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ABSTRACT

In theory, there are several reasons why physician organizational form might affect the price, quantity, and quality of physician services. In this paper, we examine the association between three aspects of physician organizational form and opioid prescribing: solo versus group practice; integration with a hospital versus independent practice; and the average age of the other physicians in the physician's group. We present three key findings. First, physicians who switch from solo to group practice, particularly large-group practice, significantly reduce their prescribing relative to those who stay in solo practice. Conversely, physicians who switch from group to solo practice significantly increase their prescribing by approximately the same amount. Second, physicians who switch from independent to hospital-integrated practice (and those who switch from integrated to independent practice) generally do not significantly change their prescribing. Third, among group-practice physicians, there are significant differences in prescribing by the average of age of physicians in the group, holding constant the physician's own age and other characteristics of the group, the physician, and the physician's patients. Physicians in groups with a higher average age (excluding the index physician) prescribe more intensively and are more likely to write inappropriate opioid prescriptions than physicians in younger groups – holding other factors constant.

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I. Introduction

Over the last two decades, consolidation in markets for health services has changed the types of organizations in which physicians work. This consolidation has taken two main forms: vertical integration of physicians and hospitals, and horizontal integration of physicians into groups. Ownership of physician practices by hospitals increased across all physician specialties from 2007-2017 (Nikpay, Richards, and Penson 2018). By 2018, more than half of physicians and 72 percent of hospitals were associated with a vertically integrated hospital system (Furukawa et al. 2020). The share of physicians in groups, and the size of groups, has also increased. The proportion of physicians in large groups had started to increase by 2010 (Welch et al. 2013); since then, small groups have consolidated into large groups (Muhlestein and Smith 2016).

In theory, there are several reasons why physician organizational form might affect the price, quantity, and quality of physician services. On one hand, integration may increase efficiency by enhancing coordination across settings of care, expanding the ability of physicians to invest in new technology, increasing monitoring of individual physicians' treatment decisions, and achieving economies of scale (Pope and Birge 1996; McCullough and Snir 2010; Post, Buchmueller, and Ryan 2018). On the other hand, as several studies (discussed below) demonstrate, larger organizations may also have greater market power, reducing efficiencies generated through competition. Finally, integration with a hospital or membership in a group may affect the composition of a physician's peer group, and in turn affect treatment decisions. For example, physicians in groups may practice with nurse practitioners, competition from whom may lead physicians to prescribe more controlled substances (Currie, Li, and Schnell 2026). Several studies (discussed below) have demonstrated that a physician's peers affect his or her practice patterns. Physicians are more likely to share patients with other physicians in the same group (Geissler, Lubin, and Ericson 2020) and the number and type of physicians with whom a physician shares patients are associated with Medicare utilization (Landon et al. 2018).

Several studies (discussed below) seek to assess empirically the effects of physician organizational form. This work finds that both vertical and horizontal integration are associated with higher market prices. Evidence on the effects of vertical and horizontal integration on quantity and quality is more mixed, and research on peer effects is more recent and limited.

In this paper, we examine the association between physician organizational form and a measure of health care use that has not been previously considered in this literature: opioid prescribing. Opioid prescribing has important implications for patients. The volume of prescribed opioids approximately tripled from 1999 to 2015 (Guy et al. 2017), and several indicators suggest that at least some of this expansion in prescribing is medically inappropriate (Baker, Bundorf, and Kessler 2020). Several studies have documented both that variation across physicians exists in opioid prescribing and that patients treated by high-prescribing physicians are more likely to use opioids long term and be diagnosed with opioid use disorder (Barnett et al. 2017; Barnett et al. 2019; Eichmeyer and Zhang 2022; Eichmeyer and Zhang 2023). While researchers have examined individual physician characteristics associated with opioid prescribing behavior (Baker, Kessler and Vaska 2022; Schnell and Currie 2018) and have documented the importance of geographic location in determining opioid prescribing (Finkelstein et al. 2022), we are unaware of any work examining either how the type of organization within which a physician works or the characteristics of a physician's peers affects opioid prescribing.

Previous research suggests several reasons why physician organizational form might affect opioid prescribing. Integration between physicians and a hospital might decrease the cost of monitoring individual physicians' treatment decisions (Post, Buchmueller, and Ryan 2018); integration among physicians might increase consultation with or oversight by peers, and might support other organized processes for increasing patient safety (Casalino et al. 2003). For example, Ketcham, Baker, and MacIsaac (2007) find that physicians in groups are more likely to comply with treatment guidelines and Beaulieu et al. (2023) find that hospital-integrated physicians and physicians in larger groups had modestly higher clinical quality measures.

We match several measures of the intensity and appropriateness of opioid prescribing to Medicare beneficiaries by primary care physicians at the physician level with data on that physician's personal characteristics, organizational form, peers, patient characteristics, and geographic location. We consider one aspect of a physician's peers: their average age. In earlier work, one of us demonstrated a substantial age gradient in opioid prescribing: older physicians prescribe a much greater volume of opioids (Baker, Kessler, and Vaska 2022). In this paper, we focus on how a physician's prescribing changes when the physician changes the type of organization in which the physician works. We isolate the association between changes in prescribing and changes in organizational form and peer age from other characteristics of the physician, the physician's patients, and geographic location.

We present three key findings. First, all else held constant, physicians who switch from solo to group practice, particularly large-group practice, significantly reduce their prescribing relative to those who stay in solo practice. Almost all of this change is on the intensive margin, i.e., on the volume of opioids prescribed conditional on prescribing any opioids rather than the probability of prescribing any opioids. Second, although physicians who are employed by a hospital or practice in a hospital-owned group[1] prescribe fewer opioids than do independent physicians, there is evidence that this difference is due to differences in the other characteristics of physicians and the physicians' patients who are hospital-integrated. Third, a physician's prescribing is significantly associated with the physician's peers' characteristics. Physicians in groups with a higher average age (excluding the index physician) prescribe more intensively and inappropriately than physicians in younger groups – holding constant the physician's own age and other characteristics of the physician, the physician's patients, and geographic location.

The magnitude of our estimates is substantial. Physicians who switched from solo practice in 2014 to a large group practice in 2018 reduced opioid prescribing by 4.25 more days per patient-year than did physicians who remained in solo practice in 2014 and 2018, all else held constant. Evaluated at the solo practice 2014 average of 41.14 days per patient-year, physicians who switched from solo in 2014 to group in 2018 thus reduced their prescribing by approximately 10 percent more than did those who remained solo. Peer effects are even larger. Conditional on being in a group, physicians in groups with an average age of 40-44 prescribe 8.46 fewer days than physicians in groups with an average age of 65+, with a lower confidence interval of 5.35 days – by comparison, larger than the solo to large-group switcher difference of 4.25 days. The magnitudes of our estimated differences in opioid/benzodiazepine overlap, a measure of inappropriate prescribing, are generally larger than those of our estimated differences in days supplied. Our estimates suggest that physician organizational form, and the composition of physicians in the organization in which a physician works, are associated with their opioid prescribing, and in turn, their quality of care.

[1] In the remainder of the paper, we follow the convention in the literature and categorize hospital-employed physicians together with physicians in hospital-owned groups.

The remainder of our paper proceeds in five sections. Section II reviews the large literature on the effects of physician organization (including peer effects) on price, quantity, and quality of care. Section III explains our data and analysis sample in detail. Section IV presents our regression models. Section V presents our results, and Section VI concludes.

II. Previous Literature and Conceptual Framework

A large empirical literature seeks to assess the effects of physician organizational form on the price, quantity, and quality of physician services. This work documents that both vertical and horizontal integration of physicians have led to higher prices for health care services (Baker et al. 2014; Dunn and Shapiro 2014; Neprash et al 2015; Capps, Dranove, and Ody 2018; Baker, Bundorf, and Kessler 2020; Godwin et al. 2021; Hausman and Lavetti 2021; Curto, Sinaiko, and Rosenthal 2022).

Evidence on the effects of vertical and horizontal integration on quantity and quality is more mixed. Studies of the effects of vertical integration generally find no quality benefits (Casalino et al. 2018; Baker et al. 2020; Koch, Wendling, and Wilson 2021; Saghafian et al. 2023), but find increased referrals to lower quality hospitals (Baker, Bundorf, and Kessler 2016), higher Medicare and commercial insurance spending on outpatient services (respectively, Whaley et al. 2021 and Ho et al. 2020), greater use of inappropriate imaging (Young et al. 2021), and a shift from low-cost ambulatory surgery centers to high-cost hospital outpatient departments (Richards, Seward, and Whaley 2022).

Studies of the effects of horizontal integration on quantity and quality, taken together, are inconclusive. In early work, Ketcham, Baker, and MacIsaac (2007) find that patients of group physicians received more intensive treatment and had better health outcomes after heart attack than patients of solo physicians. Along these lines, Dunn and Shapiro (2018) find that cardiologists in more concentrated markets perform more intensive procedures, which leads to fewer readmissions but no significant effect on mortality. In more recent work, Casalino et al. (2018) find that large groups have more readmissions than small groups. (Using the same data sources but examining changes over time rather than cross-sectional relationships, Baker et al. (2020) find no association between group size and Medicare spending or readmission rates.) Zhang et al. (2020) find a negative association between the share of patients served by large groups and Medicare spending. Beaulieu et al. (2023) find a small positive association between group size and process measures of quality (i.e., provision of preventive care and patient experience), but mixed effects on outcomes such as readmission rates or mortality.

The studies of the effect of horizontal integration on quantity and quality have important limitations. For example, Dunn and Shapiro (2018), who study horizontal integration among physicians, do not control for differences in hospital ownership, and none of the other studies of organizational size control for differences in physician market concentration. In light of the mechanical relationship between physician group size and concentration, and the documented opposing effects of group size and concentration on prices (Hausman and Lavetti 2021), the absence of controls for physician market concentration makes the associations between group size and quality in this work difficult to interpret.

Several recent studies have found evidence of peer effects among physicians. Silver (2021) finds that an emergency-department physician working with peers who work faster induce the index physician to work faster, with adverse effects on quality of care. Agha and Zeltzer (2022) find that a physician who receives promotional payments from pharmaceutical manufacturers is more likely to prescribe the promoted drug, an effect which spills over to the physician's peers independent of the peers' receipt of promotional payments. Using clinical registry data from Sweden, Avdic et al. (2023) find that migrating cardiologists' stent choices rapidly adapt to their peers' choices after relocation, but that the quantity of treatment and health outcomes remain largely unchanged despite the change in practice styles. Doyle and Staiger (2025) find that physicians who switch into groups with a greater average treatment intensity immediately increase their individual treatment intensity, but do not have better patient health outcomes.

Our study contributes to the literature on the effects of physician organization by examining a measure of health care use – prescribing. In this context, we propose that the organizations may affect prescribing through the adoption of processes to improve care delivery, such as the development of systems to monitor physician behavior or promote adherence to clinical guidelines. Direct financial incentives are likely to be second order since physicians have few such incentives to prescribe opioids. By 2016, more than 90 percent of prescribed opioids were generic (US FDA 2018), and generic drugmakers do not generally seek to reward physicians for prescribing their products. However, physicians may benefit indirectly from the fees associated with office visits in which patients receive prescriptions. Group practices are likely to dilute the returns to any individual physician from these indirect benefits (Gaynor and Gertler 1995). Groups and hospital-integrated practices may also benefit from economies of scale in the implementation of high-fixed cost interventions which enable physicians to understand and adhere to evidence-based practice protocols.

We focus on opioids which allows us to examine both intensity and appropriateness of prescribing. During the time period we study, physician decision making regarding opioid prescribing was facing rising scrutiny, and organizations such as the Centers for Disease Control (CDC), the Pharmacy Quality Alliance (PQA) and the National Quality Forum (NCF) began to introduce opioid prescribing measures (Shoemaker-Hunt, Sargent, Swan, et al. 2021). Because these guidelines were explicitly targeted toward prescribing, groups may have adopted strategies to achieve these types of metrics. Physician-hospital organizations, in contrast, had fewer direct incentives to focus on this aspect of physician performance.

We also address some of the empirical limitations of prior literature. Our models control for group size, hospital ownership, physician market concentration, and peer characteristics. We identify the coefficients on group size and hospital ownership based on physicians who changed their group size.

III. Data

We begin with all the physicians serving Medicare beneficiaries with full-year Part D coverage in Medicare's Research Identifiable 20% Part D Event (PDE) claims sample in 2014 or 2018. We include physicians serving both traditional Medicare fee-for-service and Medicare Advantage beneficiaries. We match each physician in the sample by NPI to records in the Medicare Provider Practice and Specialty File (MD-PPAS) to obtain the physician's age, gender, and specialty. We examine physicians who were at least 30 years old in 2014 or 2018 with valid gender. We assign a single county of practice to each physician based on the location in the 20% carrier file from which the physician billed the largest volume of charges (Neprash, Chernew, and McWilliams 2017). We assign physicians in our sample to 7 age cohorts: [30,40), [40,45), [45,50), [50,55), [55,60), [60,65) and 65+.

In each year, we attribute patients to physicians based on the share of prescriptions for any drug that each physician prescribed for each patient. Formally, the number of attributed patients of physician i in year t is N_{it}, where

$$N_{it} = \Sigma_j \frac{RX_{ijt}}{RX_{jt}},$$

RX_{ijt} is the number of prescriptions written by physician *i* filled by patient *j* in year *t*, and RX_{jt} is the total number of prescriptions filled by patient *j* in year *t*. We then characterize each physician's patient population by calculating averages of the characteristics of the physicians' attributed patients, weighted by the share of each patient attributed to the physician. Using CMS' Master Beneficiary Summary File (MBSF) data for 2014 and 2018, we calculate the age, gender, race (Black vs non-Black), original Medicare eligibility status (disabled vs aged vs both), current Medicare eligibility status, dually eligible status (12 months of dual coverage or not) and patient health mix of the physician's patients in the year. We use all of the 62 patient health characteristics in the MBSF, which include extremely detailed information on acute, chronic, and mental health conditions.[2] We group patients into different age cohorts (<65, 65-74, 75-84, >84) than the physicians because the distribution of patients is highly skewed to older ages.

We calculate several measures of the intensity and appropriateness of opioid prescribing. For all physicians, we calculate days supplied of opioids per attributed patient; for physicians prescribing at least one opioid, we calculate days supplied per attributed patient and the number of overlapping opioid/benzodiazepine prescriptions per 100 patients receiving an opioid prescription from the physician.[3] We determine which drug claims are for opioids based on National Drug Code (NDC) on the claim and *CDC's Opioid NDC and Oral MME Conversion File*. We exclude prescriptions for buprenorphine because it is mainly prescribed for opioid use disorder rather than for pain.

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[2] See https://resdac.org/cms-data/files/mbsf-27-cc and https://resdac.org/cms-data/files/mbsf-other-conditions for a detailed description.
[3] This is a standard measure of inappropriate prescribing because of the danger, especially to older individuals, of concomitant use of opioids and benzodiazepines (Huang et al. 2016).

To investigate how opioid prescribing varies by group and hospital-integration status and other group characteristics, we assign each physician in each year to a group based on the tax identification number (TIN) the physician uses to bill Medicare. We then aggregate TINs based on the Welch-Bindman method and TINs that share a common legal name in a given hospital referral region (Baker, Bundorf, and Kessler 2018). Similar to county practice location, we assign each physician to the group (if any) that represents the largest volume of charges the physician billed to Medicare in a given year. We categorize physicians as solo or group, and categorize groups as small (2-10 physicians), medium (11-100), or large (> 100). We also calculate the average age of physicians in each group for each group physician as the average age of all the other physicians in the group. We classify physicians as hospital-integrated if more than 90 percent of the individual physician's or group's claims have a place of service that is a hospital or are associated with a hospital outpatient claim (Neprash, Chernew, and McWilliams 2017).

After calculating group and integration status, and other group characteristics, we limit our analysis sample to those physicians who report a specialty of "family practice," "geriatrics" or "internal medicine" (i.e., primary care physicians (PCPs)). Primary care is the most frequently utilized health service and the source of nearly half of all of the opioids prescribed (Eichmeyer and Zhang 2023).

We construct an HHI of physician market concentration in county *c* at year *t* following the method used by Kessler and McClellan (2000), Dunn and Shapiro (2014, 2018), and others:

$$HHI_{ct} = \Sigma_{j\ serving\ county\ c} v_{cjt} \times \Sigma_{zipcode\ k\ served\ by\ j} b_{kjt} \times \Sigma_{j\ serving\ zipcode\ k} a^2{}_{jkt}$$

where *j* and *k* index group and patient zip codes, respectively; a_{jkt} is the share of charges from Medicare patients who live in zip *k* served by group *j*; b_{kjt} is the share of charges from Medicare patients served by group j who live in zip k; and v_{cjt} is the share of office visits (number of claims) from Medicare patients who live in county c served by group j. The b_{kjt}-weighting in HHI_{it} assumes that the characteristics of group j's market depends on the weighted average of all of the zip-code patient residence areas that it serves; the v_{ijt}-weighting defines a county's characteristics as the weighted average of all of the groups that serve patients who live in county c. We calculate the above separately for family practice and internal medicine specialties, and average the two weighted by the number of visits (number of claims) for each in county c in year t (we are not able to calculate an HHI for geriatricians due to the relatively small number of physicians reporting this specialty).

