18 and under	0.25	0.25	0.25
Percent high school or less	0.47	0.48	0.43
Percent in poverty	0.28	0.29	0.27
Psychiatrists per 100,000	11.88	12.15	10.91
Primary care MDs/DOs per 100,000	96.02	96.60	93.90
Observations	313,400	215,500	97,900

Notes: Observations are at the county-quarter level. Statistics are weighted by population. "Mental-Health-Related Deaths" include suicides, deaths of unknown intent, and accidental deaths involving firearms, trains, and poisonings. "Ever (Never) Independent Rx Authority" includes counties that had independent prescriptive authority for NPs at some point (at no point) during our sample. "Independent prescriptive authority" reflects whether a county allowed NPs independent prescriptive authority in a given year. "Low psychiatrist-to-pop. ratio" reflects whether a county had fewer than one psychiatrist per 30,000 residents in 1990. Mortality statistics come from the U.S. Mortality Files, provider counts come from the HRSA's Area Resource Files, and all other variables come from the 1990, 2000, and 2010 Censuses and the 5-year pooled (2008-2012) American Community Survey (ACS). Census and ACS variables are linearly interpolated at the county-year level. Refer to Table A.2 for summary statistics across counties that are and are not underserved for mental health care services.

Figure 3 shows mental-related-mortality at the county-year level in event time around the year in which states grant NPs independent prescriptive authority. This analysis is done separately for counties that are and are not considered underserved for mental heath care services. Suicide rates are fairly noisy, likely due to both low incidence rates and differences in how suspected suicides are reported across counties and over time. However, there is a clear pattern of decreased mental-health-related deaths after states allow NPs to prescribe independently. These decreases are more pronounced in underserved counties and are the largest for low-education populations living in

these underserved areas. Furthermore, there is no evidence of pre-trends in mortality in the lead up to the law changes.

Figure 3: Event Time: Independent Prescriptive Authority and Mental-Health-Related Mortality



Notes: Observations are at the county-year level and are population weighted. "Mental-Health-Related Deaths" include suicides, deaths of unknown intent, and accidental deaths involving firearms, trains, and poisonings. A county is considered "underserved" if the county had fewer than one psychiatrist per 30,000 residents in 1990. Individuals are considered "Low Educ." if they have a high school degree or less.

3.3.2 Self-Reported Mental Health

Our second outcome is the number of days in the past month that a person reports being in poor mental health. This measure comes from the Behavioral Risk Factor Surveillance System survey (BRFSS)—a large, annual phone survey that collects information on health-related risk behaviors, chronic health conditions, and use of preventive services in the US. The BRFSS is representative at the state-year level. Starting in 1993 and in most state-years during our sample frame, respondents were asked the following question:

> "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?"

This question is not designed to draw a particular mental health diagnosis, but rather to indicate whether a respondent experiences any symptoms associated with a wide range of mental health conditions. Importantly, responses are elicited from those with either diagnosed or undiagnosed mental illnesses, as respondents are not asked whether they have ever been diagnosed with a mental illness by a doctor.

We consider as outcome variables both the number of days reported in poor mental health and an indicator for whether the respondent reported having spent at least 21 of the past 30 days in poor mental health. According to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5), to be diagnosed with a major depressive episode a patient must have either "a depressed mood most of the day, nearly every day" or "a markedly diminished interest or pleasure in all, or almost all, activities most of the day, nearly every day" for two consecutive weeks. In addition to major depressive disorder, the diagnostic criteria for many mental health conditions include extended time periods over which symptoms must be experienced in order for the diagnosis to apply. Thus, we believe creating a binary variable focusing on those experiencing prolonged symptoms will help identify people suffering from more severe forms of mental illness.

The BRFSS also includes information on each respondent's sex, race, ethnicity, age, education, income, and employment and health insurance status. These variables allow us to separately consider disadvantaged populations and to control for underlying differences across respondents in our analysis.

As shown in Table 2, BRFSS respondents report spending 3.33 days in the past month in poor mental health on average, with 67% of respondents reporting no days in poor mental health and 6% of respondents reporting at least 21 days in poor mental health. Similar to the pattern observed in Table 1, survey respondents in states that ever had independent prescriptive authority during our sample have similar age, education, and income profiles to control states, although states that grant independent prescriptive authority over our sample period are less racially diverse.

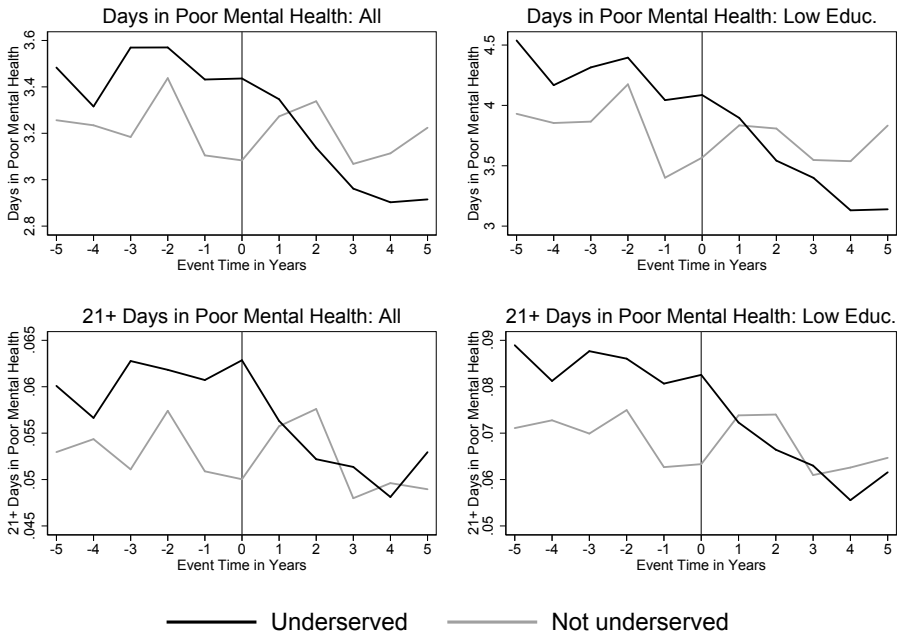
Table 2: Summary Statistics: Self-Reported Mental Health and Controls, 1993–2015

	All	Never Indep. Rx Authority	Ever Indep. Rx Authority
Days in poor mental health:			
Average	3.35	3.37	3.25
Percent 0	0.66	0.67	0.66
Percent >= 21	0.06	0.06	0.05
Indep. prescriptive authority	0.14	0.00	0.66
Low psychiatrist-to-pop. ratio (underserved)	0.38	0.40	0.32
Male	0.48	0.48	0.49
White	0.71	0.68	0.79
Black	0.10	0.11	0.05
Hispanic	0.13	0.14	0.08
Health insurance	0.85	0.84	0.86
Age: 18 to 34	0.31	0.31	0.31
Age: 35 to 44	0.20	0.20	0.20
Age: 45 to 54	0.18	0.18	0.18
Age: 55 to 64	0.13	0.13	0.13
Age: 65+	0.17	0.17	0.17
Education: high school or less	0.43	0.44	0.40
Education: college or more	0.29	0.29	0.30
Married	0.58	0.57	0.60
Income: 1st quintile	0.20	0.21	0.17
Income: 2nd quintile	0.18	0.18	0.18
Income: 3rd quintile	0.17	0.16	0.18
Income: 4th quintile	0.19	0.18	0.19
Income: 5th quintile	0.13	0.13	0.14
Employment: for wages	0.52	0.52	0.54
Employment: self-employed	0.08	0.08	0.09
Employment: out of work 1+ yrs	0.02	0.03	0.02
Employment: out of work <1 yr	0.03	0.03	0.03
Employment: homemaker	0.08	0.08	0.07
Employment: student	0.05	0.05	0.05
Employment: retired	0.16	0.16	0.17
Employment: unable to work	0.05	0.05	0.04
Observations	6,097,491.00	3,369,957.00	2,727,534.00

Notes: Observations are at the individual level. Statistics are weighted using BRFSS sample weights. "Ever (Never) Independent Rx Authority" includes respondents living in states that had independent prescriptive authority for NPs at some point (at no point) during our sample. "Independent prescriptive authority" reflects the fraction of respondents living in a state with independent prescriptive authority in the year that he/she responded. "Low psychiatrist-to-pop. ratio" reflects the fraction of respondents living in a state that was underserved for mental health services in 1990. Some categorical variables do not sum to one; the difference reflects the percentage of missings. Refer to Table A.3 for summary statistics across states that are and are not underserved for mental health care services.

The question on days in poor mental health was not asked in some state-years during our sample frame.[11] These missing state-years correspond to 3.08% of state-year observations representing 2.26% of the population. The missing state-years do not correspond with the year before, the year of, or the year after a relevant law change for any state, and thus our identification is not directly affected.

Figure 4: Event Time: Independent Prescriptive Authority and Self-Reported Mental Health



Notes: Observations are at the individual level and are weighted using the BRFSS sample weights. A state is considered "underserved" if the population-weighted average of binary, underserved categorizations across all counties in the state is less than the median across all states in 1990. Individuals are considered "Low Educ." if they have a high school degree or less.

Figure 4 shows improvements in self-reported mental health when states grant NPs independent prescriptive authority. The patterns in these improvements follow those observed for mental-health-related mortality in Figure 3: across both measures of self-reported mental health, those living in underserved states report both higher initial levels of mental illness symptoms and larger decreases following broadened scope of practice legislation. Notably, individuals with low levels

[11] In particular, the BRFSS did not this question in Wyoming in 1993, Rhode Island in 1994, Washington D.C. in 1995, 29 states in 2002, and Hawaii in 2004. The states missing in 2002 are: Alabama, Arkansas, Arizona, Colorado, Connecticut, Washington D.C., Delaware, Florida, Georgia, Indiana, Louisiana, Massachusetts, Maryland, Maine, Michigan, Mississippi, Montana, North Dakota, Nebraska, New Hampshire, Nevada, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Vermont, Wisconsin, West Virginia.

of education have worse average baseline mental health and experience the largest improvements when independent prescriptive authority is extended to NPs.