IV. Models

To estimate the association between organizational form and opioid prescribing, holding other factors constant, we specify the following regression model:

$$Y_{ict} = \alpha_c + \beta_t + G_{it}\gamma + H_{it}\delta + A_{it}\theta + GA_{it}\varphi + X_{it}\pi + \epsilon_{ict},$$

where

i, c, t index physicians, practice counties, and years (2014 or 2018), respectively;

Y is days supplied or the proportion of patients with opioid/benzodiazepine overlap;

α is a fixed effect for the county of the physician's practice;

β is a fixed effect for year = 2018;

G is a vector of indicators for group status;

H is a vector of indicators for hospital-integration status;

A is a vector of indicators for physician age;

GA is a vector of indicators for the average age in a physician's group;

X is a vector of physician and patient characteristics; and

ε is an error term.

We divide solo and group physicians (and, analogously, independent and hospital-integrated physicians) into switchers, stayers, leavers, and joiners. We define a switcher as a physician who is present in the sample in both years and changed status from group to solo, solo to group, or among size categories of groups (small (2-10 physicians), medium (11-100 physicians), and large groups (101+ physicians)); a stayer as a physician who is present in the sample in both years and did not change "group status" as described above; a leaver as a physician who was present in the sample in 2014 but not 2018; and a joiner as a physician who was present in the sample in 2018 but not 2014. We separately estimate differences in changes by group status for switchers, stayers, leavers, and joiners by interacting the group status indicator with an indicator for year = 2018.

The model thus categorizes physicians into 24 solo/group size categories: solo, small-, medium-, and large-group switchers observed in 2014 and 2018 (8 categories = 4 * 2 years); solo, small-, medium-, and large-group stayers observed in 2014 and 2018 (8 categories = 4 * 2 years); solo, small- medium-, and large-group joiners (observed in 2018 only, 4 categories); and solo, small-, medium-, and large-group leavers (observed in 2014 only, 4 categories). The base group is solo stayers in 2014 (and, analogously, independent stayers in 2014). The vector *G* thus contains 22 indicators (omitting indicators for the base group and 2018 solo stayers, which would be equal to the year fixed effect). The differences in changes of interest are differences between selected pairs of coefficients. For example, the difference between the coefficient on large group switchers in 2018 and solo switchers in 2014 is the 2014-2018 change in prescribing for physicians who switch from solo to large group, relative to the change in prescribing for solo stayers. The differences in changes of interest are thus identified by a comparison of the prescribing of physicians who switch organizational form versus those who do not.

The model similarly stratifies physicians into 12 hospital integration categories: independent and integrated switchers observed in 2014 and 2018 (4 categories = 2 * 2 years); independent and integrated stayers observed in 2014 and 2018 (4 categories = 2 * 2 years); independent and integrated joiners (in 2018 only, 2 categories); and independent and integrated leavers (in 2014 only, 2 categories). The base group is 2014 independent stayers. The vector *H* thus contains 8 indicators (omitting indicators for the base group; 2018 independent stayers which would be equal to the year fixed effect; and for independent joiners and leavers, because the sum of indicators for independent and integrated joiners (leavers) would be equal to the sum of indicators for joiners (leavers) in *G*). As with *G*, the differences in changes of interest are differences between selected pairs of coefficients. For example, the difference between the coefficient on integrated switchers in 2018 and independent switchers in 2014 is the 2014-2018 change in prescribing for physicians who switch from independent to integrated, relative to the change in prescribing for independent stayers.

V. Results

Table 1 presents the means and standard deviations of the variables in our analysis by year. From 2014 to 2018, both opioid prescribing in general, and inappropriate opioid prescribing in particular, declined. The number of days supplied of opioids per patient-year, the principal measure of opioid prescribing in our analysis, declined from 34.56 to 22.01, or by approximately 36 percent (≈ (34.56 – 22.01) / 34.56); the number of days supplied per patient-year for physicians who prescribed at least one opioid declined from 39.34 to 26.81, or by approximately 32 percent; and the number of overlapping opioid/benzodiazepine prescriptions per 100 opioid-prescribed patient-years declined from 13.29 to 11.92, or by approximately 10 percent. Most of the declines in days supplied occurred on the intensive margin. The share of physicians who prescribed at least one opioid declined from 0.878 (= 34.56 / 39.34) to 0.821 (= 22.01 / 26.81), or approximately 7 percent (≈ (0.878 – 0.821) / 0.878).

The characteristics of physicians and the patients they treated remained roughly constant. For example, physicians became slightly older (from 49.53 to 50.10 years), more female (0.36 to 0.39), and more concentrated (from an HHI of 0.17 to 0.19). Patients became slightly older (from 71.04 to 71.81 years), although less likely to be eligible for Medicaid (dual eligibility declining from 0.28 to 0.26) or for Medicare due to disability (originally or currently).

Table 2 shows how days supplied, days supplied conditional on the prescription of any opioid, and opioid/benzodiazepine overlap differed for physicians with different group statuses. Table 2 does not differentiate by group size among those in group practice. Appendix Table 1 reports the means underlying Table 2, along with the means and standard deviations of the other variables. Appendix Table 1 shows that group and integration status are highly correlated. In 2014, for example, 82 percent of physicians overall practiced in groups (Table 1). In that year, however, 97 percent of integrated stayers were in groups, versus 78 percent of independent stayers. In addition, hospital-ownership switchers are more likely to practice in groups, even before (after) they became integrated (independent). We investigate whether our model is robust to this correlation below. Appendix Table 2 reports the number of stayers and switchers across size categories in order to show the composition of the variation in switchers.

Rows [1] - [4] document that there are large cross-sectional differences in prescribing between group and solo physicians. In 2014, for example, group physicians prescribed 32.89 days versus 42.16 days for solo, resulting in a difference of 9.27 days (standard error 1.12); conditional on any opioid prescribing, group physicians prescribed 37.77 days versus 46.17 days for solo, resulting in a difference of 8.30 days (standard error 1.16). In 2014, overlap was also lower for group versus solo, by 6.92 prescriptions per 100 patients (standard error 0.27). However, these differences do not control for any differences in the physician or patient characteristics of group versus solo practitioners.

The remaining rows of the Table report 2014 to 2018 changes in prescribing. According to the first column, days supplied declined by 20.65 for physicians who switched from solo to group (row [5]). Row [6] shows that solo stayers days supplied declined by 11.06, or 9.59 less than solo-to-group switchers (standard error 1.15). This simple difference-in-changes estimator shows that physicians who switch from solo to group practice reduced their prescribing more than physicians who did not. Row [7] considers the opposite case of physicians who switched from group to solo. These physicians reduced their opioid prescribing by 1.31 days – much less than the average decline in prescribing of 12.55 days (= 34.56 - 22.01, Table 1). Row [8] shows that the group stayers' days supplied declined by 10.94 days, or 9.63 more than group-to-solo switchers (standard error 1.52). This simple difference-in-changes estimator shows that physicians who switch from group to solo practice increase their prescribing relative to group stayers.

The second column replicates these calculations for the 87.8 (82.1) percent of physicians who prescribed at least one opioid in 2014 (2018). Most of the difference in changes in the first column are due to differences in changes on the intensive margin: differences in conditional changes in prescribing in the second column are very similar to the differences in unconditional changes in the first column.

The third column shows that differences in changes in overlap between physicians who switched group status versus physicians who did not are also substantial. Solo-to-group switchers reduced their overlap by 6.70 prescriptions per 100 patients (row [5]), whereas solo stayers reduced their overlap by only 0.37 prescriptions (row [6]) – more than an order of magnitude less. Group-to-solo switchers actually *increased* their overlap by 4.73 prescriptions – remarkably, given the decline in overlap in the sample as a whole (Table 1). Although these differences in changes control for fixed differences in the physician or patient characteristics of solo and group practitioners, they do not control for changes in the physician or patient characteristics of practitioners who change group status, such as geographic area.

Table 3 replicates Table 2, but categorizes physicians by changes in their hospital integration rather than their group status (i.e., substitute "independent" for "solo" and "integrated" for "group"). Appendix Table 3 reports the means underlying Table 3, along with the means and standard deviations of the other variables. Rows [1] - [4] of Table 3 document that there are large cross-sectional differences in prescribing between integrated and independent physicians. In 2014, for example, integrated physicians prescribed 29.45 days versus 35.38 days for independents, resulting in a difference of 5.93 days (standard error 0.91); conditional on any opioid prescribing, integrated physicians prescribed 35.95 days versus 39.84 days for independents, resulting in a difference of 3.89 days (standard error 1.11). Overlap was also lower for integrated versus independent physicians by 5.26 prescriptions per 100 patients (standard error 0.26).

The remaining rows of the Table report 2014 to 2018 changes in these variables. Row [5] shows that days supplied declined by 13.68 for physicians who switched from independent to integrated. Row [6] shows that independent stayers days supplied declined by 11.37, or 2.31 less than independent-to-integrated switchers (standard error 1.16). This simple difference-in-changes estimator shows that physicians who switch from independent to integrated practice reduce their opioid prescribing more than independent stayers. The magnitude of this difference in changes is substantially smaller than the magnitude for solo-to-group switchers versus solo stayers. Rows [7] and [8] consider the opposite case of physicians who switched from integrated to independent. For this subsample, a simple difference-in-changes estimator shows that physicians who switch from integrated to independent practice decrease their opioid prescribing by 0.24 days more than integrated stayers, although this difference in changes is not statistically distinguishable from zero.

Differences in changes in overlap between physicians who did and did not change integration status follow the same pattern. For example, independent-to-integrated switchers reduced their overlap by 2.33 prescriptions, versus independent stayers who reduced their overlap by only 0.66 prescriptions (rows [5] and [6]), for a difference of 1.67 prescriptions per 100 patients (standard error 0.39). Integrated-to-independent switchers increased their overlap by 0.93 prescriptions per 100 patients more than integrated stayers (standard error 0.48), although this difference in changes is not statistically distinguishable from zero at the 5 percent level.

In summary, differences in changes in prescribing of physicians who change group status are greater than differences in changes in prescribing of physicians who change integration status. However, neither of the simple differences-in-changes analyses above control for differences in changes in the characteristics of physicians and their patients, including geographic areas.

Figure 1 presents results from our models to address these concerns. The results in Figure 1 also differentiate by group size as described in the methods section. Appendix Table 4 reports the full regression results underlying Figure 1. Figure 1 presents estimates of the association between 2014-18 changes in group status and changes in days supplied for switchers, relative to changes for solo stayers.[4] These estimates control for county-of-physician-practice fixed effects as well as the characteristics of physicians and their patient populations. The error bars report 95 percent confidence intervals.

Although controlling for changes in physician and patient characteristics reduces the magnitude of the simple differences-in-changes from Table 2, differences in changes in days between group-status switchers and solo stayers are still statistically significant and economically important. The left panel of the Figure reports differences in changes between solo stayers and physicians who switched from smaller groups (or solo) in 2014 to larger groups in 2018. Physicians who switched from solo in 2014 to a large group in 2018 reduced days by 4.25 more than solo stayers, with a confidence interval that excludes zero; physicians who switched from solo to a medium group reduced days by 3.99 more than solo stayers, with a confidence interval that excludes zero. These associations are economically important as well as statistically significant. On a base of solo stayers' 2014 average of 41.14 days (Table 2), physicians who switched from solo in 2014 to a medium or large group in 2018 reduced their days by around 10 percent more than did solo stayers (= 3.99 / 41.14 to 4.25 / 41.14). Physicians who switched

[4] The results in Figure 1 are robust to the exclusion of integration controls. The results in Figure 1 are virtually identical to those in Appendix Figure 1, which is based on the regression model underlying Figure 1 without controls for integration status.

from small groups in 2014 to medium or large groups in 2018 reduced their prescribing by approximately 6 days, whereas physicians who switched from medium to large groups did not change their days statistically significantly.

The right panel of the Figure reports differences in changes in days for physicians who switched in the opposite direction – from larger to smaller groups (or solo). These physicians increased days relative to solo stayers. Physicians who switched from a large group in 2014 to solo in 2018 increased days by 3.52 more than solo stayers, although with a confidence interval that includes zero; physicians who switched from solo to a medium group increased days by a similar amount. Physicians who switched from larger to smaller groups other than solo also increased days, by approximately 3.5 days with confidence intervals that exclude zero. Like physicians who switched from a medium to a large group, physicians who switched from a large to a medium group did not change their days statistically significantly.

Consistent with Table 2, most of this association occurred on the intensive margin. For example, conditional on prescribing at least one opioid, physicians who switched from solo in 2014 to a large group in 2018 reduced days by 4.72 more than solo stayers (= -5.43 – -0.71, not in Figure, see Appendix Table 4) – in percentage terms, by approximately 11 percent (= 4.72 / 44.16, Appendix Table 2) on a base of solo stayers' 2014 average, only slightly larger than the unconditional change of approximately 10 percent discussed above.

To investigate physicians' behavior before and after they changed group status, we created a new analysis sample of physicians who were a) present in 2016 and 2018 (no joiners or leavers from 2016 to 2018) and b) had the same integration status (either integrated or independent) in 2016 and 2018. We categorized physicians based on their group and integration status from 2016 to 2018. We supplemented the analysis sample with 2014, 2015, 2019, and

2020 prescribing data. We estimated models analogous to those underlying Figure 1, but excluding controls for joiners and leavers and for integration-status switchers (because these physicians were absent from the sample) and including time fixed effects and controls for 2014, 2015, 2019, and 2020 based on their group and integration status from 2016 to 2018. Appendix Table 5 reports the results from these models. As in the models underlying Figure 1 in Appendix Table 4, the models in Appendix Table 5 define the base group as solo stayers in 2014, with time fixed effects capturing the trends for solo stayers.

Figures 2a – 2c present results from this analysis. The figures show the 2014 – 2020 time trends in days for physicians who switched from large group to solo (or solo to large group) between 2016 and 2018, and for physicians who remained in a large group from 2014 – 2020. The figures plot days supplied for 2014 and 2015 (the two years before the switcher physicians switched), 2016 and 2018 (the switching period for the switcher physicians), and 2019 and 2020 (the two years after the switcher physicians switched). The coefficients and standard errors underlying the figures appear directly in Appendix Table 5. For example, Figure 2a shows SoloSwit X 2014, SoloSwit X 2015, SoloSwit X 2016, LgSwit X 2018, LgSwit X 2019, LgSwit X 2020. Pre- and post-trends for every other group status switcher/stayer pair, and for the other two dependent variables, are also reported in Appendix Table 5.

Figures 2a – 2b show that the difference in changes in days between switchers and solo stayers a) is not preceded by pre-switch trends in days moving in the same direction as the estimate and b) persists for at least two years after the switch occurs. According to Figure 2a, in the two years before switching, physicians who switched from solo were statistically indistinguishable from solo stayers (the base group): their estimated coefficient on days for 2014 and 2015 was small in magnitude and statistically indistinguishable from zero. In 2016, the first year of these physicians' switching period, their estimated coefficient on days was -1.93, with a confidence interval that includes zero.[5] In 2018, the last year of these physicians' switching period, their estimated coefficient was -2.91, with a confidence interval that excludes zero. In the two years after switching, physicians who switched to large groups continued to prescribe fewer days than solo stayers – 4.5 to 5.5 fewer days, with confidence intervals that exclude zero.

Figure 2b is analogous to Figure 2a, but for physicians who switched from large group to solo. According to Figure 2b, in the two years before switching, physicians who switched from large group to solo prescribed fewer days than solo stayers and actually reduced their prescribing. During their 2016 – 2018 switching period, their prescribing remained statistically significantly below that of solo stayers by 6.5 – 7 days. In the two years after switching, however, physicians who switched to solo prescribed similarly to that of solo stayers (+/- 1 day), with confidence intervals that include zero.

Figure 2c is analogous to Figures 2a – 2b, but for physicians who were in a large group in 2014 and remained in a large group through 2020. These physicians consistently prescribed fewer days than solo stayers: 4.3 – 5 days fewer from 2014 – 2018 (with confidence intervals that exclude zero), 2.8 – 3.3 days fewer in 2019 – 2020 (with confidence intervals that include zero).

Figure 3 shows that the association between group status and appropriateness are generally (although not always) larger in magnitude than the association between group status and days. As in Figure 1, the left panel of the Figure reports differences in changes in overlap

[5] We classify a physician as a switcher between 2016 and 2018 if the physician's group status changed from 2016 to 2018. As we describe above, we stratify physicians into groups based on the TIN that represents the largest volume of charges that the physician billed to Medicare in a given year. For this reason, some physicians classified as a switcher between 2016 and 2018 may have a 2016 group status that does not reflect their true group status for all of 2016. For example, a physician classified as a 2016 solo switcher may have switched to a group in late 2016. Thus some decline in days during the first year of 2016 solo switchers' switching period should not be interpreted as the existence of a pre-trend.

between solo stayers and physicians who switched from smaller groups (or solo) in 2014 to larger groups in 2018. Physicians who switched from solo in 2014 to a large group in 2018 reduced overlap by 3.59 more than solo stayers, with a confidence interval that excludes zero; physicians who switched from solo to small group reduced overlap by 2.72 more than solo stayers, with a confidence interval that excludes zero. On a base of solo stayers' 2014 average overlap of 18.94 (Table 2), physicians who switched from solo in 2014 to a large group in 2018 thus reduced overlap by approximately 19 percent (≈ 3.59 / 18.94) percent more than solo stayers. By comparison to the difference in change in days between solo-to-large-group switchers and solo stayers of approximately 10 percent, the difference in change in appropriateness above is substantial. However, physicians who switched from small groups in 2014 to medium or large groups in 2018 reduced overlap by approximately 1.85 or 1.53 days respectively, which is less in percentage terms than the change in days for physicians who switched from small to medium or large groups (Figure 1).

The right panel of the Figure reports differences in changes in overlap for physicians who switched in the opposite direction – from larger to smaller groups (or solo). These physicians generally increased overlap relative to solo stayers. Physicians who switched from a large group in 2014 to solo in 2018 increased overlap by 2.71 more than solo stayers. On a base of solo stayers' 2014 average overlap of 18.94 (Table 2), physicians who switched from a large group in 2014 to solo in 2018 thus increased overlap by approximately 14 percent (≈ 2.71 / 18.94) percent more than solo stayers. Physicians who switched to small from larger-sized groups increased overlap slightly, although with confidence intervals that include zero; physicians who switched from large to medium groups actually decreased overlap.

To investigate the importance of time-invariant differences in the characteristics of physicians and their patients to our estimates, we reestimated the models underlying Figure 1 and Appendix Table 4 with physician fixed effects; those results are in Appendix Table 6. The coefficients in Appendix Table 6 cannot be compared directly to the coefficients in Appendix Table 4. The model underlying Appendix Table 6 has fewer group size and integration controls than the (full) model underlying Appendix Table 4. All of the joiner, leaver, and stayer controls are perfectly collinear with the physician fixed effects, so the regression coefficients on joiner, leaver, and stayer controls are unidentified. For the same reason, solo stayers cannot serve as the base group for Appendix Table 6. Instead, Appendix Table 6 defines the base group to be large switchers in 2018.

Although the coefficients in Appendix Table 6 cannot be compared directly to the coefficients in Appendix Table 4, the coefficients in Appendix Table 6 can be used to construct differences that are analogous to the differences reported in Figures 1 and 3. Differences in coefficients from Appendix Table 6 are similar in magnitude to the differences reported in Figures 1 and 3, although with larger standard errors. For example, physicians who switched from solo in 2014 to a large group in 2018 reduced days by 2.53 more than solo stayers (standard error 3.19), as compared to an estimate of 4.25 (standard error 1.65) from Figure 1. Physicians who switched from solo in 2014 to a large group in 2018 reduced overlap by 2.7 more than solo stayers (standard error 1.1), as compared to an estimate of 3.59 (standard error 0.50) from Figure 3.

Figure 4 investigates a possible mechanism behind the association between prescribing and group status: the effect of switching group status on the number of prescribing physicians (i.e., the average number of unique NPIs prescribing opioids to a physician's attributed patients) and the number of prescribing practices (i.e., the average number of unique TINs prescribing opioids to a physician's attributed patients). Figure 4 shows that the patients of solo-to-group switchers have no statistically significant change in the number of prescribing physicians, but a statistically significant decrease in the number of prescribing practices. Conversely, the patients of group-to-solo switchers have a statistically significant decline in the number of prescribing physicians, but not the number of prescribing practices. This is inconsistent with the hypothesis that groups obtain their effects (at least in part) by reducing the number of prescribing physicians ("doctor shopping"), which is sometimes hypothesized as a source of inappropriate opioid prescribing. However, it is consistent with the hypothesis that groups obtain their effects (at least in part) by reducing the number of prescribing practices.

Figure 5 presents estimates of the association between 2014-18 changes in hospital integration status and changes in prescribing relative to changes for independent stayers.[6] The left panel of the Figure shows changes for independent-to-integrated switchers; the right panel shows changes for integrated-to-independent switchers. Physicians who switched from independent in 2014 to integrated in 2018 reduced days by 2.0 more than independent stayers, with a confidence interval that includes zero. These switchers also reduced overlap by 1.02 – statistically significantly, although in percentage terms by much less than group-status switchers (compare 7 percent ≈ 1.02 / 14.49 to 19 percent for solo-to-large-group switchers from Figure 3). Physicians who switched from integrated to independent (right panel) show differences in changes of opposite sign and roughly similar magnitudes, although confidence intervals include zero for both unconditional days and overlap.

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[6] The results in Figure 5 are robust to the exclusion of group-size controls. The results in Figure 5 are virtually identical to those in Appendix Figure 2, which is based on the regression model underlying Figure 5 without controls for group status.

Figure 6 presents estimates of the association between days and the third aspect of groups we examine – the age of the group's physicians. The regressions underlying Figure 6 are same as those underlying Figure 1 (see Appendix Table 4). The left panel of Figure 6 reports differences in prescribing by a physician's own age; the right panel reports differences in prescribing by the average age of physicians in each physician's group (excluding the index physician). The left panel shows that opioid prescribing monotonically increases with a physician's own age, with the largest difference between the youngest physicians and everyone else. Physicians aged 30-39 prescribed 8.6 fewer days than did physicians aged 65+ (the base group) – more than the magnitude of the change for physicians who switched from solo to large-group of 4.25 days (Figure 1). The difference between physicians aged 40-64 and those aged 65+ declines with age from age 40 to 64, with physicians aged 60-64 prescribing 0.51 fewer days than physicians aged 65+ (with a confidence interval including zero).

The right panel shows opioid prescribing increases with the average age of a physician's colleagues, although with a less-regular pattern and much larger confidence intervals than it increases with a physician's own age. Nonetheless, the association between the average age of a physician's colleagues and a physician's own prescribing behavior (holding constant own age) is large in magnitude, even at the lower end of the estimated confidence intervals. For example, physicians in groups with an average age of 40-44 prescribe 8.46 fewer days than physicians in groups with an average age of 65+, with a lower confidence interval of 5.35 days – by comparison, larger than the solo to large-group switcher difference of 4.25 days (Figure 1).

Figure 7 replicates Figure 6, but with overlap as the dependent variable. Like days, overlap increases monotonically with a physician's own age (left panel). For the youngest physicians (aged 30-39) versus the oldest physicians (aged 65+), the difference in overlap is approximately the same magnitude as the difference in changes between solo stayers and solo-to-large-group switchers (compare 4.5 less overlap in Figure 7 to 3.59 less overlap in Figure 3). Physicians aged 65+ are outliers in terms of overlap, with every other age group writing economically and statistically significantly fewer overlap prescriptions. Physicians in groups with a lower average age generally have less overlap than physicians in older groups (right panel), although the differences by group-average age are generally smaller than the differences by own age. For older group-average age categories (50-54, 55-59, and 60-64), overlap rates are not statistically distinguishable from those of the oldest group.

Figures 8 and 9 investigate the extent of heterogeneity across geographic locations and types of patients in the association between 2014-18 changes in group status and changes in days. Appendix Table 7 reports the full regression results underlying Figures 8 and 9. Figure 8 presents results for physicians from counties with above-median 2014 levels of days supplied (results for physicians from counties with below-median 2014 levels of days supplied are not reported in any Figure, but are reported in Appendix Table 7). Figure 8 shows that the magnitude of the changes in days for physicians from above-median-prescribing counties are similar to (and well within the confidence intervals of) the magnitude of the changes in days for the full sample (compare Figure 8 to Figure 1). The similarity of the magnitude of the changes in days for physicians from above-median-prescribing counties to the magnitude of changes in days from the full sample is surprising, given that average days supplied in the above-median counties is more than 25 percent larger than the average days supplied in the full sample (compare average days supplied in above-median counties of 35.66, Appendix Table 7, to average days supplied in the full sample of 28.39, Table 1).

Figure 9 presents results for patients in the top decile of opioid prescriptions. The dependent variable of the regression underlying Figure 9 is the number of days prescribed to patients in the top decile of opioid use divided by the total number of each physician's attributed patients, so it measures at the physician level the product of the number of attributed high-use patients and the intensity of use per high-use patient. Figure 9 shows that essentially all of the aggregate change in days of physicians who switched group status comes through changes in days for high-use patients. For example, according to Figure 1, physicians who switched from solo to large group practice reduced days to all patients by 4.25 more than solo stayers, 4.24 of which – more than 99 percent – were from reductions in days to patients in the top decile of opioid use (Figure 9). Results for switchers to other types of groups were similar, if not quite as dramatic. According to Figure 1, physicians who switched from solo to medium group practice reduced days to all patients by 3.99 more than solo stayers, 3.7 of which – approximately 93 percent – were from reductions in days to patients in the top decile.

VI. Conclusion

Understanding how physician organizations affect health care use is a first-order problem in health economics. Over the past 20 years, physicians have transitioned from independent, largely solo practitioners to members of large groups that are integrated with hospitals. Although it is empirically well-established that this transition has led to higher prices for physician services, empirical evidence about its effects on health care use and quality is more mixed. This is not surprising, since changes in physician organizational form have the potential to affect use and quality through many channels, including through peer effects. Previous research shows that physicians are more likely to share patients with other physicians in the same group (Geissler, Lubin, and Ericson 2020) and the number and type of physicians with whom a physician shares patients are associated with Medicare utilization (Landon et al. 2018).

In this paper, we examine how three key features of physician organizations – group status and size, whether the physician is employed by or in a practice owned by a hospital or health system, and the average age of the other physicians in a physician's group – are associated with an important component of health care use – opioid prescribing. We construct measures of the intensity and appropriateness of opioid prescribing for approximately 200,000 primary care physicians serving Medicare beneficiaries (including enrollees in Medicare Advantage) in 2014 and 2018. To this information, we match other physician characteristics (age and gender); the characteristics of each physician's practice setting, including not only the three characteristics above but also the county and concentration (HHI) of the physician's market; and highly detailed characteristics of the physician's patients, including 62 different health characteristics, age, gender, race, and disability status (both current and historical). We assess how prescribing changed among physicians who switched their organizational form between 2014 and 2018, holding constant other characteristics of the physician, the physician's patients, and geographic location.

We present three main findings. First, group physicians prescribe fewer days of opioids per patient-year than solo physicians, and prescribe them more appropriately, holding all else constant. For example, physicians who switched from solo practice in 2014 to a large group in 2018 reduced opioid prescribing by 4.25 more days per patient-year than did physicians who remained in solo practice in 2014 and 2018, holding other factors constant (Figure 1). Evaluated at the solo practice 2014 average of 41.14 days per patient-year (Appendix Table 2), this amounts to a reduction of approximately 10 percent. The magnitudes of differences in changes in opioid/benzodiazepine overlap, a standard measure of inappropriate prescribing, are generally larger than those in days supplied. Physicians who switched from solo practice in 2014 to a large group in 2018 reduced the number of overlapping opioid/benzodiazepine prescriptions per 100 patient-years by 3.59 more, all else held constant (Figure 3), amounting to a reduction of 19 percent.

Changes in prescribing were generally larger for physicians who switched between solo and group practice than for physicians who switched between similarly-sized groups. For example, solo-to-large (101+ physicians) and solo-to-medium (11-100 physicians) switchers and their reverse analogues have larger changes on days than switchers among groups, although small-to-large and small-to-medium group switchers and their reverse analogues' changes in days are nonetheless statistically distinguishable from those of solo stayers (the comparison group). The estimated effects of medium-to-large and large-to-medium group switchers are small and statistically insignificant.

Second, although there are statistically significant raw differences in levels of prescribing between independent and hospital-integrated physicians, raw differences in changes in prescribing between hospital-integration switchers and stayers are much smaller than the raw differences in levels. Physicians who switch from independent to integrated reduce days by 2.31 more than independent stayers, versus a 2014 difference in levels between integrated and independent stayers of 7.19 days (Table 3). Moreover, confidence intervals around changes in prescribing for independent-to-integrated switchers (and the reverse), controlling for geography and physician and patient characteristics, generally include zero (Figure 5).

Third, there are substantial differences in prescribing by the age of a physician's peers. Consistent with earlier work, we find large differences by a physician's *own* age on the volume and appropriateness of opioid prescribing: older physicians prescribe more opioids and are more likely to have patients with opioid/benzodiazepine overlap. Differences between physicians aged 30-39 and those aged 65+ are of a larger magnitude than that of the difference between solo-to-large-group switchers and solo stayers. This is not surprising in light of research (reviewed in Baker, Kessler, and Vaska (2022)) that finds that older physicians are less likely to follow current standards of care and more likely to use low-value services than their younger counterparts.

Here, we extend Baker, Kessler, and Vaska (2022) to test the hypothesis that the association between opioid prescribing and individual physician age spills over to other physicians in the same group. We find that physicians in groups with older colleagues prescribe more opioids, and prescribe them less appropriately, than physicians in groups with younger colleagues – after holding constant the physician's own age. Differences by peer age are less-precisely estimated than differences by own age or group status. Conditional on being in a group, physicians in groups with an average age of 40-44 prescribed 8.46 fewer days, versus physicians in groups with an average age of 65+, holding all else constant (including the index physician's own age).

Our paper has several limitations. Because our research design is observational in nature, we cannot rule out the possibility that physicians who switch from solo to group, or group to solo, would have prescribed differently due to unobservable characteristics that caused them to switch. We conduct two analyses to investigate this possibility. We conduct a standard pre-trend analysis of large-group-to-solo switchers, which shows no pre-switch decline in days but does show a persistent post-switch decline (Figure 2a). In addition, we reestimate our models with physician fixed effects, which yields estimates of the difference in changes in prescribing similar in magnitude to (although with larger standard errors than) estimates from our models without physician fixed effects. In addition, groups with older physicians may differ in dimensions (other than physician gender, geographic location, market competitiveness, size, hospital-integration status, and patient characteristics, for which we control) that we do not observe but are correlated with opioid prescribing. Finally, we do not identify the effect of prescribing behavior on health outcomes, so our conclusion about appropriateness is based on intermediate endpoints only. Future work might further explore how peer effects other than age affect not only opioid prescribing but also other measures of quality of care, including health outcomes.

Our research provides important insights for understanding how the structure of physician organizations influences quality of care. The movement of physicians into group practice is more strongly associated with prescribing behavior than vertical integration with hospitals. This is consistent with previous research, which suggests that group practice more strongly promotes the use of organizational mechanisms to improve care quality than does hospital integration. In particular, our research contributes to the literature documenting differences in treatment decisions between physicians with different types of peers. Even with this, however, differences in treatment by group status remain after controlling for hospital-integration status and the age of physicians in the group.

Table 1: Means and (Standard Deviations)

Dependent Variables	All	2014	2018
Days Supplied per patient-year	28.39	34.56	22.01
	(63.29)	(67.23)	(58.25)
Days Supplied if Days > 0	33.39	39.34	26.81
	(67.40)	(70.40)	(63.27)
Overlapping opioid/benzo rx	12.64	13.29	11.92
	(17.47)	(17.23)	(17.69)
Physician and Practice Characteristics			
Physician Age	49.81	49.53	50.10
	(11.88)	(11.67)	(12.08)
Physician Gender (Female)	0.38	0.36	0.39
	(0.48)	(0.48)	(0.49)
Practice HHI	0.18	0.17	0.19
	(0.13)	(0.12)	(0.13)
Physician in Group	0.83	0.82	0.85
	(0.37)	(0.38)	(0.36)
Physician is Hospital-Owned	0.14	0.14	0.14
	(0.35)	(0.34)	(0.35)
Patient Characteristics			
Age	71.37	71.00	71.75
	(12.06)	(12.54)	(11.54)
Female	0.60	0.61	0.60
	(0.19)	(0.19)	(0.19)
Black	0.14	0.14	0.14
	(0.22)	(0.22)	(0.22)
Dual Eligible	0.27	0.28	0.26
	(0.25)	(0.25)	(0.24)
Current Eligibility = Disabled	0.17	0.18	0.16
	(0.18)	(0.19)	(0.17)
Original Eligibility = Disabled	0.27	0.28	0.26
	(0.21)	(0.22)	(0.21)
Number of physicians	202,939	163,351	157,985
Number of counties	2,304	2,190	2,004

Table 2: Changes in Days Supplied, Days Supplied | Days > 0, and Opioid/Benzo Overlap
Physicians With and Without Changes in Group Status
2014 and 2018

	Days Supplied	Days Supplied If Days > 0	Benzo Overlap
Levels			
2014			
[1] Group	32.89	37.77	11.98
[2] Solo	42.16	46.07	18.90
Difference	-9.27	-8.30	-6.92
	(1.12)	(1.16)	(0.27)
2018			
[3] Group	20.57	25.30	10.71
[4] Solo	30.16	34.83	18.32
Difference	-9.57	-9.53	-7.61
	(0.97)	(1.02)	(0.28)
2014 -> 2018 Changes			
[5] Solo -> Group Switchers	-20.65	-19.71	-6.70
[6] Solo Stayers	-11.06	-9.93	-0.37
Difference	-9.59	-9.78	-6.33
	(1.15)	(1.20)	(0.40)
[7] Group -> Solo Switchers	-1.31	-0.50	4.73
[8] Group Stayers	-10.94	-10.60	-0.60
Difference	9.63	10.10	5.33
	(1.52)	(1.66)	(0.41)

Table 3: Changes in Days Supplied, Days Supplied | Days > 0, and Opioid/Benzo Overlap
Physicians With and Without Changes in Integration Status
2014 and 2018

	Days Supplied	Days Supplied If Days > 0	Benzo Overlap
Levels			
2014			
[1] Integrated	29.45	35.95	8.70
[2] Independent	35.38	39.84	13.96
Difference	-5.93	-3.89	-5.26
	(0.91)	(1.11)	(0.26)
2018			
[3] Integrated	16.86	22.75	7.08
[4] Independent	22.87	27.41	12.64
Difference	-6.01	-4.66	-5.56
	(0.79)	(1.07)	(0.26)
2014 -> 2018 Changes			
[5] Independent -> Integrated Switchers	-13.68	-13.32	-2.33
[6] Independent Stayers	-11.37	-10.90	-0.66
Difference	-2.31	-2.42	-1.67
	(1.16)	(1.44)	(0.39)
[7] Integrated -> Independent Switchers	-10.40	-10.21	-0.36
[8] Integrated Stayers	-10.16	-9.94	-1.29
Difference	-0.24	-0.27	0.93
	(1.41)	(1.65)	(0.48)