3.4 Prescription Data

Finally, to examine how extending independent prescriptive authority to NPs influences the number of prescriptions being written, we use the QuintilesIMS Xponent database. Our version of the database contains the universe of antidepressant, antipsychotic, and opioid prescriptions filled at U.S. retail pharmacies between 2006 and 2014 and allows us to construct prescription measures at the county-year level. Furthermore, the database contains information on how a patient paid for their prescription, allowing us to stratify by payment type: Medicaid, third party, and cash. This is particularly important given that the predicted impacts of expanded scope of practice legislation are largest for populations that traditionally find it difficult to access physician-provided care, such as Medicaid beneficiaries.

While rich, this data requires us to use a restricted time span: in contrast to the outcome measures introduced in Sections 3.3 that are available from either 1990 or 1993 onward, we only have the prescription data from 2006. However, eight states granted independent prescriptive authority to NPs during this time frame—Colorado, Hawaii, Maryland, Nevada, North Dakota, Rhode Island, Kentucky, and Minnesota—so there is limited but nonetheless meaningful variation that we can exploit.

We focus on antidepressants and antipsychotics as two representative classes of pharmaceuticals used to treat mental illness.[12] These medications are widely used: as shown in Table 3, on average 0.67 antidepressants and 0.12 antipsychotics were filled annually per capita between 2006 and 2014.[13] These medications are also commonly prescribed by NPs, with 8 (10) percent of

[12]Despite their name, antidepressants have a wide range of indications, with the most common being depressive, anxiety, and panic disorders (Wong et al., 2017). Antipsychotics are used primarily to manage psychosis and are most frequently used for schizophrenia and bipolar disorder. While antipsychotics are much less commonly prescribed than antidepressants, they are relatively more important for low-income populations (24 percent of antipsychotics are covered by Medicaid compared to just 7 percent of antidepressants; see Table 3). While a discussion of the efficacy of antidepressants and antipsychotics is outside the scope of this paper, we note that the recommended treatment for most common mental illnesses is a combination of medication and counseling (SAMHSA, 2015).

[13]Antidepressants are one of the most commonly prescribed classes of pharmaceuticals, and the largest class used

Table 3: Summary Statistics: Prescriptions, 2006–2014

	All	Never Indep. Rx Authority	Ever Indep. Rx Authority
Antidepressants			
Annual Rx (millions)	206.67	157.79	48.88
Rx per capita	0.67	0.65	0.73
Percent from MDs	0.88	0.90	0.81
Percent from NPs	0.08	0.07	0.13
Medicaid			
Percent of total	0.07	0.07	0.09
Percent from MDs	0.82	0.85	0.75
Percent from NPs	0.14	0.12	0.19
Commercial			
Percent of total	0.86	0.87	0.84
Percent from MDs	0.89	0.91	0.82
Percent from NPs	0.08	0.06	0.12
Antipsychotics			
Annual Rx (millions)	35.67	28.26	7.41
Rx per capita	0.12	0.12	0.11
Percent from MDs	0.87	0.90	0.79
Percent from NPs	0.10	0.08	0.18
Medicaid			
Percent of total	0.24	0.24	0.23
Percent from MDs	0.85	0.88	0.76
Percent from NPs	0.12	0.10	0.20
Commercial			
Percent of total	0.72	0.72	0.73
Percent from MDs	0.88	0.90	0.80
Percent from NPs	0.10	0.08	0.17
Opioids			
Annual Rx (millions)	227.30	177.56	49.74
Rx per capita	0.74	0.73	0.74
Percent from MDs	0.81	0.82	0.75
Percent from NPs	0.05	0.04	0.07
Medicaid			
Percent of total	0.07	0.07	0.07
Percent from MDs	0.77	0.79	0.72
Percent from NPs	0.07	0.06	0.09
Commercial			
Percent of total	0.81	0.81	0.82
Percent from MDs	0.82	0.83	0.76
Percent from NPs	0.04	0.04	0.07

Notes: Statistics represent national averages from 2006 to 2014. The percentage of prescriptions written by doctors and NPs does not sum to one; the remaining prescriptions are written by other providers such as dentists and physician assistants.

antidepressant (antipsychotic) prescriptions being written by NPs.

In addition to antidepressants and antipsychotics, we further examine whether extending independent prescriptive authority to NPs leads to increases in the number of opioid prescriptions—a class of drugs with a high potential for abuse and addition. We note, however, that there were many changes in the market for opioids between 2006 and 2014, including a range of state-level legislation aimed to limit prescribing and curb abuse. As these changes may coincide with the changes in scope of practice legislation we consider, we interpret the results involving opioids with caution.

While the data is sufficiently detailed to allow us to examine the number of prescriptions written by either physicians or NPs separately, we believe that the total number of prescriptions most accurately reflects changes in prescription patterns associated with expanded prescriptive authority for two reasons. First, we want to capture the net effect of broadened scope of practice legislation on prescription patterns. If people switch from a doctor to an NP when NPs are granted prescriptive authority but still receive the same prescription, we would not want to claim that the law change resulted in improved access to pharmaceuticals. Second, there are technical issues that arise when attributing prescriptions to different types of providers. When NPs have a supervisory or collaborative relationship with a physician, the prescription pad used by the NP may bear either the affiliated physician's name and national provider identifier (NPI) or the NP's name and NPI.[14] If NPs obtain their own prescription pads when they gain independent prescriptive authority, we would observe a mechanical shift in the number of prescriptions from MDs to NPs in the absence of any true change in the providers writing prescriptions. Thus, we consider the total number of prescriptions filled within a county as our primary measure.

to treat mental illness. While it has been argued that medications such as antidepressants may be over prescribed, we note that this does not preclude the possibility that they are considerably under-prescribed for populations with limited access to providers.

[14]Skillman et al. (2012) estimate that only 76% of NPs had an NPI in 2010, providing an upper bound for the percent of NPs who could have a prescription pad bearing their name.

4 Prescriptive Authority and Mental Health Outcomes

In order to identify whether extending independent prescriptive authority to NPs improves mental health outcomes, we exploit time-series variation in state-level scope of practice legislation and mental health outcomes using a difference-in-difference framework. As described in Section 3.3, we consider two categories of mental health outcomes: mental-health-related mortality and self-reported days in poor mental health. The impact of prescriptive authority on each category of outcomes is considered in turn below.

4.1 Mental-Health-Related Mortality

When NPs are allowed to independently prescribe, do we see reductions in the prevalence of suicides and other mental-health-related deaths? Letting $Deaths_{cqy}$ denote either of these outcomes in county c in quarter q of year y, we estimate the following equation:

$$Deaths_{cqy} = \beta_0 + \beta_1 Indep.\, Rx_{sqy} + \beta_2 Pop_{cy} + \beta_3 X_{cy} + \gamma_c + \gamma_q + \gamma_y + \epsilon_{cqy} \tag{1}$$

where $Indep.Rx_{sqy}$ is an indicator denoting whether NPs had independent prescriptive authority in state s in quarter q of year y; Pop_{cy} is the population of county c in year y; X_{cy} is a vector of other county-year controls; and λ_c, λ_q, and λ_y are county, quarter, and year fixed effects, respectively.[15]

To avoid introducing measurement error into the outcome, our preferred specification uses the number of deaths in a county-quarter as the outcome variable and includes a control for the corresponding population estimate on the right-hand side. While one could use county-level death rates as the outcome variable, death rates are very sensitive to population counts, and precise county-level population estimates are only available every ten years. Whereas measurement error from population estimates on the right-hand side will attenuate the estimated coefficient on population,

[15] Since we include county fixed effects, we do not control for county demographics that are nearly constant over time. However, we do control for time-varying county-year demographics: population, population density, percent unemployed, percent with a high school diploma or less, percent with a college degree or more, a quadratic in median income, and the number of practicing psychiatrists and primary care physicians. Results are robust to including a wider range of county-level demographics.

it will not affect the precision of our estimated coefficients of interest. On the other hand, measurement error in the outcome would serve to attenuate all estimated coefficients, including those of key policy relevance.

Increasing the supply of providers should impact mental health outcomes most for populations living in areas with an insufficient supply of providers and for populations who find it more difficult to access physician-provided care. We therefore allow the impact of changing scope of practice legislation to differentially influence mental health in counties with an under-provision of mental health care services and for populations who are traditionally disadvantaged. Letting $Underserved_c$ be a dummy which equals one if county c was underserved for mental health care services in 1990 and zero otherwise, we estimate the following equation:

$$\begin{aligned} Deaths_{cqy} = \beta_0 + \beta_1 Indep.\ Rx_{sqy} + \beta_2 Indep.\ Rx_{sqy} \cdot Underserved_c \\ + \beta_3 Pop_{cy} + \beta_4 X_{cy} + \gamma_c + \gamma_q + \gamma_y + \epsilon_{cqy} \end{aligned} \tag{2}$$

where all other variables are defined as in Equation (1). To look specifically at disadvantaged populations, we further estimate Equation (2) separately for different demographic groups. Results for individuals with low levels of education are provided with the main results below; refer to Tables A.5 and A.6 for results for additional subpopulations.

As shown in Columns (1) and (4) of Table 4, on average there is no statistically significant effect of granting independent prescriptive authority to NPs on deaths across all counties. However, as expected, counties that are underserved by psychiatrists experience larger and more precisely estimated decreases in mortality when NPs can prescribe independently. As shown in Column (2), underserved counties experience a reduction of 1.39 suicides per quarter, or 5% of the mean, when independent prescriptive authority is extended to NPs. Considering all mental-health-related deaths in Column (5), we see that underserved counties experience a reduction of 6.64 deaths per quarter, or nearly 13% of the mean, when NPs can prescribe independently.