Figure 1: Change in Days of Opioids Supplied, 2014-18
Physicians Who Switched Group Status From 2014-18 vs. Solo-Practice Stayers

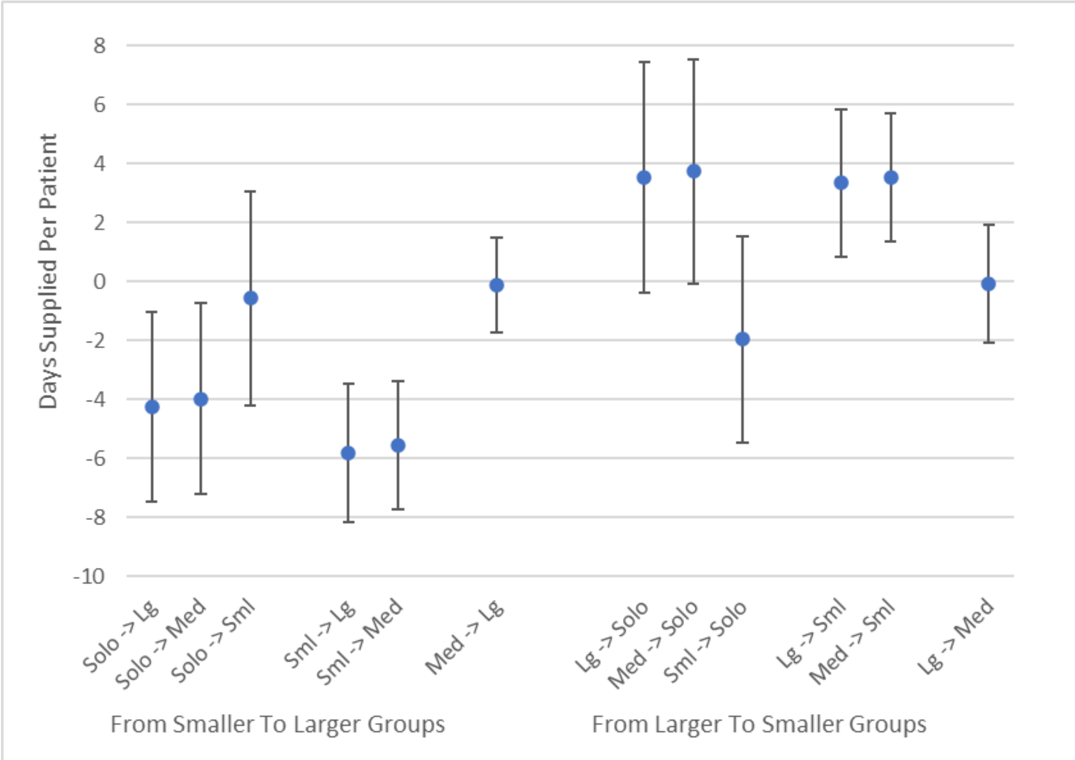


Figure 2a: Days of Opioids Supplied 2014-20, Solo-to-Large-Group Switchers
Physicians Who Switched Group Status From 2016-18

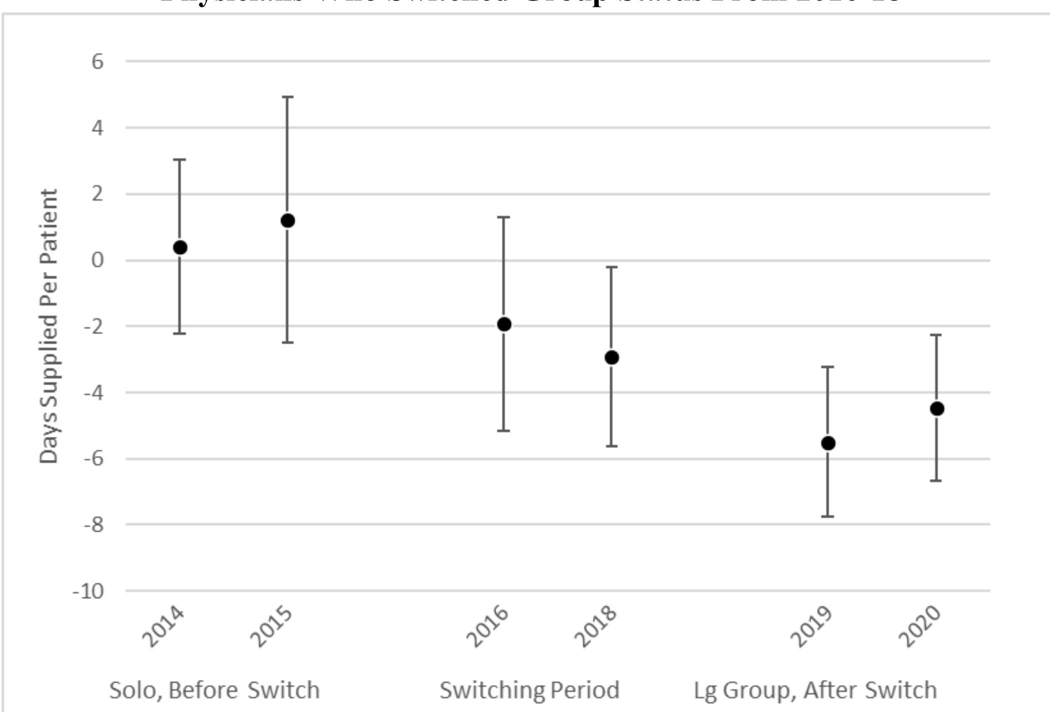


Figure 2b: Days of Opioids Supplied 2014-20, Large-Group-to-Solo Switchers
Physicians Who Switched Group Status From 2016-18

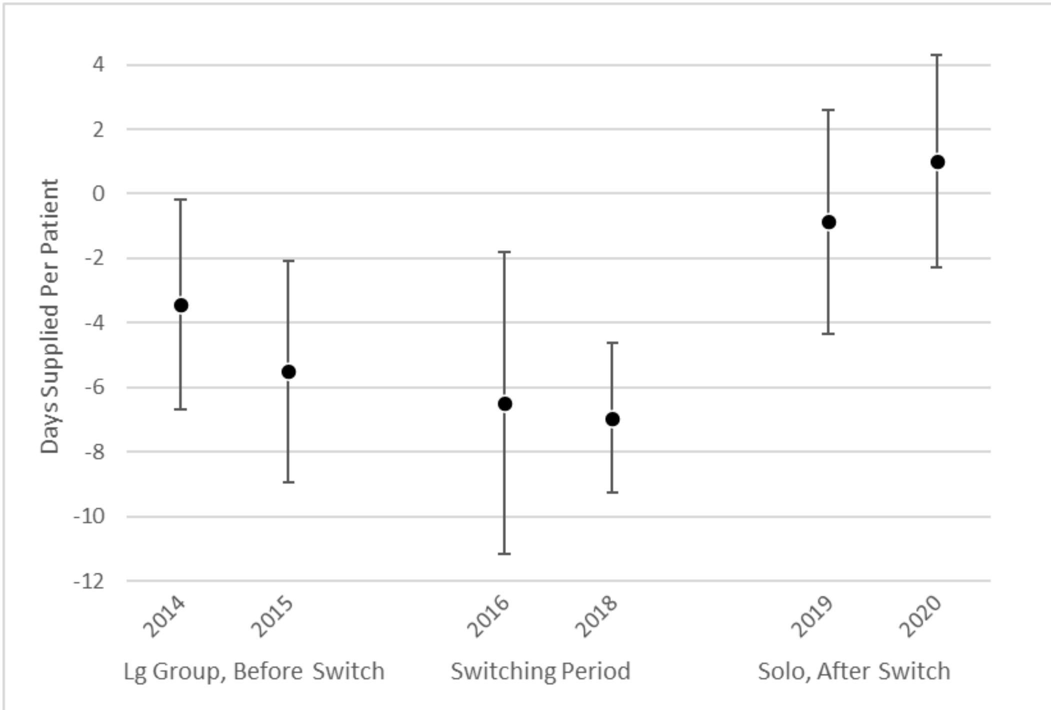


Figure 2c: Days of Opioids Supplied, Large Group Stayers
2014-20

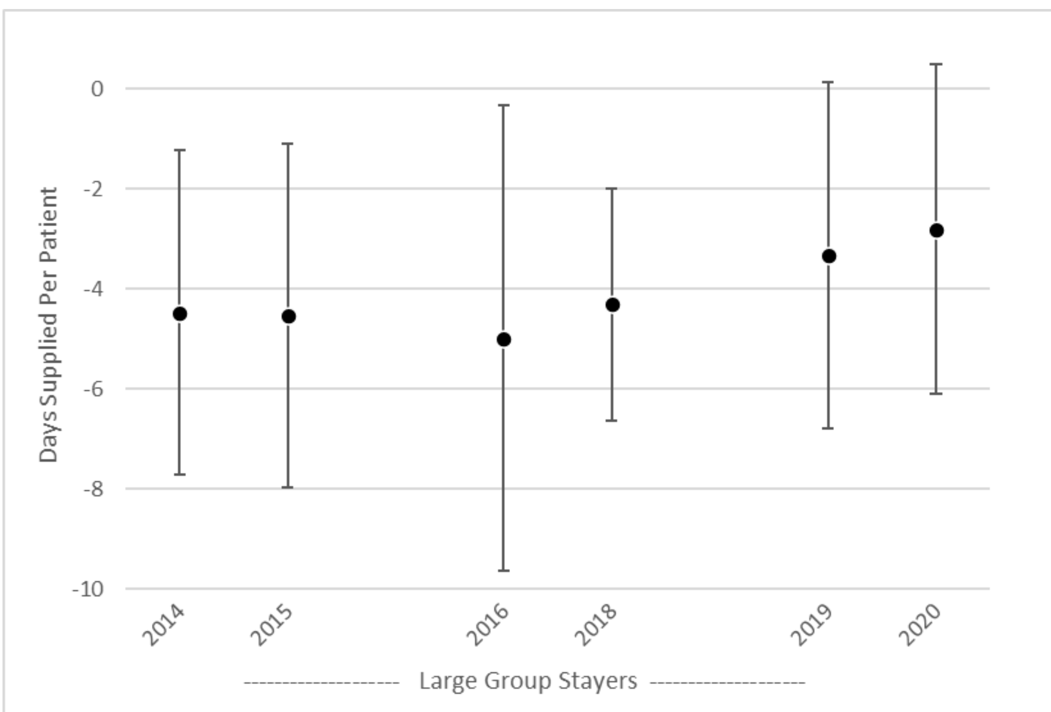


Figure 3: Change in Opioid/Benzo Overlap, 2014-18
Physicians Who Switched Group Status From 2014-18 vs. Solo-Practice Stayers

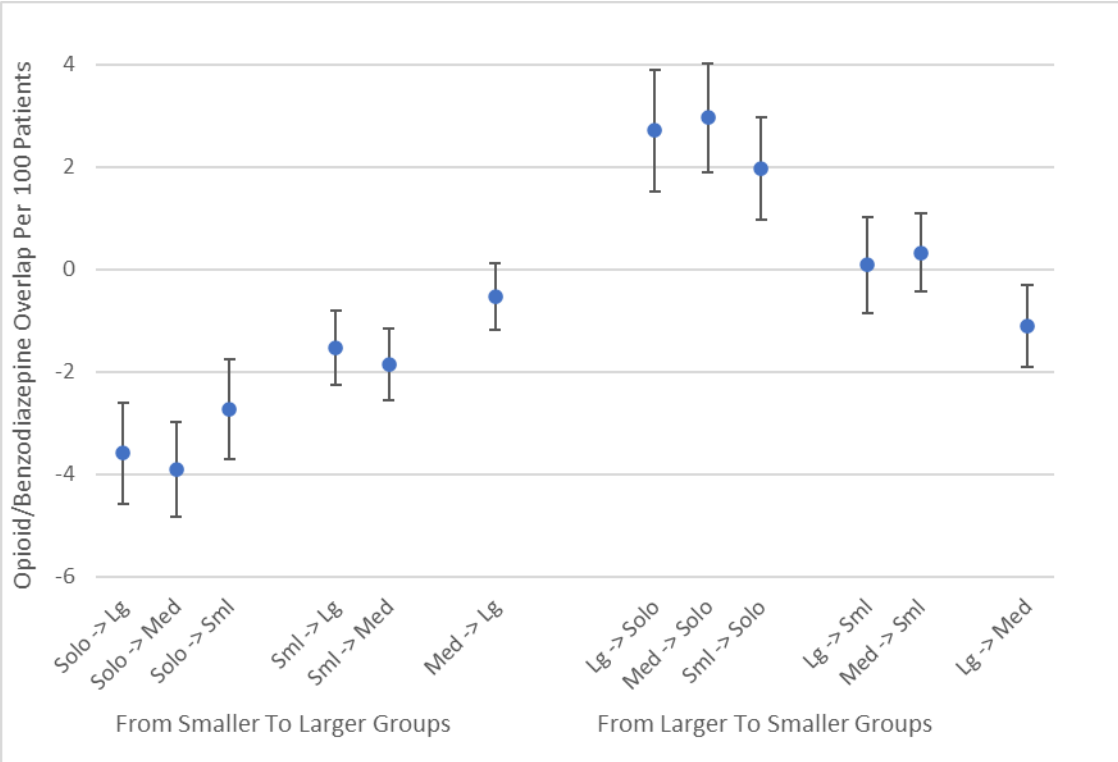


Figure 4: Change in the Average Number of Prescribers and Prescribing Practices
Physicians Who Switched Group Status From 2014-18

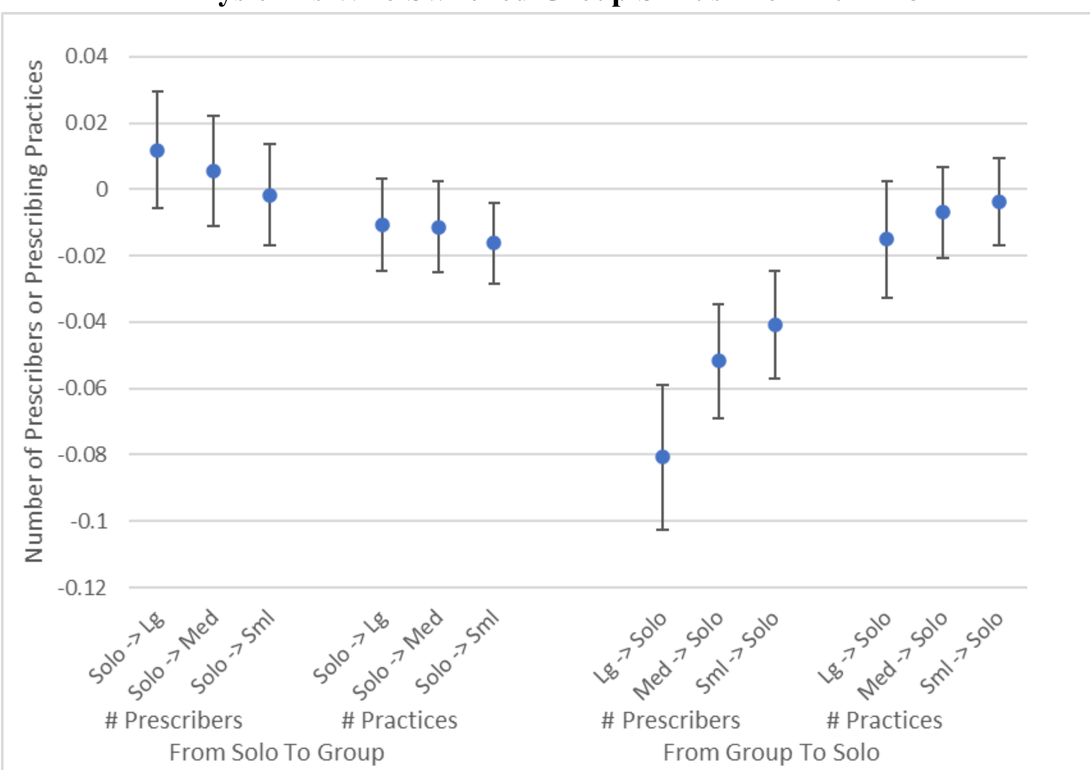


Figure 5: Changes in Opioid Prescribing, 2014-18
Physicians Who Switched Hospital Integration Status 2014-18 vs. Independent Stayers

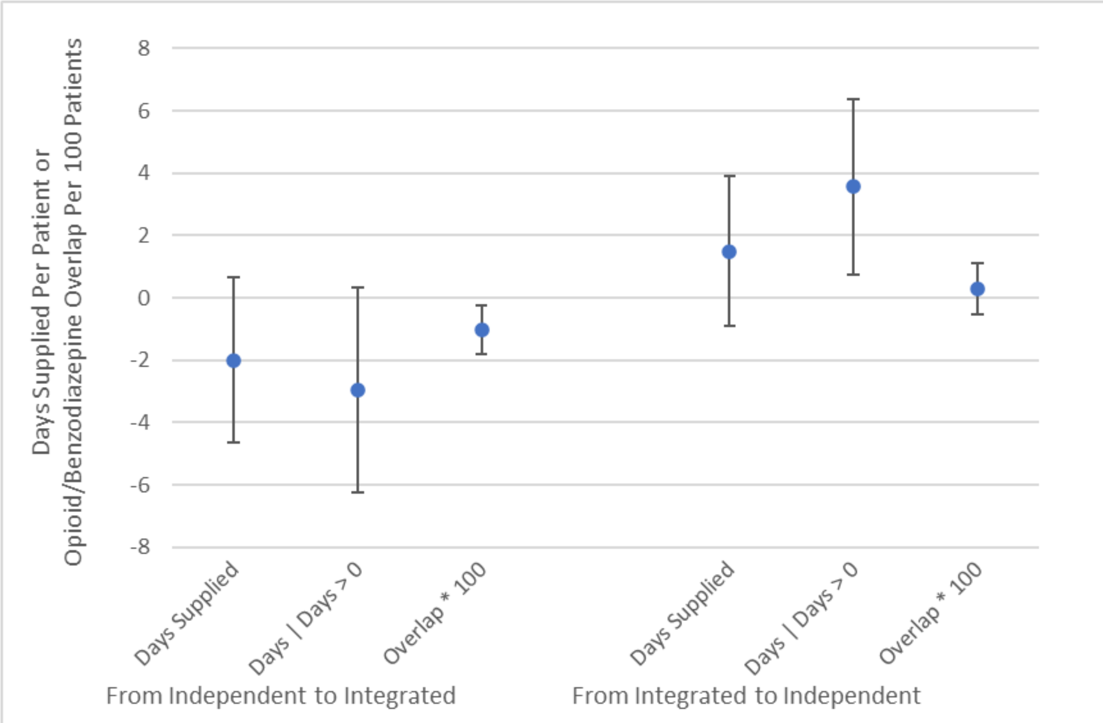


Figure 6: Association of Physician's Own Age and Physician's Group's Average Age With Days of Opioids Supplied, 2014-18