Table 4: Independent Prescriptive Authority and Mental-Health-Related Mortality

	Suicides			Mental-Health-Related Deaths		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Low Educ.	Full Sample	Full Sample	Low Educ.
Indep. prescriptive authority	0.356	0.941	0.363	-1.872	-0.277	-0.444
	(0.696)	(0.643)	(0.473)	(1.461)	(1.447)	(0.899)
Indep. Rx * underserved		-2.335**	-1.577***		-6.364***	-4.148***
		(0.988)	(0.510)		(1.978)	(1.417)
Observations	313,400	313,400	313,388	313,400	313,400	313,388
R^2	0.969	0.969	0.950	0.971	0.971	0.956
Mean dependent variable	28.52	28.52	14.85	51.34	51.34	28.94
F-test: $\beta_1 + \beta_2 = 0$		0.26	0.06		0.01	0.00

Notes: Observations are at the county-quarter level and are population weighted. Standard errors are clustered by state. All regressions include county, quarter, and year fixed effects. Additional controls include total population (or subgroup population), population density, percent unemployed, percent with a high school diploma or less, percent with a college degree or more, a quadratic in median income, and the number of practicing psychiatrists and primary care physicians. "Low Educ." is defined as having a high school degree or less. Refer to Table A.4 for the full regression results.

Individuals with low levels of education living in underserved counties see even greater reductions in suicides and mental-health-related deaths when NPs are granted independent prescriptive authority (Columns (3) and (6)). For those with low levels of education who reside in underserved counties, suicides and mental-health-related deaths are reduced by 8% and 16%, respectively, when independent prescriptive authority is extended to NPs (1.21 fewer suicides and 4.59 fewer mental-health-related deaths per county-quarter). Given that suicides and mental-health-related deaths are quite rare, there is likely more noise when we restrict our sample to individuals with a high school degree or less. As measurement issues will serve to attenuate our estimates, it is notable that we still identify effects of comparable, if not larger, magnitudes.

Finally, the results presented in Table 4 are robust to a wide range of alternative specifications. While all regressions are weighted by population in Table 4, Table A.7 reports the analogous results of unweighted specifications. If anything, the effects of extending prescriptive authority to NPs are more precisely estimated in the unweighted regressions, as the law changes have the largest impacts in less populous counties. Furthermore, Table A.8 shows that the results are robust

to the inclusion of state-level linear time trends, and Table A.11 shows that our results are robust to the exclusion of demographic controls. Finally, the results presented in Table 4 are not driven by any one particular state. Tables A.9 and A.10 show that the point estimates are very stable when we separately drop each state extends independent prescriptive authority to NPs over our sample period.

4.2 Self-Reported Mental Health

In Section 4.1 we found that allowing NPs to prescribe independently leads to significant reductions in mental-health-related mortality. As mortality is an extreme outcome, we next ask whether extending prescriptive authority to NPs leads to improvements in the mental health of individuals on a day-to-day basis. As described in Section 3.3.2, we consider both the number of days in the past month respondents report being in poor mental health as well as a binary variable which equals one if the respondent reports having spent at least three weeks in poor mental health and zero otherwise. Letting $Poor\ Mental\ Health_{isy}$ denote either of these outcomes for individual i in state s in year y, we estimate the following equation:

$$Poor\ Mental\ Health_{isy} = \beta_0 + \beta_1 Indep.\ Rx_{sy} + \beta_2 X_{isy} + \gamma_s + \gamma_y + \epsilon_{isy} \tag{3}$$

where $Indep.\ Rx_{sy}$ is an indicator denoting whether NPs had independent prescriptive authority in state s in year y; X_{isy} is a vector of individual-level controls; and γ_s and γ_y are state and year fixed effects, respectively.[16] We define a state as having independent prescriptive authority in a given year if NPs had the legislative authority to prescribe independently at any point within the year; all of our results are robust to alternative timing assumptions.

As before, we examine whether extending prescriptive authority to NPs impacts mental health more for populations living in states with an under-provision of mental health care services and among populations who are traditionally disadvantaged. Letting $Underserved_s$ be a dummy which

[16]Individual-level controls include sex, age, education, income quintile dummies, and indicators for race (white, black, and missing), Hispanic, employment status, and insurance status.

equals one if state s is less equipped for mental health care services in 1990 and zero otherwise, we estimate the following equation:

$$\begin{aligned} Poor\ Mental\ Health_{isy} = \beta_0 + \beta_1 Indep.\ Rx_{sy} + \beta_3 Indep.\ Rx_{sy} \cdot Underserved_s \\ +\beta_3 X_{isy} + \gamma_s + \gamma_y + \epsilon_{isy} \end{aligned} \tag{4}$$

where all other variables are defined as in Equation (3). To look specifically at disadvantaged populations, we further estimate the coefficients in Equation (4) separately for different subpopulations of interest. Results for individuals with low levels of education are provided with the main results below; refer to Tables A.13 and A.14 for results for other subpopulations.

As shown in Table 5, independent prescriptive authority for NPs is associated with significant reductions in the number of poor-mental-health days reported by survey respondents. Looking first to Column (1), we see that respondents report on average having spent 0.17 fewer days in poor mental health when NPs are allowed to prescribe—a reduction of 5% of the mean. Adhering to the expectation that areas with an insufficient supply of providers should experience greater improvements, Column (2) demonstrates that the benefits are again concentrated among respondents in areas that are less equipped for mental health care. For respondents in underserved states, allowing NPs to prescribe independently leads to 0.17 fewer days in poor mental health relative to other states. The overall effect of the law change on those in underserved states (0.29 fewer days in poor mental health, or 8.5% of the mean) is nearly twice the improvement observed for the population on average. Finally, consistent with the mortality results, we find that the most disadvantaged populations—individuals with low levels of education living in areas underserved by psychiatrists—see the greatest reductions in poor mental health on a day-to-day basis. As seen in Column (3), independent prescriptive authority leads to a reduction of over 10.5% in poor mental health days (0.41 days in poor mental health) relative to the average for low-education respondents who live in underserved states.

Table 5: Independent Prescriptive Authority and Self-Reported Mental Health

	Days in Poor Mental Health			21+ Days in Poor Mental Health		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Low Educ.	Full Sample	Full Sample	Low Educ.
Indep. prescriptive authority	-0.170**	-0.118	-0.103	-0.005**	-0.003**	-0.001
	(0.066)	(0.071)	(0.132)	(0.002)	(0.001)	(0.003)
Indep. Rx * underserved		-0.169*	-0.305**		-0.006	-0.012**
		(0.088)	(0.135)		(0.004)	(0.006)
Observations	6,540,521	6,540,521	2,606,231	6,540,521	6,540,521	2,606,231
R^2	0.083	0.083	0.083	0.052	0.052	0.052
Mean dependent variable	3.36	3.36	3.91	0.06	0.06	0.07
F-test: $\beta_1 + \beta_2 = 0$		0.00	0.00		0.05	0.01

Notes: Observations are at the individual level with BRFSS sample weights. Standard errors are clustered by state. All regressions include state and year fixed effects. Additional controls include dummies for whether the respondent is male, white, black, Hispanic, married, has health insurance, and their employment status. Dummies for age groups, education groups, and income quintiles are also included. "Low Educ." is defined as having a high school degree, less than a high school degree, or missing education information. Refer to Table A.12 for the full regression results.

Allowing NPs to independently prescribe further leads to reductions in the likelihood that individuals spend at least three weeks in poor mental health. As shown in Columns (4) and (5) of Table 5, independent prescriptive authority leads to a 5-8% reduction in this measure of more severe mental illness for the population as a whole. As before, the effects are larger among the most vulnerable populations: we see in Column (6) that individuals who are both living in underserved states and have low levels of education experience a nearly 20% reduction in the probability of reporting 21+ days in poor mental health when NPs can prescribe independently.

Taken together, the results in Table 5 indicate that individuals with both minor and more severe mental illnesses benefit from the expansion of prescriptive authority. As with our mortality results, we provide a variety of additional analyses to probe the robustness of these results. Tables A.15 and A.16 show that our results are not driven by any one state: as with our mortality results, the point estimates are very stable when we separately drop each state that takes up treatment during our sample period. Furthermore, Table A.18 shows that these results are also robust to the exclusion of demographic controls. Unlike the mortality results, however, Table A.17 shows that the self-