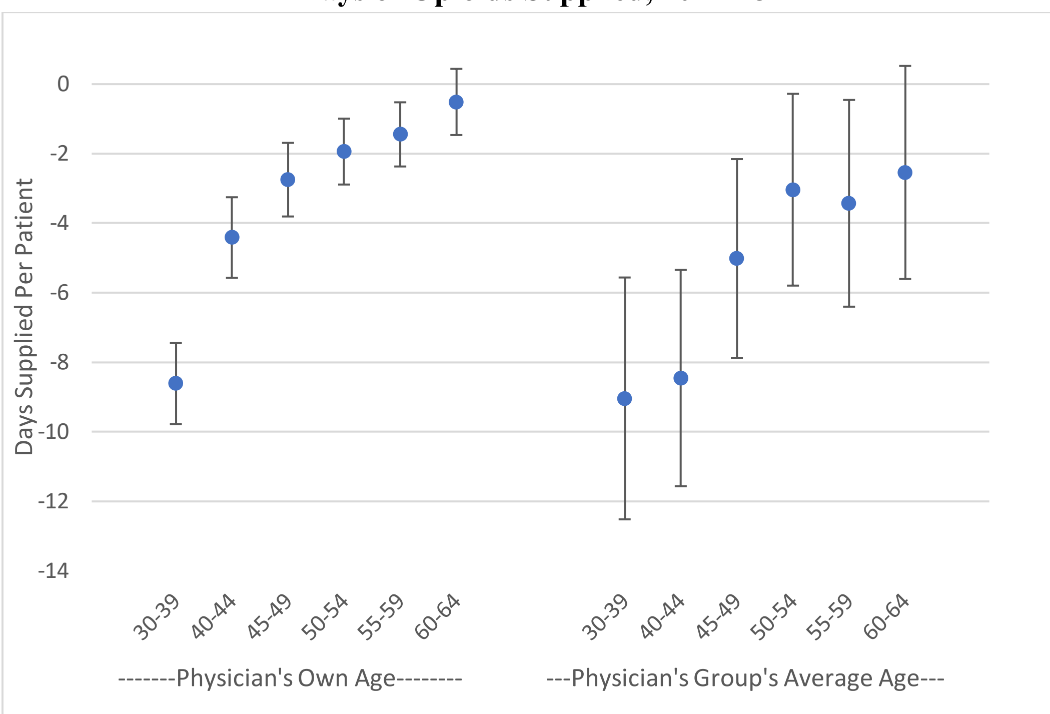


Figure 7: Association of Physician's Own Age and Physician's Group's Average Age With Opioid/Benzo Overlap, 2014-18

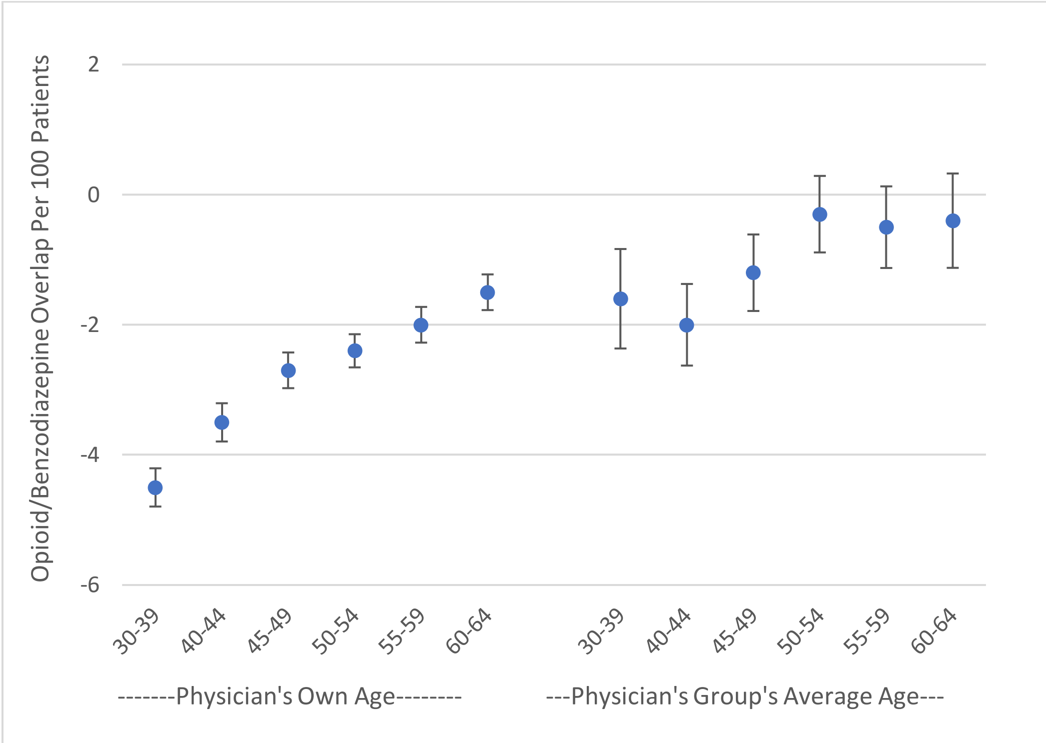


Figure 8: Change in Days of Opioids Supplied, 2014-18
Physicians Who Switched Group Status From 2014-18 vs. Solo-Practice Stayers
Counties With High Levels of Opioid Prescribing in 2014

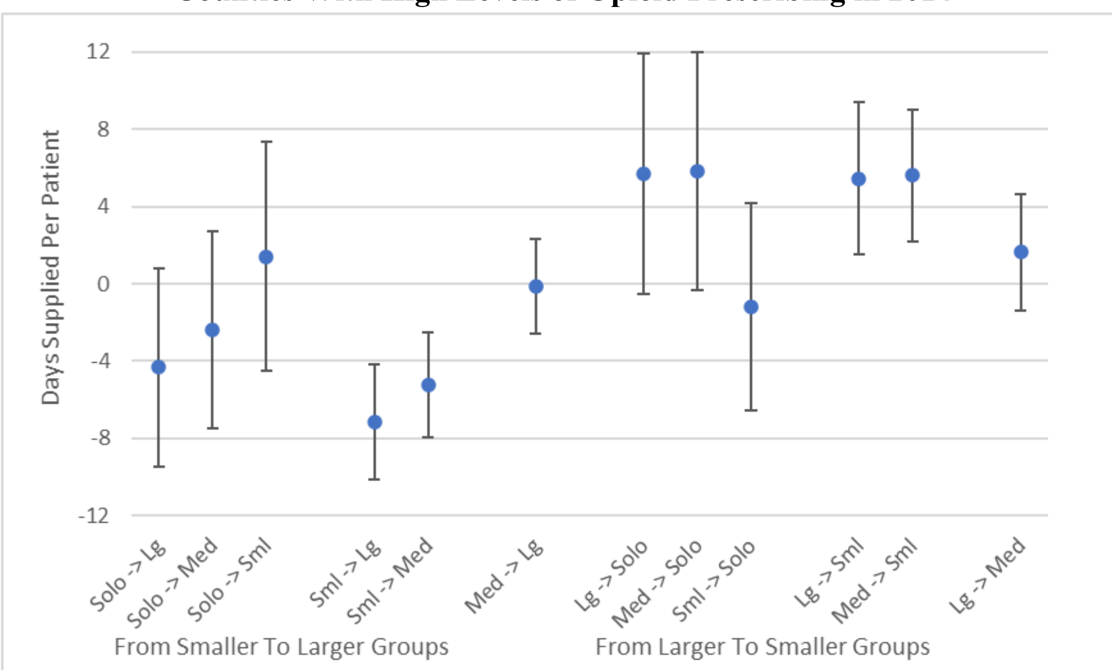
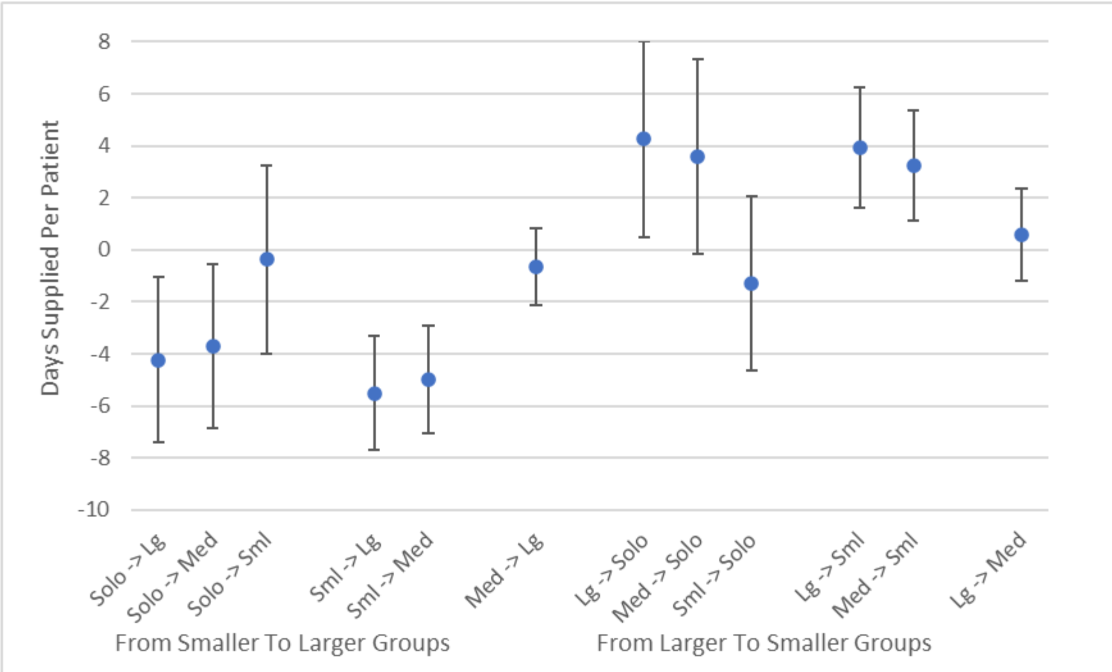


Figure 9: Change in Days of Opioids Supplied, 2014-18
Physicians Who Switched Group Status From 2014-18 vs. Solo-Practice Stayers
Patients With High Levels of Opioid Days Supplied



APPENDIX TABLE 1

Dependent Variables	Practice Size Stayers				Practice Size Switchers			
	Solo in 2014	Solo in 2018	Group in 2014	Group in 2018	Solo in 2014	Group in 2018	Group in 2014	Solo in 2018
Days Supplied per patient-year	41.14	30.08	32.85	21.91	41.12	20.47	32.99	31.68
	(59.48)	(53.71)	(52.65)	(47.80)	(60.26)	(48.66)	(61.60)	(60.57)
Days Supplied if Days > 0	44.16	34.23	36.14	25.54	44.01	24.30	36.76	36.26
	(60.53)	(56.05)	(54.13)	(50.70)	(61.31)	(52.13)	(63.96)	(63.51)
Overlapping opioid/benzo rx	18.94	18.57	12.41	11.81	18.12	11.42	12.57	17.30
	(18.77)	(20.52)	(16.00)	(16.72)	(18.22)	(17.11)	(16.33)	(19.89)
Physician Age	56.31	60.31	47.63	51.63	54.25	51.23	46.47	53.81
	(9.72)	(9.72)	(10.44)	(10.44)	(9.92)	(10.74)	(10.51)	(10.59)
Physician Gender (Female)	0.24	0.24	0.40	0.40	0.28	0.39	0.40	0.31
	(0.43)	(0.43)	(0.49)	(0.49)	(0.45)	(0.49)	(0.49)	(0.46)
Practice HHI	0.12	0.14	0.18	0.20	0.14	0.19	0.17	0.15
	(0.08)	(0.09)	(0.13)	(0.13)	(0.09)	(0.12)	(0.12)	(0.10)
Physician in Group	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Physician is Hospital-Owned	0.01	0.01	0.14	0.14	0.03	0.17	0.18	0.04
	(0.11)	(0.11)	(0.35)	(0.34)	(0.18)	(0.38)	(0.39)	(0.20)
Age	71.76	72.84	71.18	72.08	71.39	71.74	70.71	71.76
	(11.88)	(10.80)	(12.37)	(11.29)	(11.97)	(11.60)	(12.67)	(11.48)
Female	0.61	0.59	0.61	0.60	0.61	0.60	0.61	0.60
	(0.13)	(0.14)	(0.19)	(0.19)	(0.14)	(0.18)	(0.19)	(0.15)
Black	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.14
	(0.22)	(0.22)	(0.21)	(0.20)	(0.20)	(0.20)	(0.22)	(0.21)
Dual Eligible	0.30	0.27	0.25	0.23	0.26	0.25	0.28	0.27
	(0.25)	(0.25)	(0.23)	(0.23)	(0.23)	(0.23)	(0.24)	(0.24)
Current Eligibility = Disabled	0.15	0.13	0.18	0.14	0.16	0.16	0.20	0.16
	(0.15)	(0.13)	(0.18)	(0.16)	(0.15)	(0.16)	(0.19)	(0.16)
Original Eligibility = Disabled	0.24	0.23	0.27	0.24	0.26	0.26	0.30	0.26
	(0.18)	(0.17)	(0.20)	(0.19)	(0.18)	(0.20)	(0.21)	(0.19)
Number of physicians	18,857	18,857	72,091	72,091	3,534	24,837	23,915	2,612
Number of counties	1,535	1,521	1,754	1,671	952	1,488	1,633	775

Appendix Table 2: Switchers Across Group Size Categories

		2018				
		Large	Medium	Small	Solo	Leavers
	Large	37,427	3,719	1,136	376	17,759
	Medium	8,363	20,625	2,108	549	12,138
2014	Small	2,548	3,429	14,039	1,687	7,935
	Solo	999	1,102	1,433	18,857	7,122
	Joiners	20,462	11,642	5,248	2,236	0

Note: Table entries are numbers of observations.