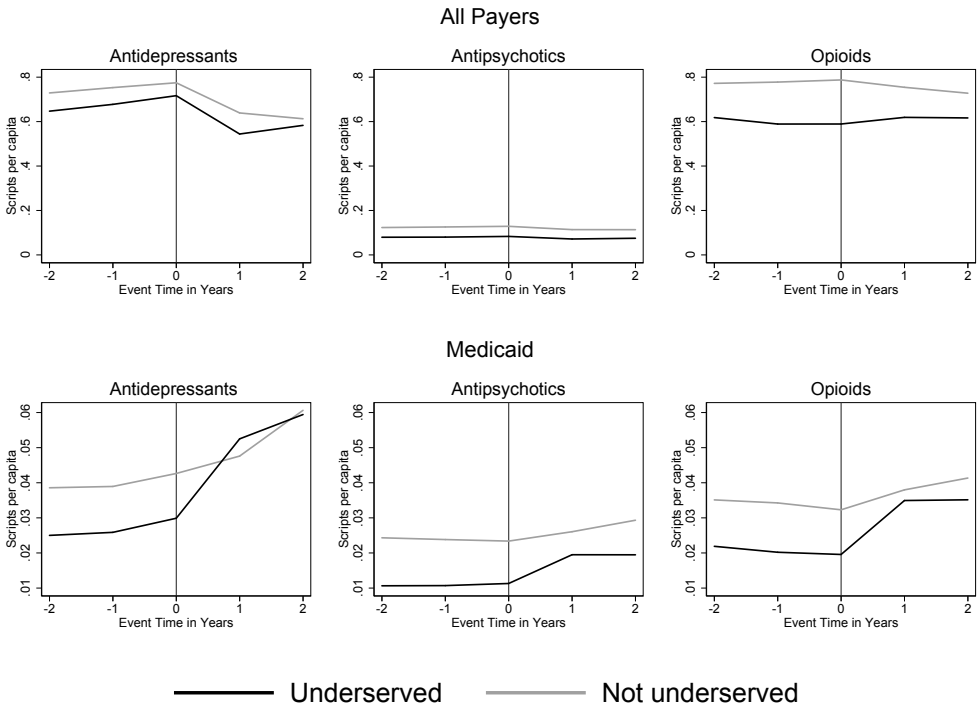
reported mental health results are not robust to adding state-level linear time trends. As all of the variation we are able to exploit in the BRFSS is at the state-year level, adding state-level linear time trends in conjunction with state and year fixed effects leaves little residual variation, so the null result is not surprising.[17]

5 Prescriptive Authority and the Number of Prescriptions

We find in the previous section that extending prescriptive authority to NPs results in substantial improvements in population mental health. Allowing NPs to prescribe medication without physician oversight could affect population mental health in two ways. The first and most direct route is that removing restrictions on NP's ability to prescribe may allow more people to access medication that affects their mental health. A second and less direct route is that granting NPs independent prescriptive authority may attract more nurses to the profession or redirect already licensed NPs to areas with more liberal scope of practice legislation, thereby expanding access to health care services more broadly. If increased access to health care leads to improved well-being, then extending prescriptive authority to NPs could improve mental health independently of the number of prescriptions written. Using prescription data from 2006-2014, we examine whether there is evidence of increased use of prescription medications when NPs are allowed to prescribe independently.

[17]Note that it is less of a concern to add state-level linear time trends to the mortality regressions. In Section 4.1, the outcome varies at the county-quarter level. Additionally, there is within-year variation in law changes and within-state variation in health resources.

Figure 5: Event Time: Independent Prescriptive Authority and Prescriptions per Capita



Notes: Observations are at the county-year level and are population weighted. A county is considered "underserved" if the county had fewer than one psychiatrist per 30,000 residents in 1990. Refer to Figure A.1 for an analogous figure that includes only prescriptions written by NPs.

Figure 5 shows prescriptions per capita for antidepressants, antipsychotics, and opioids in event time around the year in which states grant NPs independent prescriptive authority. This analysis is done separately for counties that are and are not considered underserved for mental heath care services and separately for prescriptions paid for by all payers and prescriptions paid for by Medicaid. The top panel of Figure 5 suggests that there are no noticeable changes in prescriptions per capita when NPs gain independent prescriptive authority. However, this null effect across all payers masks increases among Medicaid beneficiaries: as shown in the second panel of Figure 5, prescriptions per capita covered by Medicaid increase when independent prescriptive authority is extended to NPs. In line with our results for mental health outcomes in Section 4, these increases in prescriptions per capita covered by Medicaid are larger in counties that are underserved for mental health care services.

Figure 5 demonstrates that underserved areas have lower baseline prescriptions across all three

drug classes. If there are decreasing marginal returns to prescriptions, these level differences will result in the marginal patient gaining a prescription in an underserved county to experience larger health benefits than the marginal patient in counties with a sufficient provision of mental health care services at baseline. Therefore, while allowing NPs to prescribe independently leads to an increase in the number of Medicaid prescriptions in all counties, economic theory predicts that the health impacts should be largest in underserved areas. This is consistent with our results from Section 4: disadvantaged populations living in underserved areas experience the largest improvements in mental health when independent prescriptive authority is extended to NPs.

We see in the third column of Figure 5 that expanded prescriptive authority is associated with increased opioid prescriptions among Medicaid beneficiaries. This is not surprising, as the scope of practice legislation we consider is not limited to psychotropic medications. Given that rates of opioid abuse in the US have reached epidemic levels, any policy that increases the provision of opioids could be troublesome (NSDUH, 2014). However, we do not believe that this concurrent rise in opioid availability affects the interpretation of our main results for two reasons. First, since our measure of mental-health-related mortality includes overdose deaths, any increase in opioid abuse associated with expanded independent prescriptive authority will bias our mortality results downwards. It is therefore noteworthy that we nonetheless find significant reductions in mental-health-related mortality when NPs are allowed to prescribe independently. Second, given concerns about increasing opioid use, states can exclude opioids from the medications that NPs are allowed to prescribe independently. While all eight states that granted independent prescriptive authority to NPs between 2006 and 2014 did so for both legend drugs and controlled substances, it is not uncommon for states to have different scope of practice legislation for controlled and non-controlled substances.

6 Conclusion

Taken together, our results indicate that granting independent prescriptive authority to NPs is an important policy tool that can be used to improve population mental health. In particular, areas with an under-provision of psychiatrists or with populations who find it difficult to access physician-provided care can grant independent prescriptive authority to NPs to help mitigate the negative consequences of physician shortages and extend care to disadvantaged populations.

Policies that increase the number of providers who can prescribe medication may be particularly important in the US, where the supply of physicians has not kept pace with rising demand for health care services. Although the discussions surrounding independent prescriptive authority for NPs focus primarily on shortages of primary care providers who can prescribe medication, we show that these laws also have important implications for mental health. In particular, states that grant independent prescriptive authority to NPs see improvements in self-reported mental health and reductions in the prevalence of mental-health-related deaths, including suicides. Improvements are greatest for individuals who live in areas that are underserved by psychiatrists and among populations who have been shown to have more difficulty accessing physician-provided care.

A back-of-the-envelope calculation suggests that around 410 mental-health-related deaths were averted in underserved counties in 2014 alone by states allowing NPs to prescribe independently (to arrive at this number, we use results from an unweighted regression on only underserved counties). If all states granted NPs independent prescriptive authority, the number of deaths averted yearly in underserved counties would rise to 1,345. In addition, many more lives would be saved among disadvantaged populations who live in counties with adequate mental health resources but who have difficulty accessing physician-provided care. Furthermore, any estimate of deaths averted underestimates the full effect of the policy: for every person who commits suicide, there are over a thousand struggling with mental illness (Bureau of Health Workforce, 2016).

It is noteworthy that we observe a consistent pattern of effects despite using two very different measures of mental health. Self-reported "days in poor mental health" allows us to examine whether populations suffering from mental illnesses of varying severity, including minor mental

illness, notice improvements when NPs are allowed to prescribe. On the other hand, mental-health-related mortality allows us to examine whether populations suffering from very severe mental illnesses—that is, mental illness that may result in death—see improvements when independent prescriptive authority is extended beyond physicians. Even if extending prescriptive authority to NPs impacts one of these outcomes, it is not clear ex ante that prescriptive authority should also impact the other. In particular, since suicides and other deaths caused by poor mental health are relatively rare, it is possible that population mental health could improve without measurable effects on such extreme outcomes. The consistency of our results across these two categories of outcome measures indicates that prescriptive authority for NPs is associated with improved mental health across a spectrum of severity.

When independent prescriptive authority is extended to NPs, all NPs, not just those who specialize in mental health, have the statutory authority to prescribe. Just like physicians, however, some NPs specialize in psychiatric medicine. Psychiatric NPs with prescriptive authority traditionally provide psychotherapy in addition to psychotropic treatment, in contrast to the current movement among psychiatrists to only prescribe medications. It is therefore possible that the improvements in mental health that we observe are at least partly driven by an increase in "full-service" mental health providers—that is, specialists that provide both psychotherapy and psychotropic treatment. However, it is also possible that our results are driven by an increase in the overall supply of general practitioners who can prescribe. It remains an open question whether extending independent prescriptive authority to NPs results in improved mental health because such laws increase the number of general health care providers who can prescribe psychotropic treatment or because they increase the number of providers who provide psychotherapy in conjunction with psychotropic treatment. Answering this question is a promising area for future research.

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A Supplementary Tables and Figures

Table A.1: Correlates of Law Changes Granting Independent Prescriptive Authority

County-level outcomes	Unemployment Rates		No. Psychiatrists		No. PC MDs/DOs	
	(1)	(2)	(3)	(4)	(5)	(6)
Indep. prescriptive authority	-0.000	-0.000	0.838	0.713	-3.286	7.668
	(0.002)	(0.002)	(2.804)	(3.525)	(21.090)	(24.454)
Indep. Rx * underserved		0.000		0.500		-43.506**
		(0.002)		(3.719)		(19.418)
Observations	313,400	313,400	313,400	313,400	313,400	313,400
R^2	0.850	0.850	0.996	0.996	0.995	0.995
Mean dependent variable	0.06	0.06	157.81	157.81	1,113.17	1,113.17
F-test: $\beta_1 + \beta_2 = 0$		0.94		0.57		0.02
Individual-level outcomes	General Health		Insured			
	(1)	(2)	(3)	(4)		
Indep. prescriptive authority	-0.010	-0.009	0.007	0.007		
	(0.006)	(0.007)	(0.006)	(0.004)		
Indep. Rx * underserved		-0.002		0.001		
		(0.008)		(0.014)		
Observations	6,525,178	6,525,178	6,545,759	6,545,759		
R^2	0.009	0.009	0.015	0.015		
Mean dependent variable	2.44	2.44	0.85	0.85		
F-test: $\beta_1 + \beta_2 = 0$		0.22		0.13		

Notes: In the top panel, observations are at the county-quarter level and are population weighted; in the bottom panel, observations are at the individual level and are weighted using BRFSS sample weights. Regressions in the top panel include county, quarter, and year fixed effects and control for total population; regressions in the bottom panel include state and year fixed effects and demographic controls. Standard errors are clustered by state in all regressions.

Table A.2: Summary Statistics: County-Level Mortality and Controls by Mental Health Care Resources, 1990–2014

	All	Never Indep. Rx			Ever Indep. Rx		
		All	Not Underserved	Underserved	All	Not Underserved	Underserved
Deaths per 100,000:							
Suicides	3.32	3.10	2.97	3.53	4.15	4.17	4.10
Mental-health-related deaths	5.54	5.32	5.19	5.77	6.34	6.37	6.22
Indep. prescriptive authority	0.13	0.00	0.00	0.00	0.62	0.64	0.55
Low psychiatrist-to-pop. ratio	0.23	0.23	0.00	1.00	0.25	0.00	1.00
Total population	1,039,119	1,172,967	1,489,585	105,226	549,985	705,381	73,759
Population density (per mile^2)	2,095	2,469	3,138	216	728	929	111
Median household income	54,016	53,882	56,250	45,898	54,504	55,987	49,960
Percent unemployed	0.06	0.06	0.06	0.06	0.06	0.06	0.05
Percent male	0.49	0.49	0.49	0.49	0.49	0.49	0.50
Percent black	0.12	0.14	0.15	0.11	0.06	0.08	0.02
Percent middle aged	0.13	0.13	0.13	0.13	0.13	0.13	0.14
Percent 18 and under	0.25	0.25	0.25	0.25	0.25	0.25	0.26
Percent high school or less	0.47	0.48	0.45	0.57	0.43	0.41	0.51
Percent college or more	0.25	0.25	0.28	0.17	0.26	0.29	0.19
Psychiatrists per 100,000	11.88	12.15	15.00	2.56	10.91	13.60	2.67
Primary care MDs/DOs per 100,000	96.02	96.60	108.87	55.21	93.90	104.67	60.91
Observations	313,400	215,500	64,100	151,400	97,900	28,000	69,900

Notes: Observations are at the county-quarter level. Statistics are weighted by population. "Mental-Health-Related Deaths" include suicides, deaths of unknown intent, and accidental deaths involving firearms, trains, and poisonings. "Ever (Never) Indep. Rx" includes counties that had independent prescriptive authority for NPs at some point (at no point) during our sample. "Indep. prescriptive authority" reflects whether a county allowed NPs independent prescriptive authority in a given year. "Low psychiatrist-to-pop. ratio" reflects whether a county was underserved for mental health care services in 1990. Mortality statistics come from the U.S. Mortality Files, provider counts come from the HRSA's Area Resource Files, and all other variables come from the 1990, 2000, and 2010 Censuses and the 5-year pooled (2008-2012) American Community Survey (ACS). Census and ACS variables are linearly interpolated at the county-year level.

Table A.3: Summary Statistics: Self-Reported Mental Health and Controls by Mental Health Care Resources, 1993–2015

	All	Never Indep. Rx			Ever Indep. Rx		
		All	Not Underserved	Underserved	All	Not Underserved	Underserved
Days in poor mental health:							
Average	3.36	3.39	3.40	3.38	3.26	3.25	3.27
Percent 0	0.66	0.67	0.65	0.68	0.66	0.65	0.67
Percent >= 21	0.06	0.06	0.06	0.06	0.05	0.05	0.06
Indep. prescriptive authority	0.14	0.00	0.00	0.00	0.67	0.75	0.52
Low psychiatrist-to-pop. ratio	0.38	0.40	0.00	1.00	0.32	0.00	1.00
Male	0.48	0.48	0.48	0.48	0.49	0.49	0.49
White	0.70	0.68	0.67	0.70	0.79	0.76	0.86
Black	0.10	0.11	0.09	0.15	0.05	0.06	0.03
Hispanic	0.13	0.14	0.16	0.10	0.09	0.09	0.07
Health insurance	0.85	0.84	0.86	0.82	0.87	0.86	0.87
Age: 18 to 34	0.31	0.31	0.31	0.32	0.31	0.31	0.31
Age: 35 to 44	0.20	0.20	0.20	0.20	0.19	0.20	0.19
Age: 45 to 54	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Age: 55 to 64	0.13	0.13	0.13	0.13	0.14	0.14	0.14
Age: 65+	0.17	0.17	0.18	0.16	0.17	0.17	0.18
Education: high school or less	0.43	0.44	0.42	0.46	0.40	0.39	0.43
Education: college or more	0.29	0.29	0.30	0.26	0.30	0.31	0.27
Married	0.58	0.57	0.56	0.59	0.59	0.58	0.62
Income: 1st quintile	0.20	0.21	0.20	0.21	0.17	0.16	0.19
Income: 2nd quintile	0.18	0.17	0.17	0.18	0.18	0.18	0.18
Income: 3rd quintile	0.17	0.17	0.17	0.17	0.18	0.18	0.18
Income: 4th quintile	0.18	0.18	0.19	0.17	0.19	0.19	0.19
Income: 5th quintile	0.14	0.14	0.14	0.12	0.14	0.15	0.13
Employment: for wages	0.52	0.52	0.51	0.52	0.53	0.53	0.53
Employment: self-employed	0.08	0.08	0.08	0.08	0.09	0.09	0.09
Employment: out of work 1+ yrs	0.02	0.03	0.03	0.02	0.02	0.02	0.02
Employment: out of work <1 yr	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Employment: homemaker	0.08	0.08	0.07	0.08	0.07	0.07	0.07
Employment: student	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Employment: retired	0.16	0.16	0.17	0.16	0.17	0.17	0.17
Employment: unable to work	0.05	0.05	0.04	0.06	0.04	0.04	0.04
Observations	6,545,759	3,597,102	1,623,212	1,973,890	2,948,657	1,744,799	1,203,858

Notes: Observations are at the individual level. Statistics are weighted using BRFSS sample weights. "Ever (Never) Indep. Rx Authority" includes respondents living in states that had independent prescriptive authority for NPs at some point (at no point) during our sample. "Indep. prescriptive authority" reflects the fraction of respondents living in a state with independent prescriptive authority in the year that he/she responded. "Low psychiatrist-to-pop. ratio" reflects the fraction of respondents living in a state that was underserved for mental health services in 1990. Some categorical variables do not sum to one; the difference reflects the percentage of missings.

Table A.4: Mental-Health-Related Mortality: Full Regression Results

	Suicides			Mental-Health-Related Deaths		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Low Educ.	Full Sample	Full Sample	Low Educ.
Indep. prescriptive authority	0.356	0.941	0.363	-1.872	-0.277	-0.444
	(0.696)	(0.643)	(0.473)	(1.461)	(1.447)	(0.899)
Indep. Rx * underserved		-2.335**	-1.577***		-6.364***	-4.148***
		(0.988)	(0.510)		(1.978)	(1.417)
Total population	0.000***	0.000***		0.000***	0.000***	
	(0.000)	(0.000)		(0.000)	(0.000)	
Total population: low educ.			0.000***			0.000**
			(0.000)			(0.000)
Population density (per mile^2)	-0.001**	-0.001**	0.002***	-0.003***	-0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Percent unemployed	121.460**	121.608**	57.931**	230.099*	230.500*	133.860
	(58.081)	(58.111)	(28.715)	(119.138)	(119.172)	(79.960)
No. of psychiatrists	0.114***	0.114***	0.085***	0.117*	0.117*	0.132***
	(0.038)	(0.038)	(0.024)	(0.070)	(0.070)	(0.037)
No. of primary care MDs/DOs	-0.018**	-0.018**	-0.014***	-0.024**	-0.024**	-0.013
	(0.007)	(0.007)	(0.004)	(0.011)	(0.011)	(0.009)
Percent high school or less	6.063	5.624	-16.984	1.589	0.393	20.222
	(30.419)	(30.329)	(13.920)	(48.239)	(48.067)	(21.907)
Percent in poverty	-25.663**	-25.600**	-11.464**	-36.964*	-36.791*	-12.247
	(11.345)	(11.320)	(5.007)	(20.903)	(20.851)	(11.561)
Median household income	0.001**	0.001**	0.000*	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Median household income^2	-0.000***	-0.000***	-0.000***	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	313,400	313,400	313,388	313,400	313,400	313,388
R^2	0.969	0.969	0.950	0.971	0.971	0.956
Mean dependent variable	28.52	28.52	14.85	51.34	51.34	28.94
F-test: $\beta_1 + \beta_2 = 0$		0.26	0.06		0.01	0.00

Notes: Observations are at the county-quarter level and are population weighted. Standard errors are clustered by state. All regressions include county, quarter, and year fixed effects. "Low Educ." is defined as having a high school degree or less.

Table A.5: Suicides: Subgroup Analysis

	(1) All	(2) Black	(3) Middle Age	(4) Under 18	(5) Low Educ.	(6) Male	(7) Female
Indep. prescriptive authority	0.941	-2.770*	0.277	0.068	0.363	0.594	0.356*
	(0.643)	(1.470)	(0.229)	(0.042)	(0.473)	(0.559)	(0.182)
Indep. Rx * underserved	-2.335**	3.003**	-0.781**	-0.057	-1.577***	-1.552**	-0.751**
	(0.988)	(1.449)	(0.296)	(0.037)	(0.510)	(0.726)	(0.315)
Observations	313,400	310,148	313,400	313,376	313,388	313,400	313,400
R^2	0.969	0.856	0.927	0.696	0.950	0.968	0.915
Mean dependent variable	28.52	5.24	7.53	0.99	14.85	21.88	6.65
F-test: $\beta_1 + \beta_2 = 0$	0.26	0.18	0.09	0.80	0.06	0.29	0.21

Notes: Observations are at the county-quarter level and are population weighted. Standard errors are clustered by state. All regressions include county, quarter, and year fixed effects. Additional controls include total population (or subgroup population), population density, percent unemployed, percent with a high school diploma or less, percent with a college degree or more, a quadratic in median income, and the number of practicing psychiatrists and primary care physicians. "Low Educ." is defined as having a high school degree or less.