APPENDIX TABLE 3

Dependent Variables	Practice Ownership Stayers: Indep in 2014	Indep in 2018	Integ in 2014	Integ in 2018	Practice Ownership Switchers: Indep in 2014	Integ in 2018	Integ in 2014	Indep in 2018
Days Supplied per patient-year	35.37	24.00	28.18	18.02	31.93	18.25	30.75	20.35
	(56.49)	(47.84)	(46.91)	(52.48)	(52.24)	(61.29)	(64.03)	(58.59)
Days Supplied if Days > 0	38.42	27.52	32.53	22.59	37.08	23.76	35.89	25.68
	(57.87)	(50.28)	(48.97)	(57.86)	(54.57)	(69.00)	(67.83)	(64.76)
Overlapping opioid/benzo rx	14.49	13.83	8.85	7.56	10.29	7.96	9.37	9.01
	(16.87)	(17.93)	(15.76)	(15.29)	(15.70)	(15.88)	(15.73)	(16.42)
Physician Age	49.80	53.80	45.26	49.26	44.71	48.71	44.23	48.23
	(10.85)	(10.85)	(10.03)	(10.03)	(10.18)	(10.18)	(10.07)	(10.07)
Physician Gender (Female)	0.36	0.36	0.39	0.39	0.37	0.37	0.41	0.41
	(0.48)	(0.48)	(0.49)	(0.49)	(0.48)	(0.48)	(0.49)	(0.49)
Practice HHI	0.17	0.19	0.18	0.19	0.18	0.19	0.19	0.21
	(0.12)	(0.12)	(0.14)	(0.14)	(0.13)	(0.13)	(0.13)	(0.13)
Physician in Group	0.78	0.79	0.97	0.98	0.92	0.97	0.98	0.95
	(0.41)	(0.41)	(0.16)	(0.15)	(0.27)	(0.16)	(0.13)	(0.21)
Physician is Hospital-Owned	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age	71.42	72.27	70.04	71.26	70.20	71.26	69.80	71.68
	(12.12)	(11.08)	(13.31)	(12.41)	(13.26)	(12.26)	(13.57)	(12.01)
Female	0.62	0.60	0.59	0.58	0.59	0.58	0.59	0.59
	(0.17)	(0.17)	(0.22)	(0.22)	(0.21)	(0.22)	(0.21)	(0.21)
Black	0.13	0.12	0.16	0.16	0.17	0.16	0.17	0.15
	(0.21)	(0.20)	(0.24)	(0.23)	(0.25)	(0.23)	(0.25)	(0.23)
Dual Eligible	0.25	0.22	0.35	0.33	0.35	0.35	0.34	0.29
	(0.23)	(0.22)	(0.27)	(0.26)	(0.26)	(0.26)	(0.26)	(0.25)
Current Eligibility = Disabled	0.16	0.13	0.23	0.20	0.23	0.20	0.23	0.18
	(0.16)	(0.15)	(0.21)	(0.20)	(0.21)	(0.19)	(0.21)	(0.19)
Original Eligibility = Disabled	0.25	0.23	0.34	0.32	0.35	0.33	0.35	0.29
	(0.19)	(0.18)	(0.24)	(0.23)	(0.23)	(0.23)	(0.23)	(0.22)
Number of physicians	98,812	98,812	9,647	9,647	4,729	4,729	5,209	5,209
Number of counties	2,013	1,878	736	704	904	713	698	760

Appendix Table 4: Regression Results – Main Model

	Days Supplied		Days Supplied | Days > 0		Overlap | Days > 0	
Organization Chars	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
SoloJoin	-5.617***	1.6622	-1.96	1.8564	-0.066***	0.004
SoloLeav	-4.251**	2.074	1.745	2.2828	-0.064***	0.0041
SmlJoin	-8.787***	1.5834	-6.502***	1.7915	-0.067***	0.004
SmlLeav	-6.284***	1.7449	-2.361	1.9071	-0.054***	0.004
MedJoin	-0.818	2.2319	4.275	2.8491	-0.059***	0.0046
MedLeav	0.844	1.8365	5.194***	1.9332	-0.038***	0.0041
LgJoin	-4.415***	1.2283	-1.146	1.5653	-0.012**	0.0057
LgLeav	2.889***	1.0454	6.203***	1.1281	-0.006**	0.0032
SmlStay X 2014	2.361	1.5111	3.074*	1.5764	-0.018***	0.0034
SmlStay X 2018	1.146	1.3376	1.685	1.4013	-0.020***	0.0035
MedStay X 2014	-2.732*	1.6247	-2.853*	1.6844	-0.032***	0.0037
MedStay X 2018	-3.190**	1.5135	-3.528**	1.587	-0.041***	0.0037
LgStay X 2014	-2.856*	1.6688	-2.259	1.7302	-0.043***	0.0041
LgStay X 2018	-2.821*	1.5596	-2.277	1.6187	-0.045***	0.0041
SoloSwit X 2014	-0.547	1.0068	-0.706	1.05	-0.008**	0.0035
SoloSwit X 2018	-0.943	1.0969	-1.541	1.1997	-0.009**	0.0042
SmlSwit X 2014	1.025	1.5039	1.181	1.5343	-0.028***	0.0037
SmlSwit X 2018	-1.123	1.8528	-0.11	2.0212	-0.035***	0.0042
MedSwit X 2014	-4.670***	1.6292	-4.703***	1.7067	-0.038***	0.004
MedSwit X 2018	-4.533***	1.5246	-5.241***	1.6327	-0.047***	0.0039
LgSwit X 2014	-4.460***	1.7188	-5.454***	1.8705	-0.036***	0.0047
LgSwit X 2018	-4.797***	1.553	-5.434***	1.6351	-0.044***	0.0041
IntegJoin	-6.388***	1.3305	-6.632***	1.7718	-0.022***	0.0034
IntegLeav	-7.016***	1.5484	-5.978***	1.9413	-0.030***	0.003
IntegStay X 2014	-9.998***	1.0285	-10.950***	1.1249	-0.037***	0.0032
IntegStay X 2018	-9.480***	0.948	-10.286***	1.1133	-0.043***	0.0034
IntegSwit X 2014	-7.622***	1.2845	-8.948***	1.4264	-0.030***	0.0038
IntegSwit X 2018	-9.187***	1.342	-9.103***	1.6772	-0.040***	0.0033
IndepSwit X 2014	-7.187***	0.9562	-6.139***	1.0327	-0.030***	0.0027
IndepSwit X 2018	-6.123***	1.0023	-5.373***	1.2299	-0.027***	0.003
PCP HHI	-1.735	6.3826	-0.232	6.3609	0.021	0.0176
MD Gp Age [30,40)	-9.044***	1.7755	-9.764***	1.865	-0.016***	0.0039
MD Gp age [40,45)	-8.457***	1.5885	-9.277***	1.6711	-0.020***	0.0032
MD Gp age [45,50)	-5.021***	1.4608	-4.864***	1.544	-0.012***	0.003
MD Gp age [50,55)	-3.038**	1.4077	-2.881*	1.5223	-0.003	0.003
MD Gp age [55,60)	-3.429**	1.5175	-3.060*	1.6126	-0.005	0.0032
MD Gp age [60,65)	-2.541	1.5638	-2.114	1.673	-0.004	0.0037

<u>MD Chars</u>						
MD age [30, 40)	-8.613***	0.5961	-10.868***	0.6782	-0.045***	0.0015
MD age [40,45)	-4.413***	0.5907	-5.735***	0.7096	-0.035***	0.0015
MD age [45,50)	-2.749***	0.5404	-4.025***	0.6077	-0.027***	0.0014
MD age [50,55)	-1.941***	0.4835	-3.262***	0.546	-0.024***	0.0013
MD age [55,60)	-1.446***	0.4711	-2.402***	0.5224	-0.020***	0.0014
MD age [60,65)	-0.513	0.4857	-1.428***	0.5302	-0.015***	0.0014
MD sex	-1.553***	0.3157	-1.387***	0.4186	-0.005***	0.0008
<u>Patient Characteristics</u>						
Spinal cord injury	5.449	15.3119	-12.327	21.1389	0.028	0.0261
Pressure ulcers	0.531	3.3209	1.626	5.4153	-0.028***	0.0073
Visual impairment	-8.481	7.5832	-13.792	11.1836	0.028	0.021
Tobacco use disorder	-1.947	3.6321	-12.058**	5.8301	-0.051***	0.0062
Post-trauma stress	-28.685***	9.8913	-34.791**	17.1611	-0.114***	0.0187
Schizophrenia + oth psychotic	-0.406	7.5491	0.22	11.8522	0.02	0.0143
Spina bifida	21.865	29.4693	50.037	51.4387	-0.019	0.0451
Obesity	-10.340***	2.4703	-13.778***	3.8742	-0.045***	0.0055
Other developmental delay	-25.666*	13.6485	-47.956**	21.556	-0.047	0.0316
Peripheral vascular disease	0.802	2.5639	1.293	4.0931	0.019***	0.006
Sickle cell disease	-14.864*	8.8521	-20.584	13.7053	-0.017	0.0169
Schizophrenia	-36.382***	8.8978	-56.958***	14.094	-0.043**	0.0187
Leukemia/lymphoma	6.019	7.0432	7.796	10.4988	-0.033**	0.0154
Liver disease	-7.466*	4.1697	-9.284	6.9663	-0.043***	0.0088
Migraine	0.885	5.7959	12.97	9.1934	0.009	0.0122
Multiple sclerosis	8.227	14.2577	12.826	24.2861	0.061**	0.031
Muscular dystrophy	12.346	41.6302	62.804	72.1396	-0.005	0.0607
Mobility impairment	-0.054	5.4621	1.797	9.1012	0.027***	0.0102
Drug use disorder	17.457***	6.1613	29.909***	9.1589	0.011	0.0099
Hearing impairment	-9.765***	3.2612	-20.282***	4.8965	-0.036***	0.0082
Viral hepatitis	11.237*	6.6533	27.849**	11.0515	0.006	0.0113
HIV/AIDS	-22.123***	8.3306	-22.924*	13.758	0.047***	0.0166
Intellectual disability	-35.656***	4.7693	-59.067***	7.0446	-0.01	0.0155
Learning disability	-6.608	13.3192	-7.204	22.0826	-0.044	0.0317
Brain injury	-11.715	10.1246	-18.29	17.0324	-0.037	0.0229
Cerebral palsy	-31.158***	6.9255	-47.856***	10.9858	0.019	0.0255
Cystic fibrosis	-3.181	11.8746	0.525	19.8	0.025	0.0204
Major depressive disorder	-2.856	4.465	-1.625	7.4928	-0.013	0.0085
Epilepsy	-5.604	4.7438	-8.436	8.1688	-0.002	0.0102
Fibromyalgia	74.277***	4.0822	113.201***	6.0058	0.056***	0.0052
Chronic pain/fatigue	-4.672	7.7202	2.767	13.4318	0.067***	0.0208
Anxiety disorder	16.541***	2.8032	22.723***	4.4186	0.186***	0.007
Alcoholism	-34.791***	5.6198	-56.220***	8.7911	-0.045***	0.0102
Autism	-15.844	26.4884	-21.195	35.0946	-0.061	0.0405
Bipolar disorder	-13.642***	4.9892	-18.998**	7.9854	0.002	0.0111

Colon cancer	20.603***	7.3777	28.386**	11.6565	-0.055***	0.0133
Prostate cancer	6.267	4.675	6.002	6.8133	-0.016	0.0125
Benign prostate hyperplasia	-1.577	3.8188	-1.571	6.7758	-0.006	0.008
Hypertension	0.031	1.5944	-4.756**	2.3951	0.011**	0.0046
Hypothyrodism	-6.406***	2.4162	-6.01	3.897	0.024***	0.0048
Lung cancer	56.188***	12.1871	94.521***	19.7081	-0.029**	0.0145
Endometrial cancer	23.535	19.6195	33.502	30.2161	-0.006	0.033
Anemia	2.847*	1.5812	3.871	2.3752	-0.005	0.004
Asthma	-13.939***	3.5494	-15.820**	6.2798	-0.032***	0.0075
Hyperlipidemia	-15.090***	1.499	-19.414***	2.2233	-0.018***	0.0038
Depression	16.054***	4.0946	21.171***	6.791	0.025***	0.0071
Osteoporosis	0.489	3.5035	3.043	5.5126	-0.053***	0.0073
Rheumatoid/Osteo arthritis	23.883***	2.3583	35.839***	3.4074	0.019***	0.0049
Stroke/TIA	-3.175	3.5634	-11.726**	5.8806	-0.036***	0.0085
Breast cancer	8.131	5.4099	16.107**	8.2069	-0.022**	0.0099
Chronic obstructve pulm dis	-1.633	2.9551	-2.387	4.8365	0	0.0054
Congestive heart failure	1.554	3.3745	5.546	5.282	-0.001	0.0062
Diabetes	-1.891	2.1588	-3.757	3.3933	0.027***	0.0046
Glaucoma	-9.690***	3.4397	-5.936	6.0454	0.008	0.0073
Hip fracture	18.612*	9.7173	24.235	14.8076	-0.011	0.0157
Ischemic heart disease	-2.945	1.9035	-2.398	3.0861	0.001	0.0047
Heart attack	-26.088***	6.3693	-42.663***	10.9138	-0.099***	0.0126
Alzheimer's disease	-0.969	4.8692	-2.008	8.1151	0.021**	0.01
Alzheimer's + dementia	10.187***	3.1997	9.343*	5.214	0.021***	0.0068
Atrial fibrillation	-12.148***	2.6916	-19.374***	4.4198	-0.042***	0.0072
Cataract	-6.624***	2.3568	-5.435	3.8407	0.011*	0.0056
Chronic kidney disease	-13.476***	2.3411	-18.372***	3.717	-0.059***	0.0049
Dual eligible	4.801***	1.5224	2.794	2.1008	-0.033***	0.0033
Current source of entitlement	5.475	4.3193	8.279	7.1253	-0.012	0.0077
Original source of entitlement	40.035***	2.9819	59.622***	4.8453	0.066***	0.0049
Black	-1.768	1.5169	-4.360**	1.9765	-0.072***	0.003
Female	1.315	1.2694	1.293	1.9571	0.016***	0.0027
Age 65-74	-6.109***	2.238	-4.892	3.4013	0.002	0.0045
Age 75-84	-6.876***	1.8876	-8.585***	2.9505	0.008	0.005
Age > 84	0.207	0.4124	1.725***	0.5187	0	0.0003
Age < 65	0.333	0.2744	3.067**	1.1913	-0.001***	0.0004
Year = 2018	-13.923***	0.5837	-14.661***	0.6128	-0.009***	0.0022
Constant	33.709***	2.3201	28.991***	3.1366	0.182***	0.0058
N	321,336		273,252		273,252	
# of Counties	2,304		2,300		2,300	

Appendix Table 5: Regression Results – Model With Pre- and Post-Switch Trends

	Days Supplied		Days Supplied | Days > 0		Overlap | Days > 0	
Organization Chars	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
SmlStay X 2016	0.718	1.279	1.147	1.3774	-0.012***	0.0028
SmlStay X 2018	-0.343	0.9343	0.307	1.0233	-0.016***	0.0029
MedStay X 2016	-7.132***	1.2821	-7.835***	1.3886	-0.031***	0.0027
MedStay X 2018	-5.673***	1.0466	-6.147***	1.1402	-0.036***	0.0029
LgStay X 2016	-4.981***	1.2432	-4.805***	1.3493	-0.037***	0.0031
LgStay X 2018	-4.309***	1.0568	-4.112***	1.1503	-0.037***	0.0031
SoloSwit X 2016	-1.929	1.6509	-2.977*	1.7511	-0.012***	0.0044
SoloSwit X 2018	-2.907**	1.3819	-3.617**	1.535	-0.008	0.0054
SmlSwit X 2016	0.564	1.6602	-0.002	1.7112	-0.014***	0.0038
SmlSwit X 2018	-0.578	1.5487	-0.467	1.717	-0.027***	0.0043
MedSwit X 2016	-6.922***	1.5553	-7.506***	1.6595	-0.030***	0.0037
MedSwit X 2018	-5.154***	1.4347	-5.880***	1.5858	-0.035***	0.0042
LgSwit X 2016	-6.485***	2.3773	-7.661***	2.5801	-0.032***	0.0053
LgSwit X 2018	-6.952***	1.1828	-7.613***	1.2763	-0.033***	0.0038
SmlStay X 2014	0.771	1.0538	1.432	1.1247	-0.012***	0.0027
SmlStay X 2015	0.729	1.0826	1.462	1.1692	-0.016***	0.0026
SmlStay X 2019	0.405	0.9339	1.049	1.0397	-0.013***	0.0028
SmlStay X 2020	0.589	0.9437	1.102	1.06	-0.016***	0.0026
MedStay X 2014	-4.709***	1.1494	-4.877***	1.201	-0.025***	0.0028
MedStay X 2015	-5.528***	1.2178	-5.709***	1.2859	-0.031***	0.0026
MedStay X 2019	-4.713***	0.9948	-5.138***	1.095	-0.028***	0.0027
MedStay X 2020	-4.098***	1.0496	-4.389***	1.1698	-0.029***	0.0026
LgStay X 2014	-4.467***	1.1007	-4.043***	1.1595	-0.033***	0.003
LgStay X 2015	-4.531***	1.1513	-4.245***	1.2306	-0.038***	0.0028
LgStay X 2019	-3.325***	1.0369	-3.385***	1.1541	-0.033***	0.0029
LgStay X 2020	-2.806***	1.0277	-2.581**	1.1264	-0.033***	0.0028
SoloSwit X 2014	0.406	1.3488	-0.02	1.3682	0	0.0048
SoloSwit X 2015	1.208	1.8975	0.734	1.9822	-0.010**	0.0051
SoloSwit X 2019	-0.873	1.7612	-1.029	1.9402	-0.004	0.0061
SoloSwit X 2020	1.001	1.6787	1.196	1.8571	-0.011*	0.0054
SmlSwit X 2014	1.217	1.3905	0.644	1.4398	-0.013***	0.0039
SmlSwit X 2015	2.648	1.6123	2.942*	1.6993	-0.016***	0.0035
SmlSwit X 2019	0.782	1.7407	1.416	1.975	-0.019***	0.0049
SmlSwit X 2020	-0.337	1.6169	-0.034	1.8606	-0.017***	0.0048
MedSwit X 2014	-4.989***	1.2828	-4.983***	1.351	-0.025***	0.0037
MedSwit X 2015	-5.601***	1.3992	-5.977***	1.4898	-0.026***	0.0037
MedSwit X 2019	-3.678**	1.5623	-4.121**	1.7843	-0.025***	0.0043
MedSwit X 2020	-3.296**	1.5213	-3.188*	1.7611	-0.030***	0.004
LgSwit X 2014	-3.425**	1.657	-3.831**	1.7363	-0.019***	0.0052
LgSwit X 2015	-5.506***	1.7464	-6.120***	1.8838	-0.024***	0.005
LgSwit X 2019	-5.491***	1.157	-6.389***	1.2773	-0.031***	0.0037