Table A.6: Mental-Health-Related Deaths: Subgroup Analysis

	(1) All	(2) Black	(3) Middle Age	(4) Under 18	(5) Low Educ.	(6) Male	(7) Female
Indep. prescriptive authority	-0.277	-2.010	0.249	0.234***	-0.444	-0.342	0.097
	(1.447)	(1.642)	(0.448)	(0.074)	(0.899)	(0.996)	(0.484)
Indep. Rx * underserved	-6.364***	1.559	-1.863***	-0.299***	-4.148***	-4.215***	-2.058***
	(1.978)	(1.707)	(0.497)	(0.110)	(1.417)	(1.390)	(0.592)
Observations	313,400	310,148	313,400	313,376	313,388	313,400	313,400
R^2	0.971	0.925	0.948	0.805	0.956	0.970	0.943
Mean dependent variable	51.34	12.80	14.89	2.14	28.94	38.32	13.02
F-test: $\beta_1 + \beta_2 = 0$	0.01	0.43	0.02	0.60	0.00	0.01	0.00

Notes: Observations are at the county-quarter level and are population weighted. Standard errors are clustered by state. All regressions include county, quarter, and year fixed effects. Additional controls include total population (or subgroup population), population density, percent unemployed, percent with a high school diploma or less, percent with a college degree or more, a quadratic in median income, and the number of practicing psychiatrists and primary care physicians. "Low Educ." is defined as having a high school degree or less.

Table A.7: Mental-Health-Related Mortality: Unweighted Regressions

	Suicides			Mental-Health-Related Deaths		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Low Educ.	Full Sample	Full Sample	Low Educ.
Indep. prescriptive authority	0.051	0.601**	0.196	-0.269	0.960**	0.342
	(0.088)	(0.238)	(0.150)	(0.223)	(0.457)	(0.313)
Indep. Rx * underserved		-0.745***	-0.361**		-1.667***	-0.983***
		(0.278)	(0.160)		(0.525)	(0.351)
Observations	313,400	313,400	313,400	313,400	313,400	313,400
R^2	0.939	0.939	0.891	0.947	0.947	0.916
Mean dependent variable	3.02	3.02	1.83	5.04	5.04	3.19
F-test: $\beta_1 + \beta_2 = 0$		0.06	0.01		0.00	0.00

Notes: Observations are at the county-quarter level and are not population weighted. Standard errors are clustered by state. All regressions include county, quarter, and year fixed effects. Additional controls include total population (or subgroup population), population density, percent unemployed, percent with a high school diploma or less, percent with a college degree or more, a quadratic in median income, and the number of practicing psychiatrists and primary care physicians. "Low Educ." is defined as having a high school degree or less.

Table A.8: Mental-Health-Related Mortality: State-Specific Linear Time Trends

	Suicides			Mental-Health-Related Deaths		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Low Educ.	Full Sample	Full Sample	Low Educ.
Indep. prescriptive authority	-1.581	-1.196	-1.706	-1.813	-0.594	-1.529
	(1.630)	(1.826)	(1.591)	(1.759)	(2.012)	(1.373)
Indep. Rx * underserved		-1.512	-0.565		-4.788**	-2.462*
		(1.245)	(0.773)		(2.186)	(1.257)
Observations	313,400	313,400	313,388	313,400	313,400	313,388
R^2	0.972	0.972	0.953	0.973	0.973	0.960
Mean dependent variable	28.52	28.52	14.85	51.34	51.34	28.94
F-test: $\beta_1 + \beta_2 = 0$		0.07	0.04		0.02	0.00

Notes: Observations are at the county-quarter level and are population weighted. Standard errors are clustered by state. All regressions include county, quarter, and year fixed effects and state-specific linear time trends. Additional controls include total population (or subgroup population), population density, percent unemployed, percent with a high school diploma or less, percent with a college degree or more, a quadratic in median income, and the number of practicing psychiatrists and primary care physicians. "Low Educ." is defined as having a high school degree or less.

Table A.9: Suicides: "Leave Out" Robustness

	(1) ID	(2) NV	(3) UT	(4) CO	(5) WY	(6) NE	(7) NM	(8) ND	(9) MI
Indep. prescriptive authority	0.885	1.023	0.636	0.899	0.933	1.062	0.778	0.985	1.008
	(0.669)	(0.817)	(0.544)	(0.727)	(0.646)	(0.654)	(0.641)	(0.650)	(0.649)
Indep. Rx * underserved	-2.588**	-2.376**	-2.003**	-1.942**	-2.360**	-2.304**	-2.408**	-2.348**	-2.389**
	(1.063)	(0.900)	(0.957)	(0.948)	(0.991)	(0.966)	(1.024)	(1.015)	(0.988)
Observations	309,000	311,700	310,500	307,100	311,100	304,100	310,100	308,100	305,100
R^2	0.969	0.969	0.969	0.969	0.969	0.969	0.969	0.969	0.969
Mean dependent variable	28.63	28.27	28.50	28.70	28.56	28.65	28.62	28.58	28.67
F-test: $\beta_1 + \beta_2 = 0$	0.19	0.27	0.27	0.36	0.25	0.29	0.20	0.27	0.25

	(10) IA	(11) WI	(12) KY	(13) MD	(14) DE	(15) RI	(16) CT	(17) ME	(18) HI
Indep. prescriptive authority	0.930	1.011	0.954	1.281*	0.915	1.065	0.928	0.832	0.952
	(0.649)	(0.694)	(0.664)	(0.710)	(0.654)	(0.648)	(0.652)	(0.665)	(0.666)
Indep. Rx * underserved	-2.372**	-2.363**	-2.260**	-2.612**	-2.340**	-2.486**	-2.345**	-2.346**	-2.354**
	(1.001)	(1.058)	(1.044)	(1.009)	(0.987)	(1.001)	(0.989)	(1.005)	(1.026)
Observations	303,500	306,200	301,400	311,000	313,100	312,900	312,600	311,800	312,900
R^2	0.969	0.969	0.969	0.970	0.969	0.969	0.969	0.969	0.969
Mean dependent variable	28.78	28.89	28.84	28.56	28.56	28.57	28.66	28.62	28.54
F-test: $\beta_1 + \beta_2 = 0$	0.24	0.28	0.31	0.28	0.25	0.25	0.25	0.23	0.25

Notes: Observations are at the county-quarter level and are population weighted. Standard errors are clustered by state. All regressions include county, quarter, and year fixed effects. Additional controls include total population, population density, percent unemployed, percent with a high school diploma or less, percent with a college degree or more, a quadratic in median income, and the number of practicing psychiatrists and primary care physicians.

Table A.10: Mental-Health-Related Deaths: "Leave Out" Robustness

	(1) ID	(2) NV	(3) UT	(4) CO	(5) WY	(6) NE	(7) NM	(8) ND	(9) MI
Indep. prescriptive authority	-0.060	-0.387	-0.504	-0.393	-0.289	-0.027	-0.625	-0.213	-0.103
	(1.520)	(1.711)	(1.422)	(1.619)	(1.455)	(1.474)	(1.458)	(1.457)	(1.481)
Indep. Rx * underserved	-6.734***	-6.189***	-6.122***	-5.711***	-6.415***	-6.532***	-6.444***	-6.495***	-6.693***
	(2.189)	(1.879)	(2.022)	(1.942)	(1.989)	(1.931)	(2.052)	(2.023)	(1.995)
Observations	309,000	311,700	310,500	307,100	311,100	304,100	310,100	308,100	305,100
R^2	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.972
Mean dependent variable	51.55	50.92	51.44	51.73	51.43	51.60	51.51	51.45	51.82
F-test: $\beta_1 + \beta_2 = 0$	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00

	(10) IA	(11) WI	(12) KY	(13) MD	(14) DE	(15) RI	(16) CT	(17) ME	(18) HI
Indep. prescriptive authority	-0.271	-0.691	-0.407	0.741	-0.305	-0.351	-0.277	-0.375	-0.433
	(1.471)	(1.479)	(1.469)	(1.219)	(1.478)	(1.438)	(1.474)	(1.539)	(1.471)
Indep. Rx * underserved	-6.549***	-6.069***	-6.077***	-7.486***	-6.406***	-6.294***	-6.387***	-6.461***	-6.215***
	(2.002)	(2.057)	(2.052)	(1.759)	(1.980)	(2.032)	(1.982)	(2.010)	(2.063)
Observations	303,500	306,200	301,400	311,000	313,100	312,900	312,600	311,800	312,900
R^2	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971	0.971
Mean dependent variable	51.83	52.01	51.92	51.76	51.42	51.44	51.57	51.54	51.41
F-test: $\beta_1 + \beta_2 = 0$	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01

Notes: Observations are at the county-quarter level and are population weighted. Standard errors are clustered by state. All regressions include county, quarter, and year fixed effects. Additional controls include total population, population density, percent unemployed, percent with a high school diploma or less, percent with a college degree or more, a quadratic in median income, and the number of practicing psychiatrists and primary care physicians.

Table A.11: Mental-Health-Related Deaths: No Controls

	Suicides			Mental-Health-Related Deaths		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Low Educ.	Full Sample	Full Sample	Low Educ.
Indep. prescriptive authority	1.466*	1.726*	0.866	-0.898	0.495	-0.279
	(0.811)	(1.008)	(1.283)	(1.755)	(2.112)	(1.867)
Indep. Rx * underserved		-1.031	0.124		-5.533**	-3.848***
		(1.200)	(0.407)		(2.090)	(1.081)
Observations	313,400	313,400	313,388	313,400	313,400	313,388
R^2	0.964	0.964	0.936	0.968	0.968	0.951
Mean dependent variable	28.52	28.52	14.85	51.34	51.34	28.94
F-test: $\beta_1 + \beta_2 = 0$		0.42	0.46		0.00	0.03

Notes: Observations are at the county-quarter level and are population weighted. Standard errors are clustered by state. All regressions include county, quarter, and year fixed effects and control for population.

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Table A.12: Self-Reported Mental Health: Full Regression Results

	Days in Poor Mental Health			21+ Days in Poor Mental Health		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Low Educ.	Full Sample	Full Sample	Low Educ.
Indep. prescriptive authority	-0.170**	-0.118	-0.103	-0.005**	-0.003**	-0.001
	(0.066)	(0.071)	(0.132)	(0.002)	(0.001)	(0.003)
Indep. Rx * underserved		-0.169*	-0.305**		-0.006	-0.012**
		(0.088)	(0.135)		(0.004)	(0.006)
Married	-0.750***	-0.750***	-0.702***	-0.015***	-0.015***	-0.015***
	(0.022)	(0.022)	(0.030)	(0.000)	(0.000)	(0.001)
Married missing	-0.604***	-0.604***	-0.441**	-0.006*	-0.006*	-0.001
	(0.116)	(0.116)	(0.165)	(0.003)	(0.003)	(0.006)
Male	-1.004***	-1.004***	-1.060***	-0.014***	-0.014***	-0.016***
	(0.027)	(0.027)	(0.043)	(0.001)	(0.001)	(0.001)
White	0.173**	0.173**	0.047	-0.001	-0.001	-0.003
	(0.074)	(0.074)	(0.138)	(0.002)	(0.002)	(0.003)
Black	-0.443***	-0.443***	-0.796***	-0.014***	-0.014***	-0.024***
	(0.136)	(0.136)	(0.211)	(0.004)	(0.004)	(0.005)
Race missing	0.232*	0.232*	0.215	0.009**	0.009**	0.011
	(0.124)	(0.124)	(0.296)	(0.004)	(0.004)	(0.008)
Hispanic	-0.552***	-0.552***	-1.029***	-0.017***	-0.017***	-0.029***
	(0.110)	(0.110)	(0.174)	(0.003)	(0.003)	(0.004)
Hispanic missing	0.074	0.074	0.079	-0.000	-0.000	-0.004
	(0.075)	(0.075)	(0.146)	(0.003)	(0.003)	(0.005)
Age: 18 to 34	0.085**	0.085**	-0.011	-0.011***	-0.011***	-0.013***
	(0.039)	(0.039)	(0.072)	(0.001)	(0.001)	(0.002)
Age: 35 to 44	0.220***	0.220***	0.190***	-0.001	-0.001	-0.001
	(0.031)	(0.031)	(0.065)	(0.001)	(0.001)	(0.002)
Age: 55 to 64	-0.775***	-0.775***	-1.015***	-0.015***	-0.015***	-0.023***
	(0.036)	(0.036)	(0.065)	(0.001)	(0.001)	(0.002)
Age: 65+	-1.880***	-1.880***	-2.337***	-0.037***	-0.037***	-0.051***
	(0.044)	(0.044)	(0.069)	(0.001)	(0.001)	(0.002)
Education: high school or less	0.000	0.000	0.000	0.002***	0.002***	0.000
	(0.021)	(0.021)	(.)	(0.001)	(0.001)	(.)
Education: college or more	-0.595***	-0.595***	0.000	-0.014***	-0.014***	0.000
	(0.020)	(0.020)	(.)	(0.000)	(0.000)	(.)
Income: 1st quintile	1.311***	1.311***	1.164***	0.027***	0.027***	0.024***
	(0.032)	(0.031)	(0.052)	(0.001)	(0.001)	(0.002)
Income: 2st quintile	0.635***	0.635***	0.427***	0.009***	0.009***	0.004***
	(0.019)	(0.019)	(0.025)	(0.001)	(0.001)	(0.001)
Income: 3st quintile	0.308***	0.308***	0.062	0.000	0.000	-0.005***
	(0.032)	(0.032)	(0.040)	(0.001)	(0.001)	(0.001)
Income: 4st quintile	0.018	0.018	-0.202***	-0.006***	-0.006***	-0.011***
	(0.035)	(0.035)	(0.037)	(0.001)	(0.001)	(0.001)
Income: 5st quintile	-0.449***	-0.449***	-0.710***	-0.015***	-0.015***	-0.021***
	(0.046)	(0.046)	(0.073)	(0.001)	(0.001)	(0.002)
Employment: for wages	-0.388***	-0.388***	-0.478***	-0.012***	-0.012***	-0.012**
	(0.084)	(0.084)	(0.110)	(0.004)	(0.004)	(0.006)
Employment: self-employed	-0.276***	-0.276***	-0.302**	-0.008**	-0.008**	-0.006
	(0.095)	(0.095)	(0.142)	(0.004)	(0.004)	(0.006)
Employment: out of work 1+ yrs	2.430***	2.431***	2.342***	0.062***	0.062***	0.065***
	(0.108)	(0.108)	(0.146)	(0.004)	(0.004)	(0.007)
Employment: out of work <1 yr	1.558***	1.558***	1.471***	0.034***	0.034***	0.036***
	(0.120)	(0.120)	(0.136)	(0.004)	(0.004)	(0.006)
Employment: homemaker	-0.215**	-0.215**	-0.079	-0.004	-0.004	0.003
	(0.083)	(0.083)	(0.137)	(0.003)	(0.003)	(0.005)
Employment: student	-0.208**	-0.208**	-0.437***	-0.020***	-0.020***	-0.022***
	(0.103)	(0.103)	(0.130)	(0.004)	(0.004)	(0.006)
Employment: retired	0.049	0.049	0.173	0.003	0.003	0.009*
	(0.075)	(0.075)	(0.115)	(0.003)	(0.003)	(0.005)
Employment: unable to work	6.868***	6.868***	6.448***	0.183***	0.183***	0.174***
	(0.131)	(0.131)	(0.168)	(0.005)	(0.005)	(0.007)
Health insurance	-0.487***	-0.487***	-0.372***	-0.013***	-0.013***	-0.011***
	(0.040)	(0.040)	(0.050)	(0.001)	(0.001)	(0.001)
Health insurance missing	-0.892***	-0.892***	-0.849***	-0.019***	-0.019***	-0.019***
	(0.150)	(0.150)	(0.219)	(0.004)	(0.004)	(0.005)
Observations	6,540,521	6,540,521	2,606,231	6,540,521	6,540,521	2,606,231
R^2	0.083	0.083	0.083	0.052	0.052	0.052
Mean dependent variable	3.36	3.36	3.91	0.06	0.06	0.07
F-test: $\beta_1 + \beta_2 = 0$		0.00	0.00		0.05	0.01

Notes: Observations are at the individual level with BRFSS sample weights. Standard errors are clustered by state. All regressions include state and year fixed effects. "Low Educ." is defined as having a high school degree, less than a high school degree, or missing education information. For both income and education, the omitted category is a dummy equal to one if the relevant information is missing and zero otherwise.

Table A.13: Days in Poor Mental Health: Subgroup Analysis

	(1) All	(2) Black	(3) Middle Age	(4) Low Educ.	(5) Low Inc.	(6) Male	(7) Female
Indep. prescriptive authority	-0.118	0.018	-0.293***	-0.103	-0.189	-0.110*	-0.125
	(0.071)	(0.112)	(0.105)	(0.132)	(0.181)	(0.059)	(0.101)
Indep. Rx * underserved	-0.169*	-0.614***	0.012	-0.305**	-0.070	-0.106	-0.232
	(0.088)	(0.120)	(0.107)	(0.135)	(0.183)	(0.072)	(0.146)
Observations	6,540,521	515,582	1,221,434	2,606,231	2,275,392	2,599,150	3,941,371
R^2	0.083	0.068	0.134	0.083	0.097	0.080	0.080
Mean dependent variable	3.36	3.81	3.70	3.91	4.39	2.80	3.89
F-test: $\beta_1 + \beta_2 = 0$	0.00	0.00	0.00	0.00	0.06	0.00	0.01

Notes: Observations are at the individual level with BRFSS sample weights. Standard errors are clustered by state. All regressions include state and year fixed effects. Additional controls include dummies for whether the respondent is male, white, black, Hispanic, married, has health insurance, and their employment status. Dummies for age groups, education groups, and income quintiles are also included. "Low Educ." is defined as having a high school degree, less than a high school degree, or missing education information. "Low Inc." is defined as being in the bottom two quintiles of income.

Table A.14: 21+ Days in Poor Mental Health: Subgroup Analysis

	(1) All	(2) Black	(3) Middle Age	(4) Low Educ.	(5) Low Inc.	(6) Male	(7) Female
Indep. prescriptive authority	-0.003**	0.000	-0.009***	-0.001	-0.005	-0.003**	-0.003
	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)	(0.001)	(0.002)
Indep. Rx * underserved	-0.006	-0.016***	-0.001	-0.012**	-0.004	-0.004	-0.008
	(0.004)	(0.004)	(0.005)	(0.006)	(0.005)	(0.003)	(0.006)
Observations	6,540,521	515,582	1,221,434	2,606,231	2,275,392	2,599,150	3,941,371
R^2	0.052	0.039	0.091	0.052	0.062	0.052	0.051
Mean dependent variable	0.06	0.07	0.07	0.07	0.08	0.05	0.07
F-test: $\beta_1 + \beta_2 = 0$	0.05	0.00	0.01	0.01	0.11	0.02	0.07

Notes: Observations are at the individual level with BRFSS sample weights. Standard errors are clustered by state. All regressions include state and year fixed effects. Additional controls include dummies for whether the respondent is male, white, black, Hispanic, married, has health insurance, and their employment status. Dummies for age groups, education groups, and income quintiles are also included. "Low Educ." is defined as having a high school degree, less than a high school degree, or missing education information. "Low Inc." is defined as being in the bottom two quintiles of income.