LgSwit X 2020	-4.475***	1.1212	-5.047***	1.2643	-0.028***	0.0039
IntegStay X 2014	-7.797***	0.9651	-8.424***	1.0787	-0.028***	0.0028
IntegStay X 2015	-7.463***	0.9988	-7.238***	1.1292	-0.025***	0.0026
IntegStay X 2016	-8.833***	1.2184	-8.987***	1.3815	-0.029***	0.0026
IntegStay X 2018	-7.923***	1.0185	-8.121***	1.1672	-0.032***	0.003
IntegStay X 2019	-8.686***	1.0167	-8.574***	1.1583	-0.033***	0.0027
IntegStay X 2020	-8.680***	0.9448	-9.261***	1.0628	-0.030***	0.0028
PCP HHI	0.432	3.8964	1.512	4.042	0.019*	0.0105
MD Gp age [30, 40)	-7.426***	1.2004	-7.947***	1.3035	-0.025***	0.003
MD Gp age [40,45)	-7.718***	0.9861	-8.655***	1.0911	-0.029***	0.0024
MD Gp age [45,50)	-4.582***	0.8997	-4.586***	0.9791	-0.021***	0.0019
MD Gp age [50,55)	-2.458***	0.8311	-2.418***	0.924	-0.011***	0.002
MD Gp age [55,60)	-2.705***	0.9393	-2.608**	1.0256	-0.010***	0.0022
MD Gp age [60,65)	-2.181**	0.9742	-1.891*	1.0875	-0.009***	0.0026
<u>MD Chars</u>						
MD age [30, 40)	-8.922***	0.5554	-11.242***	0.6183	-0.048***	0.0014
MD age [40,45)	-4.896***	0.5068	-6.560***	0.559	-0.036***	0.0014
MD age [45,50)	-3.067***	0.491	-4.666***	0.536	-0.027***	0.0012
MD age [50,55)	-2.244***	0.4654	-3.862***	0.5099	-0.024***	0.0012
MD age [55,60)	-1.749***	0.4479	-3.084***	0.4964	-0.020***	0.0013
MD age [60,65)	-0.449	0.4359	-1.577***	0.475	-0.013***	0.0013
MD sex	-2.420***	0.3269	-2.209***	0.3769	-0.006***	0.0008
<u>Patient Characteristics</u>						
Spinal cord injury	-13.002	12.2095	-25.669	18.7592	-0.024	0.0168
Pressure ulcers	4.072	4.2149	9.478	6.456	-0.035***	0.0065
Visual impairment	-14.364**	5.8828	-26.479***	8.4024	0.024	0.0184
Tobacco use disorder	-9.608*	4.9511	-20.624***	7.3351	-0.053***	0.0054
Post-trauma stress	-9.379	21.4604	2.354	35.6579	-0.119***	0.014
Schizophrenia + oth psychotic	3.628	9.1199	1.849	13.3153	0.016	0.011
Spina bifida	61.825	46.7841	99.099	69.3857	-0.056	0.0378
Obesity	-18.012***	2.1701	-22.370***	3.1357	-0.057***	0.0042
Other developmental delay	-25.280**	11.4504	-32.866*	18.4118	-0.094***	0.0286
Peripheral vascular disease	2.403	2.4483	0.976	3.5793	0.025***	0.0046
Sickle cell disease	-19.329**	9.0543	-24.585*	13.5907	-0.011	0.014
Schizophrenia	-42.366***	11.5633	-56.329***	17.0608	-0.046***	0.0157
Leukemia/lymphoma	2.751	5.0167	11.119	8.4291	-0.037***	0.013
Liver disease	-3.836	5.8694	-2.045	9.228	-0.051***	0.007
Migraine	-2.258	6.0346	-3.055	9.0058	0.028***	0.0098
Multiple sclerosis	34.52	26.4355	48.889	40.0852	0.059**	0.0236
Muscular dystrophy	10.679	26.9014	50.281	41.973	0.045	0.0581

Mobility impairment	1.176	5.4118	0.655	8.2556	0.033***	0.0085
Drug use disorder	40.113***	9.3734	61.661***	13.0159	-0.001	0.0081
Hearing impairment	-12.617***	2.8806	-19.538***	4.7437	-0.047***	0.0068
Viral hepatitis	-0.361	7.0559	5.899	11.2338	-0.009	0.0107
HIV/AIDS	-32.943***	8.0376	-36.294***	11.2474	0.066***	0.019
Intellectual disability	-39.227***	3.986	-59.158***	5.2836	-0.008	0.0147
Learning disability	-17.212*	9.0949	-24.615*	14.7104	-0.008	0.0396
Brain injury	37.576	29.48	63.839	47.0699	-0.002	0.0212
Cerebral palsy	-39.209***	6.4236	-50.587***	8.6796	0.027	0.0259
Cystic fibrosis	-12.381**	6.0021	-18.683*	10.1993	0.02	0.0162
Major depressive disorder	2.214	2.9279	6.312	4.3122	-0.011*	0.0065
Epilepsy	-6.013	4.906	-11.935	7.6878	0.024***	0.0083
Fibromyalgia	82.489***	4.0492	114.843***	5.3468	0.054***	0.0046
Chronic pain/fatigue	-1.977	9.6312	-11.082	16.4416	0.070***	0.0187
Anxiety disorder	20.847***	2.8518	26.041***	4.1779	0.206***	0.0068
Alcoholism	-44.122***	5.7453	-65.363***	8.34	-0.057***	0.0089
Autism	-31.716	19.8024	-47.875**	23.8818	-0.084**	0.0338
Bipolar disorder	-18.992***	5.3372	-24.302***	8.1183	-0.008	0.0094
Colon cancer	17.483**	8.6532	26.395**	13.1161	-0.060***	0.0114
Prostate cancer	6.895*	3.6747	9.395*	5.5355	-0.007	0.0119
Benign prostate hyperplasia	-1.748	2.9433	-3.846	4.7826	0.015**	0.0071
Hypertension	0.684	1.5942	-1.685	2.2169	0.015***	0.0044
Hypothyrodism	-1.458	2.2482	0.812	3.3058	0.041***	0.0043
Lung cancer	43.265***	12.0113	64.244***	17.4523	-0.036**	0.0145
Endometrial cancer	37.288**	18.5623	61.367**	30.4162	-0.004	0.0244
Anemia	-0.857	2.2744	-1.324	3.236	-0.013***	0.004
Asthma	-20.093***	2.9659	-25.925***	4.5077	-0.024***	0.0057
Hyperlipidemia	-18.024***	1.5789	-23.164***	2.2144	-0.015***	0.0035
Depression	12.357***	3.1082	14.862***	4.4746	0.022***	0.0063
Osteoporosis	-1.068	3.8981	4.756	6.1774	-0.053***	0.0066
Rheumatoid/Osteo arthritis	26.412***	2.2376	35.420***	3.063	0.022***	0.0043
Stroke/TIA	-11.035***	2.9753	-18.225***	4.6623	-0.043***	0.0064
Breast cancer	11.438**	5.077	20.054***	7.5332	-0.032***	0.0083
Chronic obstructve pulm dis	-1.914	2.9431	-1.584	4.5528	-0.006	0.005
Congestive heart failure	3.335	3.6089	4.602	5.5392	-0.007	0.0057
Diabetes	-0.427	1.7127	-2.109	2.5032	0.028***	0.004
Glaucoma	-7.883*	4.3398	-7.969	7.2683	0.004	0.006
Hip fracture	11.442	8.242	7.521	11.6965	-0.038***	0.0129
Ischemic heart disease	-5.611**	2.2536	-5.743*	3.3586	0.005	0.0046
Heart attack	-25.112***	6.2089	-38.004***	10.3664	-0.110***	0.0111
Alzheimer's disease	6.847*	3.9822	7.362	5.5877	0.036***	0.0079
Alzheimer's + dementia	-10.903***	2.7608	-14.509***	4.4076	-0.053***	0.0058
Atrial fibrillation	-7.207***	1.6727	-7.438***	2.515	0.016***	0.0043
Cataract	-9.229***	2.7232	-12.253***	4.0861	-0.057***	0.0042
Chronic kidney disease	1.832	1.2271	-0.384	1.6008	-0.039***	0.0035

Dual eligible	11.447***	3.8265	18.767***	7.1338	-0.018***	0.0066
Current source of entitlement	45.301***	2.6641	60.867***	3.9429	0.077***	0.0049
Original source of entitlement	-2.460**	1.2463	-4.960***	1.4834	-0.078***	0.0034
Black	2.005*	1.0336	1.702	1.4509	0.018***	0.0023
Female	-3.249**	1.5653	4.591	4.5792	-0.002	0.0039
Age 65-74	-2.611*	1.4532	2.86	4.2151	0.008*	0.0043
Age 75-84	-0.022	0.2161	3.231	2.4629	-0.002**	0.0008
Age > 84	0.548***	0.1975	5.441***	1.1313	-0.002***	0.0005
Year = 2015	-1.486***	0.3199	-1.127***	0.3614	0.002	0.0013
Year = 2016	-5.499***	0.633	-5.933***	0.6892	-0.005***	0.0017
Year = 2018	-14.350***	0.5707	-14.820***	0.5948	-0.010***	0.0021
Year = 2019	-17.537***	0.6227	-17.412***	0.6588	-0.027***	0.0022
Year = 2020	-19.070***	0.6442	-18.678***	0.6652	-0.029***	0.0023
Constant	30.601***	1.754	21.570***	4.46	0.180***	0.0048
Observations	694,637		607,104		607,104	
# of Counties	2,193		2,179		2,179	

Appendix Table 6: Regression Results – Physician Fixed Effects

	Days Supplied		Days Supplied | Days > 0		Overlap | Days > 0	
Organization Chars	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
SoloJoin	0	.	0	.	0	.
SoloLeav	0	.	0	.	0	.
SmlJoin	0	.	0	.	0	.
SmlLeav	0	.	0	.	0	.
MedJoin	0	.	0	.	0	.
MedLeav	0	.	0	.	0	.
LgJoin	0	.	0	.	0	.
LgLeav	0	.	0	.	0	.
SmlStay X 2014	0.542	0.9609	0.483	0.9789	-0.002	0.0041
SmlStay X 2018	0	.	0	.	0	.
MedStay X 2014	0.128	0.895	0.231	0.947	0.005	0.004
MedStay X 2018	0	.	0	.	0	.
LgStay X 2014	-0.37	0.9834	-0.925	0.9892	0	0.0036
LgStay X 2018	0	.	0	.	0	.
SoloSwit X 2014	2.525	3.1973	1.35	3.1451	0.027**	0.0112
SoloSwit X 2018	0.375	3.8758	-1.813	3.175	0.020*	0.0108
SmlSwit X 2014	2.804	3.1258	0.031	1.4826	0.003	0.0069
SmlSwit X 2018	0.635	2.0507	1.325	1.8575	0.004	0.0076
MedSwit X 2014	-0.554	1.241	0.128	1.3279	0.003	0.005
MedSwit X 2018	-1.353	2.6638	-3.581**	1.6557	-0.009	0.0076
LgSwit X 2014	-0.603	2.6245	-3.488	2.3244	0.003	0.0089
LgSwit X 2018	0	.	0	.		.
IntegJoin	0	.	0	.	0	.
IntegLeav	0	.	0	.	0	.
IntegStay X 2014	-1.021	1.1422	-1.341	1.2511	0.005	0.0043
IntegStay X 2018	0	.	0	.	0	.
IntegSwit X 2014	-1.06	1.5437	-2.223	1.6067	-0.007	0.007
IntegSwit X 2018	-1.978	1.6729	-1.846	2.2105	-0.011*	0.0061
IndepSwit X 2014	0	.	0	.	0	.
IndepSwit X 2018	0	.	0	.	0	.
PCP HHI	0.232	8.6542	-1.452	8.9875	0.001	0.0327
MD Gp Age [30,40)	-4.996	3.062	-2.727	3.1254	0.006	0.0091
MD Gp age [40,45)	-3.715	2.5134	-3.915	2.7473	0	0.0089
MD Gp age [45,50)	-2.65	2.4711	-2.974	2.6621	0.002	0.0087
MD Gp age [50,55)	-1.608	2.4015	-1.842	2.6423	0.005	0.0087
MD Gp age [55,60)	-2.32	2.3786	-2.576	2.7095	0.005	0.0091
MD Gp age [60,65)	-2.001	2.2211	-1.802	2.5846	0.003	0.0087

MD Chars						
MD age [30, 40)	6.605**	3.005	6.288**	3.0121	0.01	0.0131
MD age [40,45)	6.625***	2.5654	6.659***	2.5134	0.011	0.0112
MD age [45,50)	4.822**	2.1844	5.132**	2.1398	0.007	0.0094
MD age [50,55)	3.116*	1.7154	3.000*	1.7042	0.003	0.0076
MD age [55,60)	1.078	1.277	1.126	1.322	-0.002	0.0057
MD age [60,65)	0.188	0.9307	-0.038	1.0238	-0.003	0.0041
MD sex	0	.	0	.	0	.
Patient Characteristics						
Spinal cord injury	30.519	31.1907	26.957	53.4022	0.081	0.0533
Pressure ulcers	2.096	7.0105	6.477	10.163	0.013	0.0211
Visual impairment	10.947	12.3845	22.718	20.2253	0.004	0.045
Tobacco use disorder	-1.716	8.1804	-1.706	11.2758	-0.008	0.0146
Post-trauma stress	-2.757	16.7206	4.083	31.2225	-0.023	0.0472
Schizophrenia + oth psychotic	0.783	9.0115	-2.399	16.1413	0.022	0.0345
Spina bifida	26.386	67.4274	74.899	133.2718	-0.03	0.1127
Obesity	-3.349	4.3872	-4.778	5.6085	-0.030**	0.0125
Other developmental delay	6.816	40.9696	-41.885	25.8316	-0.113	0.0769
Peripheral vascular disease	-4.764	6.1399	-3.768	7.7657	-0.018	0.0155
Sickle cell disease	-7.818	17.4628	-7.566	28.5634	0.026	0.0398
Schizophrenia	-1.579	14.4395	1.88	25.552	-0.039	0.0469
Leukemia/lymphoma	14.776	16.2956	14.487	28.2257	0.036	0.0484
Liver disease	-2.154	6.7852	-4.93	9.5428	-0.001	0.0239
Migraine	2.708	10.0562	11.542	15.9867	0.033	0.0325
Multiple sclerosis	36.29	32.5694	50.982	64.7293	0.059	0.0901
Muscular dystrophy	-18.902	24.7523	-21.629	49.9546	-0.205	0.1267
Mobility impairment	-9.925	11.4911	-17.071	17.0137	-0.005	0.0259
Drug use disorder	3.634	11.3306	4.358	15.5348	0.003	0.0247
Hearing impairment	-1.954	7.8304	-13.1	12.6865	-0.03	0.0209
Viral hepatitis	12.207	12.1665	19.936	23.7212	-0.013	0.0345
HIV/AIDS	-12.781	12.5883	-35.73	26.3353	-0.03	0.0529
Intellectual disability	-34.566***	9.7837	-43.228***	13.7025	0.005	0.0346
Learning disability	-30.255	21.5533	-34.618	33.6118	0.012	0.0894
Brain injury	2.724	27.1115	22.497	53.8608	-0.012	0.068
Cerebral palsy	-19.491	17.2263	-22.401	27.5143	-0.014	0.0609
Cystic fibrosis	6.408	16.7316	21.323	29.0432	-0.012	0.0445
Major depressive disorder	-2.702	6.7219	-1.869	10.6351	-0.005	0.0186
Epilepsy	-0.59	10.4796	1.871	15.4538	0.025	0.0287
Fibromyalgia	28.363***	5.4192	40.462***	7.2713	0.035***	0.0122
Chronic pain/fatigue	-1.507	16.1898	15.645	30.4146	-0.025	0.0504
Anxiety disorder	9.652*	5.0977	11.286	7.5297	0.124***	0.0162
Alcoholism	-14.578	12.3351	-25.553*	13.7545	-0.047*	0.0267
Autism	17.895	74.4845	-63.863***	21.6553	-0.026	0.12
Bipolar disorder	-3.763	9.8654	-0.235	16.6379	-0.003	0.0261

Colon cancer	4.073	10.6385	-7.153	16.3158	-0.012	0.0389
Prostate cancer	12.254	9.7357	-10.007	15.3968	0.007	0.0347
Benign prostate hyperplasia	-2.308	10.0746	-1.584	19.9568	-0.016	0.0192
Hypertension	2.67	3.3576	3.29	4.2148	-0.006	0.0113
Hypothyrodism	-3.888	4.2809	-9.113	5.9907	0.005	0.0144
Lung cancer	13.771	13.6075	10.684	21.5768	-0.03	0.0438
Endometrial cancer	-4.067	20.8878	-28.171	26.1391	0.013	0.0715
Anemia	2.623	3.6023	9.479*	5.7573	-0.002	0.0109
Asthma	-4.9	9.7398	0.32	12.2618	-0.002	0.0191
Hyperlipidemia	-3.634	3.0934	-7.426*	4.4482	-0.001	0.0109
Depression	9.676*	5.2151	13.77	8.6889	0.013	0.0193
Osteoporosis	2.492	8.0293	-6.515	11.2826	-0.01	0.0206
Rheumatoid/Osteo arthritis	12.506***	4.6254	14.546**	5.9421	0.005	0.0107
Stroke/TIA	1.471	7.2274	1.849	8.6492	-0.001	0.0212
Breast cancer	-5.675	11.528	-11.768	18.1036	-0.011	0.0342
Chronic obstructve pulm dis	3.1	6.1151	1.157	8.5428	0.01	0.014
Congestive heart failure	-0.118	6.7963	1.561	7.8805	0.005	0.0164
Diabetes	-4.019	4.1735	-1.493	6.4361	0	0.0122
Glaucoma	-5.575	6.5157	-2.416	10.6108	-0.021	0.0214
Hip fracture	-12.819	37.1653	-2.16	17.283	0	0.0378
Ischemic heart disease	3.167	4.9952	1.46	6.546	0.002	0.0136
Heart attack	-11.206	8.1466	-21.944	15.3381	-0.058*	0.0319
Alzheimer's disease	-17.354	13.8955	-16.501	14.8525	0.005	0.0272
Alzheimer's + dementia	-1.143	5.1642	-0.723	8.2088	0.012	0.0177
Atrial fibrillation	3.719	5.7139	4.453	8.5	-0.011	0.0197
Cataract	-4.798	3.3199	-2.556	4.7681	0.012	0.0136
Chronic kidney disease	-4.242	3.6358	-3.777	5.0282	-0.019	0.0125
Dual eligible	5.535*	3.2311	4.185	3.3993	-0.008	0.0086
Current source of entitlement	3.021	7.8237	4.171	10.3629	0.002	0.0183
Original source of entitlement	21.517***	5.2514	28.182***	8.2542	0.029**	0.0129
Black	-1.956	3.1762	-4.345	3.9126	-0.038***	0.0089
Female	1.112	2.7563	0.28	3.7874	0.007	0.0086
Age 65-74	-2.443	5.5172	-4.468	4.4869	-0.002	0.0116
Age 75-84	-2.76	6.5954	-1.856	4.4536	-0.005	0.0134
Age > 84	0.426	0.4509	2.634***	0.4406	-0.001	0.0007
Age < 65	0.014	0.2874	0.95	0.8045	-0.001*	0.0007
Year = 2018	-10.866***	1.1005	-11.320***	1.1554	-0.008*	0.0041
Constant	20.923***	6.0271	24.043***	6.377	0.111***	0.0168
N	321,336		273,252		273,252	
# of Counties	2,304		2,300		2,300	

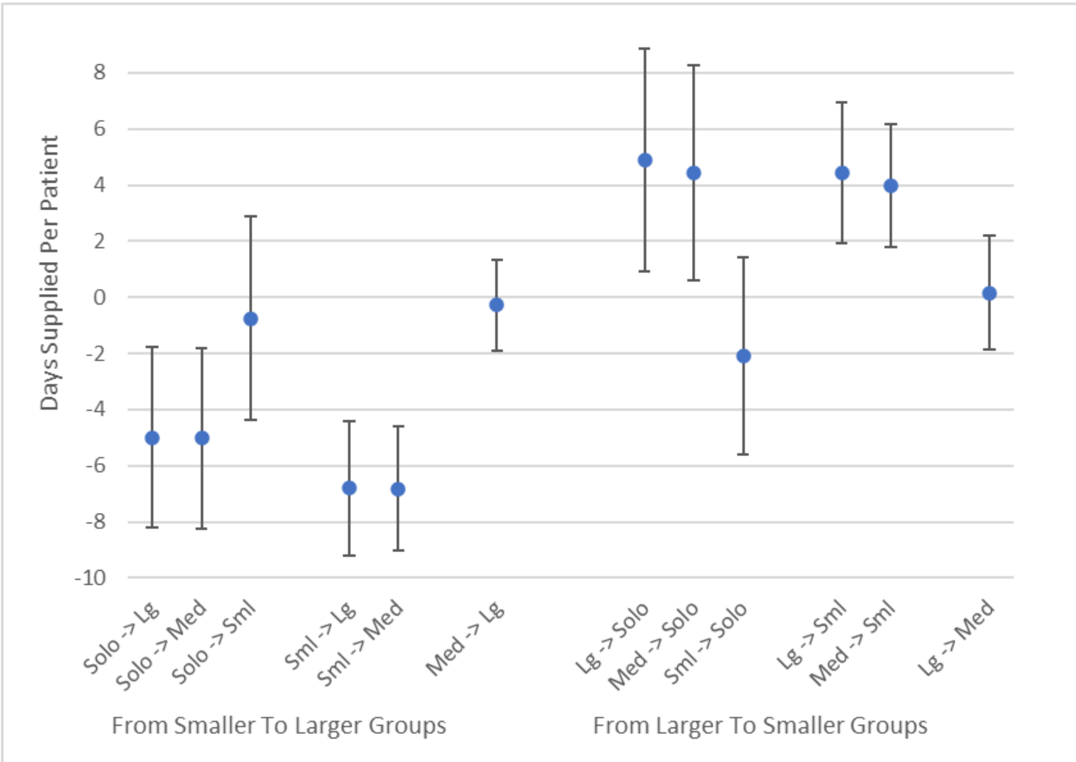
Appendix Table 7: Regression Results – Days Supplied by Type of Area and Patient

	Above-Median Area		Below-Median Area		Top Decile Patients	
<u>Organization Chars</u>	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
SoloJoin	-6.754***	2.1678	-2.194	1.4173	-4.657***	1.1981
SoloLeav	4.360**	1.8778	1.799*	0.9884	2.332**	1.006
SmlJoin	-4.393	3.073	3.244	3.3787	-0.949	2.1746
SmlLeav	0.236	3.0204	-0.797	1.8145	-0.168	1.7185
MedJoin	-12.080***	2.4916	-5.991***	1.6153	-8.912***	1.5551
MedLeav	-8.984***	2.7771	-5.721***	1.9723	-7.090***	1.6587
LgJoin	-7.827***	2.7288	-5.603***	1.6445	-5.905***	1.5736
LgLeav	-5.192	3.6964	-5.086**	2.0136	-5.973***	1.8751
SmlStay X 2014	1.851	2.4325	1.106	1.6434	2.06	1.4611
SmlStay X 2018	1.286	2.1604	0.211	1.3778	0.963	1.3053
MedStay X 2014	-4.905*	2.632	-2.472	1.7643	-3.091**	1.5645
MedStay X 2018	-4.226*	2.4025	-3.101*	1.599	-3.708**	1.4847
LgStay X 2014	-3.3	2.6848	-4.064**	1.8394	-3.237**	1.5807
LgStay X 2018	-3.291	2.4908	-3.964**	1.6081	-3.239**	1.4934
SoloSwit X 2014	-2.682*	1.5129	1.169	1.2155	-0.756	0.9543
SoloSwit X 2018	-1.058	1.8669	-1.546	0.9729	-0.779	1.0872
SmlSwit X 2014	0.156	2.2339	0.068	1.8107	0.51	1.4132
SmlSwit X 2018	-1.277	3.0361	-1.799	1.7513	-1.129	1.8273
MedSwit X 2014	-6.874***	2.6368	-4.228**	1.752	-4.366***	1.5958
MedSwit X 2018	-5.095**	2.4108	-4.985***	1.6518	-4.463***	1.4835
LgSwit X 2014	-6.733**	2.7172	-4.288**	1.8954	-5.038***	1.6285
LgSwit X 2018	-7.009***	2.491	-4.183***	1.5776	-5.000***	1.5113
IntegJoin	-8.214***	2.1068	-3.567**	1.5214	-6.751***	1.1898
IntegLeav	-8.684***	2.5242	-4.189***	1.5214	-7.924***	1.4439
IntegStay X 2014	-13.188***	1.657	-5.682***	1.2204	-9.927***	1.0246
IntegStay X 2018	-12.373***	1.6987	-5.569***	0.9514	-9.634***	0.9615
IntegSwit X 2014	-8.436***	1.9568	-6.317***	1.4222	-8.039***	1.181
IntegSwit X 2018	-12.228***	2.0861	-4.625**	1.8486	-9.509***	1.2061
IndepSwit X 2014	-9.449***	1.5612	-4.207***	0.9451	-7.744***	0.8686
IndepSwit X 2018	-5.679***	1.6462	-5.930***	0.7762	-6.199***	1.0106
PCP HHI	-1.6	7.128	3.756	6.2731	-3.678	5.9312
MD Gp Age [30,40)	-11.832***	2.6291	-5.667***	1.8722	-9.152***	1.6579
MD Gp age [40,45)	-11.277***	2.4822	-5.171***	1.4569	-8.492***	1.495
MD Gp age [45,50)	-8.235***	2.187	-0.729	1.53	-4.872***	1.4246
MD Gp age [50,55)	-5.552**	2.1911	0.493	1.4475	-2.917**	1.3742
MD Gp age [55,60)	-5.582**	2.191	-0.376	1.9489	-3.216**	1.4934
MD Gp age [60,65)	-3.967	2.5624	-0.704	1.4008	-2.447	1.5303

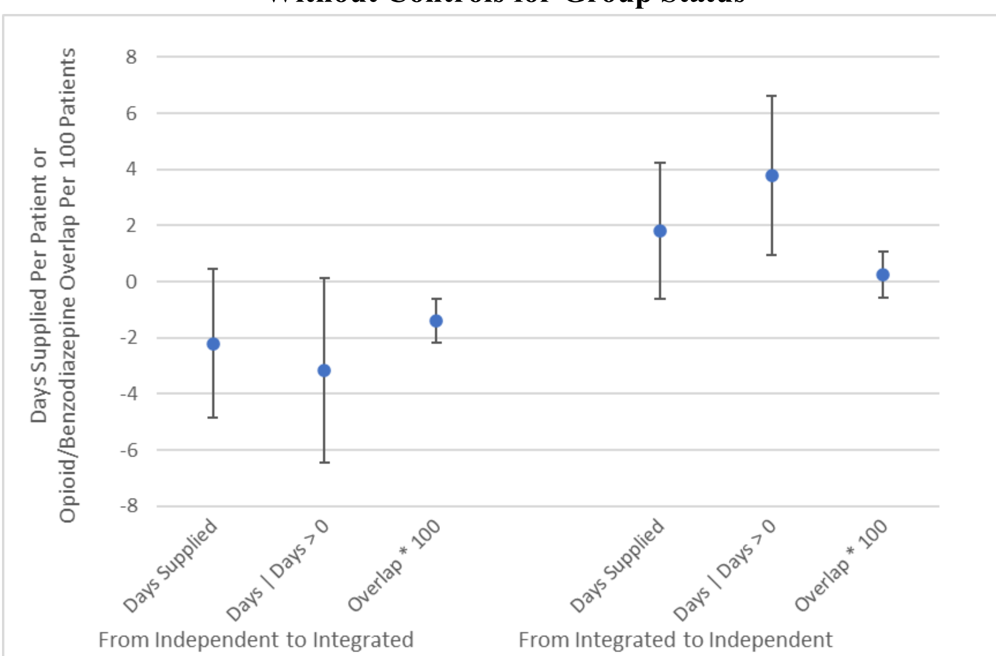
MD Chars						
MD age [30, 40)	-11.882***	1.0137	-4.915***	0.5882	-9.218***	0.5635
MD age [40,45)	-6.405***	0.8784	-2.333***	0.679	-5.095***	0.5625
MD age [45,50)	-3.924***	0.8683	-1.445**	0.6477	-3.490***	0.5191
MD age [50,55)	-2.635***	0.8263	-1.143**	0.4642	-2.440***	0.4687
MD age [55,60)	-2.115***	0.7812	-0.684	0.4927	-1.850***	0.4573
MD age [60,65)	-1.383*	0.7801	0.448	0.4929	-0.765	0.4676
MD sex	-1.541***	0.5352	-1.767***	0.3279	-1.243***	0.2897
Patient Characteristics						
Spinal cord injury	-8.243	20.6708	18.102	19.2034	-8.323	11.5951
Pressure ulcers	-0.598	5.2927	1.494	3.7822	-2.514	3.0029
Visual impairment	-5.572	11.1677	-8.293	8.4746	-10.783*	5.7519
Tobacco use disorder	-2.208	6.0869	-5.241	3.4655	1.154	3.5668
Post-trauma stress	-28.642*	16.5665	-29.063***	9.9514	-29.700***	9.5371
Schizophrenia + oth psychotic	15.663	13.7523	-15.205***	5.8746	-1.417	6.9655
Spina bifida	70.63	52.9489	-27.302***	9.2593	26.251	28.3261
Obesity	-13.481***	3.6834	-6.869**	2.8564	-10.827***	2.1056
Other developmental delay	-46.934***	14.8458	-10.757	24.0839	-22.227*	13.2958
Peripheral vascular disease	1.241	4.5815	1.101	2.4279	1.712	2.3276
Sickle cell disease	-9.702	13.5525	-17.879	11.3663	-17.924**	8.9482
Schizophrenia	-61.574***	14.6117	-11.563	8.8051	-30.230***	8.4258
Leukemia/lymphoma	23.588**	11.3118	-5.699	5.4955	-0.859	5.333
Liver disease	-16.546**	6.6365	2.809	4.5694	-10.197***	3.7428
Migraine	-4.854	9.2268	6.402	6.558	1.89	5.9338
Multiple sclerosis	2.337	22.1078	13.607	16.9416	12.972	13.4078
Muscular dystrophy	-1.102	38.6429	32.117	66.1879	-22.91	18.7902
Mobility impairment	1.874	8.9455	-1.581	5.9562	-1.56	4.1706
Drug use disorder	10.271	9.2322	26.267***	7.0615	20.685***	6.0525
Hearing impairment	-7.903	5.615	-10.046***	2.8747	-11.519***	2.4335
Viral hepatitis	11.15	10.3552	12.148	8.6919	11.106*	6.349
HIV/AIDS	-31.297**	14.7174	-8.858	9.3957	-19.661**	7.6613
Intellectual disability	-43.263***	7.2654	-26.279***	6.4983	-29.619***	4.6486
Learning disability	-2.135	28.086	-13.234	9.925	-0.442	13.3436
Brain injury	-5.885	18.9884	-16.381**	7.9813	-6.421	10.0359
Cerebral palsy	-45.081***	10.8079	-15.500*	9.1344	-25.161***	6.9909
Cystic fibrosis	-12.75	8.5478	6.868	21.0168	-8.74	7.1243
Major depressive disorder	-9.079	7.8173	2.765	3.4018	-3.385	4.3604
Epilepsy	-7.567	7.9355	-3.908	4.5353	-4.304	4.2769
Fibromyalgia	95.276***	6.8964	51.685***	3.5625	68.443***	4.0094
Chronic pain/fatigue	-20.027**	9.5196	8.006	12.0223	0.719	7.8823
Anxiety disorder	18.814***	4.5312	11.127***	2.9981	14.656***	2.9845
Alcoholism	-37.595***	8.3936	-29.632***	7.1089	-35.950***	5.1231
Autism	-45.643***	7.5605	21.143	50.568	-16.545	25.4312
Bipolar disorder	-19.660**	8.348	-6.159	4.8607	-13.385***	4.7342

Colon cancer	27.295**	10.7726	14.704	9.7821	20.650***	7.2117
Prostate cancer	4.953	6.8418	5.572	5.9309	4.548	3.882
Benign prostate hyperplasia	-4.882	7.2598	1.045	2.9281	-1.608	3.6188
Hypertension	0.909	2.7441	-1.166	1.6445	1.981	1.5316
Hypothyrodism	-10.073**	4.3034	-2.871	2.184	-4.744**	2.3319
Lung cancer	85.911***	19.9592	30.466***	11.752	31.346***	8.4167
Endometrial cancer	21.241	32.3127	26.155	22.1531	22.569	20.0509
Anemia	3.049	2.845	3.645**	1.6301	-1.301	1.425
Asthma	-21.025***	6.355	-6.439**	3.1744	-14.222***	2.9158
Hyperlipidemia	-16.350***	2.3987	-12.660***	1.7391	-13.577***	1.323
Depression	19.503***	7.4311	13.234***	2.7619	13.597***	3.9467
Osteoporosis	4.125	6.2714	-1.4	3.3544	0.327	3.3658
Rheumatoid/Osteo arthritis	32.716***	3.5831	15.115***	2.528	21.136***	2.0805
Stroke/TIA	-10.250*	6.2217	2.963	3.5576	-6.391**	2.7785
Breast cancer	4.472	9.3376	12.087**	5.7412	7.809	4.7741
Chronic obstructve pulm dis	-3.37	4.9203	-1.745	3.1316	-3.72	2.6449
Congestive heart failure	3.122	5.7005	-0.034	2.9159	2.088	2.6661
Diabetes	-3.077	4.152	-0.181	1.4432	-0.947	1.7692
Glaucoma	-8.738*	5.0373	-7.949*	4.4458	-8.469***	2.4933
Hip fracture	17.703	15.5584	16.848	11.8642	13.165	9.5121
Ischemic heart disease	-3.012	3.2148	-2.83	2.0855	-3.782**	1.7307
Heart attack	-34.604***	11.52	-16.021***	3.7626	-26.456***	4.0609
Alzheimer's disease	7.074	8.2905	-9.334*	5.0368	-1.324	3.4335
Alzheimer's + dementia	8.098	5.2928	12.755***	3.6425	11.083***	2.6516
Atrial fibrillation	-17.419***	4.3631	-7.952***	2.4727	-12.984***	2.0577
Cataract	-9.371**	4.2658	-3.619*	1.8633	-5.630***	2.0425
Chronic kidney disease	-15.999***	3.9626	-10.747***	2.332	-12.191***	1.9265
Dual eligible	9.508***	2.7704	1.554	1.4363	4.029***	1.5377
Current source of entitlement	9.257	7.4592	1.3	3.5522	3.162	4.1104
Original source of entitlement	51.747***	5.1178	26.110***	2.4702	38.873***	2.8042
Black	-5.896**	2.5903	1.614	1.4875	-3.641***	1.4007
Female	0.11	2.1455	2.720**	1.2356	0.733	1.1681
Age 65-74	-0.927	2.4493	-8.697***	3.1033	-5.202**	2.1353
Age 75-84	-4.983*	2.8445	-6.569***	2.3664	-6.709***	1.8831
Age > 84	0.39	0.7871	0.032	0.2235	-0.245*	0.1443
Age < 65	0.266	0.4758	0.368	0.2834	0.389*	0.2289
Year = 2018	-17.718***	0.8608	-10.432***	0.6058	-8.793***	0.4952
Constant	37.607***	3.3162	26.351***	2.7381	29.562***	2.1474
N	162,249		159,087		321336	

Appendix Figure 1: Change in Days of Opioids Supplied, 2014-18
Physicians Who Switched Group Status From 2014-18 vs. Solo-Practice Stayers
Without Controls for Integration Status



Appendix Figure 2: Changes in Opioid Prescribing, 2014-18
Physicians Who Switched Hospital Integration Status 2014-18 vs. Independent Stayers
Without Controls for Group Status



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