Table A.15: Days in Poor Mental Health: "Leave Out" Robustness

	(1) ID	(2) NV	(3) UT	(4) CO	(5) WY	(6) NE	(7) NM	(8) ND	(9) MI
Indep. prescriptive authority	-0.118	-0.080	-0.119	-0.086	-0.118	-0.119	-0.117	-0.118	-0.123*
	(0.071)	(0.068)	(0.071)	(0.086)	(0.071)	(0.071)	(0.071)	(0.071)	(0.072)
Indep. Rx * underserved	-0.217**	-0.209**	-0.168*	-0.202**	-0.169*	-0.178*	-0.169*	-0.188**	-0.169*
	(0.085)	(0.086)	(0.088)	(0.099)	(0.088)	(0.094)	(0.089)	(0.090)	(0.089)
Observations	6,430,612	6,471,578	6,398,983	6,387,373	6,443,881	6,329,702	6,420,995	6,459,761	6,405,519
R^2	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Mean dependent variable	3.36	3.36	3.36	3.37	3.36	3.37	3.36	3.36	3.35
F-test: $\beta_1 + \beta_2 = 0$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	(10) IA	(11) WI	(12) KY	(13) MD	(14) DE	(15) RI	(16) CT	(17) ME	(18) HI
Indep. prescriptive authority	-0.119	-0.131*	-0.119	-0.143	-0.117	-0.120	-0.116	-0.149**	-0.117
	(0.071)	(0.073)	(0.072)	(0.088)	(0.071)	(0.072)	(0.071)	(0.065)	(0.075)
Indep. Rx * underserved	-0.168*	-0.155*	-0.104	-0.142	-0.170*	-0.166*	-0.168*	-0.137	-0.169*
	(0.088)	(0.090)	(0.080)	(0.103)	(0.089)	(0.090)	(0.089)	(0.085)	(0.092)
Observations	6,427,817	6,448,936	6,384,413	6,380,399	6,462,560	6,445,858	6,419,326	6,431,572	6,428,946
R^2	0.083	0.083	0.083	0.084	0.083	0.083	0.083	0.083	0.083
Mean dependent variable	3.37	3.37	3.35	3.37	3.36	3.36	3.37	3.36	3.37
F-test: $\beta_1 + \beta_2 = 0$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: Observations are at the individual level with BRFSS sample weights. Standard errors are clustered by state. Additional controls include dummies for whether the respondent is male, white, black, Hispanic, married, has health insurance, and their employment status. Dummies for age groups, education groups, and income quintiles are also included.

Table A.16: 21+ Days in Poor Mental Health: "Leave Out" Robustness

	(1) ID	(2) NV	(3) UT	(4) CO	(5) WY	(6) NE	(7) NM	(8) ND	(9) MI
Indep. prescriptive authority	-0.003**	-0.003**	-0.003**	-0.002	-0.003**	-0.003**	-0.003**	-0.003**	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Indep. Rx * underserved	-0.008	-0.006	-0.006	-0.007	-0.006	-0.006	-0.006	-0.007	-0.006
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
Observations	6,430,612	6,471,578	6,398,983	6,387,373	6,443,881	6,329,702	6,420,995	6,459,761	6,405,519
R^2	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Mean dependent variable	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
F-test: $\beta_1 + \beta_2 = 0$	0.03	0.05	0.05	0.04	0.05	0.07	0.05	0.04	0.05

	(10) IA	(11) WI	(12) KY	(13) MD	(14) DE	(15) RI	(16) CT	(17) ME	(18) HI
Indep. prescriptive authority	-0.003**	-0.003**	-0.003**	-0.003**	-0.003**	-0.003**	-0.003**	-0.003***	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Indep. Rx * underserved	-0.006	-0.006	-0.001	-0.006	-0.006	-0.006	-0.006	-0.005	-0.006
	(0.004)	(0.004)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	6,427,817	6,448,936	6,384,413	6,380,399	6,462,560	6,445,858	6,419,326	6,431,572	6,428,946
R^2	0.052	0.052	0.051	0.052	0.052	0.052	0.052	0.052	0.052
Mean dependent variable	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
F-test: $\beta_1 + \beta_2 = 0$	0.05	0.05	0.01	0.05	0.05	0.05	0.05	0.05	0.05

Notes: Observations are at the individual level with BRFSS sample weights. Standard errors are clustered by state. Additional controls include dummies for whether the respondent is male, white, black, Hispanic, married, has health insurance, and their employment status. Dummies for age groups, education groups, and income quintiles are also included.

Table A.17: Self-Reported Mental Health: State-Specific Linear Time Trends

	Days in Poor Mental Health			21+ Days in Poor Mental Health		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Low Educ.	Full Sample	Full Sample	Low Educ.
Indep. prescriptive authority	0.010	-0.036	0.076	0.000	-0.001	0.001
	(0.111)	(0.157)	(0.172)	(0.002)	(0.002)	(0.002)
Indep. Rx * underserved		0.126	-0.068		0.003	-0.003
		(0.189)	(0.241)		(0.003)	(0.004)
Observations	6,540,521	6,540,521	2,606,231	6,540,521	6,540,521	2,606,231
R^2	0.084	0.084	0.083	0.053	0.053	0.053
Mean dependent variable	3.36	3.36	3.91	0.06	0.06	0.07
F-test: $\beta_1 + \beta_2 = 0$		0.42	0.96		0.35	0.73

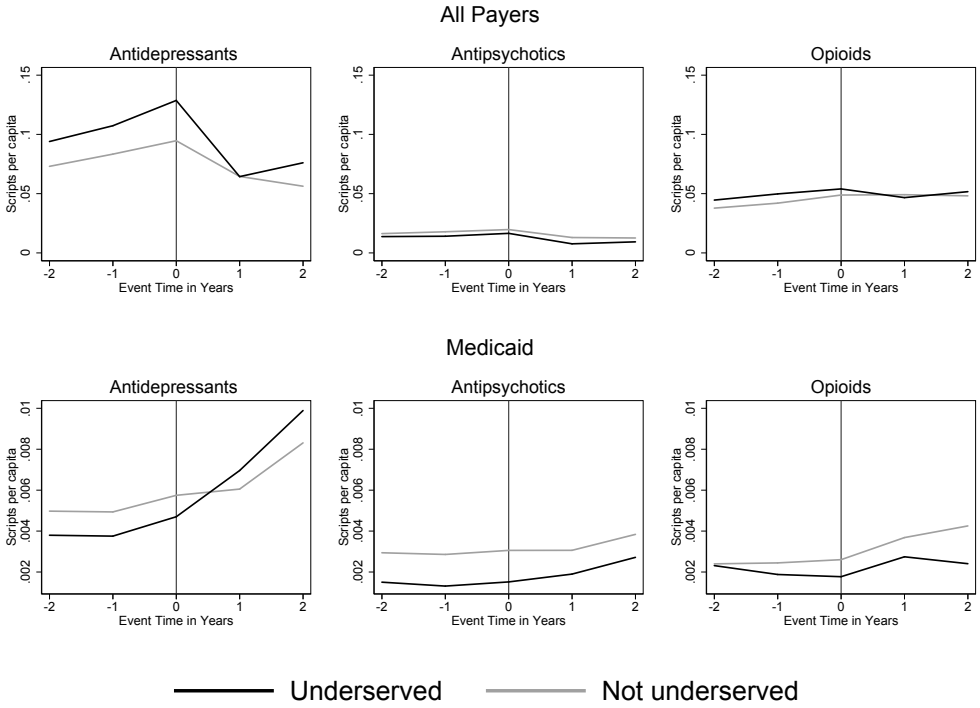
Notes: Observations are at the individual level with BRFSS sample weights. Standard errors are clustered by state. All regressions include state and year fixed effects and state-specific linear time trends. Additional controls include dummies for whether the respondent is male, white, black, Hispanic, married, has health insurance, and their employment status. Dummies for age groups, education groups, and income quintiles are also included. "Low Educ." is defined as having a high school degree, less than a high school degree, or missing education information.

Table A.18: Self-Reported Mental Health: No Controls

	Days in Poor Mental Health			21+ Days in Poor Mental Health		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Low Educ.	Full Sample	Full Sample	Low Educ.
Indep. prescriptive authority	-0.247***	-0.206**	-0.211	-0.007***	-0.005***	-0.004
	(0.077)	(0.088)	(0.157)	(0.002)	(0.002)	(0.004)
Indep. Rx * underserved		-0.132	-0.248*		-0.005	-0.011**
		(0.081)	(0.131)		(0.004)	(0.005)
Observations	6,545,759	6,545,759	2,606,851	6,545,759	6,545,759	2,606,851
R^2	0.003	0.003	0.005	0.002	0.002	0.003
Mean dependent variable	3.36	3.36	3.91	0.06	0.06	0.07
F-test: $\beta_1 + \beta_2 = 0$		0.00	0.00		0.01	0.00

Notes: Observations are at the individual level with BRFSS sample weights. Standard errors are clustered by state. All regressions include state and year fixed effects. "Low Educ." is defined as having a high school degree, less than a high school degree, or missing education information.

Figure A.1: Event Time: Independent Prescriptive Authority and Prescriptions Written by NPs



Notes: Observations are at the county-year level and are population weighted. A county is considered "underserved" if the county had fewer than one psychiatrist per 30,000 residents in 1990.