HOW ACQUISITIONS AFFECT FIRM BEHAVIOR AND PERFORMANCE: EVIDENCE FROM THE DIALYSIS INDUSTRY*

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Many industries have become increasingly concentrated through mergers and acquisitions, which in health care may have important consequences for spending and outcomes. Using a rich panel of Medicare claims data for nearly one million dialysis patients, we advance the literature on the effects of mergers and acquisitions by studying the precise ways in which providers change their behavior following an acquisition. We base our empirical analysis on more than 1,200 acquisitions of independent dialysis facilities by large chains over a twelve-year period and find that chains transfer several prominent strategies to the facilities they acquire. Most notably, acquired facilities converge to the behavior of their new parent companies by increasing patients' doses of highly reimbursed drugs, replacing high-skill nurses with less-skilled technicians, and waitlisting fewer patients for kidney transplants. We then show that patients fare worse as a result of these changes: outcomes such as hospitalizations and mortality deteriorate, with our long panel allowing us to identify these effects from within-facility or within-patient variation around the acquisitions. Because overall Medicare spending increases at acquired facilities, mostly as a result of higher drug reimbursements, this decline in quality corresponds to a decline in value for payers. We conclude the paper by considering the channels through which acquisitions produce such large changes in provider behavior and outcomes, finding that increased market power cannot explain the decline in quality. Rather, the adoption of the acquiring firm's strategies and practices drives our main results, with greater economies of scale for drug purchasing responsible for more than half of the change in profits following an acquisition.

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I. Introduction

Health-care markets have become increasingly concentrated through mergers and acquisitions (Gaynor, Ho and Town, 2015). Proponents of this industry trend cite several potential benefits of consolidation, including lower costs through economies of scale and better patient outcomes through coordinated care. But greater concentration may also result in higher prices or lower quality (Gaynor and Town, 2012; Cuellar and Gertler, 2006; Dafny, Duggan and Ramanarayanan, 2012). Previous studies of this topic typically consider only broad notions of market structure and outcomes — by showing, for instance, that more-concentrated hospital markets have higher mortality rates. Comparatively less work has examined the precise channels through which mergers and acquisitions ultimately lead to changes in outcomes. In this paper, we use detailed claims and facility data from the U.S. dialysis industry to show directly how large chains transfer their corporate strategies to the independent facilities they acquire and leverage their greater economies of scale, seen most prominently in larger drug doses, which substantially affect the cost and quality of care they provide.

We focus our study on the U.S. market for outpatient dialysis — a medical procedure that cleans the blood of patients suffering from end-stage renal disease (ESRD) — because it offers several distinct advantages as an empirical setting for this topic. First, dialysis is a fairly standardized treatment that allows for a direct comparison of providers. Second, the dialysis industry has become increasingly concentrated following a series of mergers and acquisitions: today, dialysis is provided primarily by multi-establishment, for-profit firms, with the share of independently owned and operated dialysis facilities falling from 86% to 21% over the past three decades and the two largest publicly traded corporations, DaVita and Fresenius, now owning over 60% of facilities and earning over 90% of the industry's revenue (United States Renal Data System, 2014; Baker, 2019). Third, detailed Medicare claims and clinical data allow us to identify important changes in providers' behavior and patients' outcomes following an acquisition. Finally, the dialysis industry is an important market to study in and of itself, with total Medicare reimbursements for treating the nation's 430,000 dialysis patients amounting to about $33 billion each year, or 6% of total Medicare expenditures.

We find that acquired facilities alter their treatments in ways that increase reimbursements and decrease costs. For instance, facilities capture higher payments from Medicare by increasing the amount of drugs they administer to patients, for which Medicare paid providers a fixed per-unit rate during

our study period. The most noteworthy of these is Epogen (EPO), a drug used to treat anemia, which represented the single largest prescription drug expenditure for Medicare in 2010, totaling $2 billion (U.S. Government Accountability Office, 2012). Perhaps reflecting the profits at stake, patients' EPO doses increase 129% at independent facilities acquired by large chains. Similarly, acquired facilities increase their use of the iron-deficiency drug Venofer relative to Ferrlecit, a perfect substitute that offers lower reimbursements. On the cost side, large chains replace high-skill nurses with lower-skill technicians at the facilities they acquire, reducing labor expenses. Facilities also increase the patient-load of each employee by 11.7% and increase the number of patients treated at each dialysis station by 4.5%, stretching resources and potentially reducing the quality of care received by patients.

Adopting the acquiring firm's operational strategies directly affects patients' outcomes and Medicare's expenditures. Patients at acquired facilities are 4.2% more likely to be hospitalized in a given month, while the survival rate for new patients falls by 1.3-2.9% depending on the time horizon. In addition, new ESRD patients who start treatment at an acquired facility are 8.5% less likely to receive a kidney transplant or be added to the transplant waitlist during their first year on dialysis, a reflection of worse care because transplants provide both a better quality of life and a longer life expectancy than dialysis. Other measures of clinical quality are mixed, at best. We find, for example, that patients are 5.1% less likely to have hemoglobin values within the recommended range and 10.0% more likely to have values that are too high, an indication of poor anemia treatment. The only outcome for which we find unequivocal evidence of improved quality at acquired facilities is the urea reduction ratio, a measure of the waste cleared during dialysis, with patients at acquired facilities becoming 1.8% more likely to have adequate clearance levels. And although patients receive worse care on these measures following an acquisition, acquired facilities increase per-treatment Medicare reimbursements by 6.9%, resulting in $301.7 million in additional Medicare spending throughout our sample on a base of $4.5 billion.

As in much of the merger-effects literature, our findings may face multiple threats to identification, as acquisitions do not occur randomly and acquired facilities likely differ from those not acquired in important, potentially unobservable ways. We overcome these challenges by using detailed claims data that allow us to observe patients with the same characteristics being treated at the same facility before and after acquisition, which allows us to identify the effects of an acquisition solely from within-facility changes in ownership. In many cases, we can also estimate specifications that include patient fixed effects and identify the acquisition effects from within-patient changes in outcomes, a particularly conservative

approach.

We then examine the mechanisms through which acquisitions affect firm behavior. We first consider whether an acquisition's effect on market power can explain the changes we observe for patient outcomes, as would be predicted by standard models of regulated markets with endogenous product quality (e.g., Gaynor (2004) and the models discussed therein). With prices set administratively for Medicare patients, these models predict that a facility facing more competition in its market would offer higher-quality care to attract patients, given the assumption that demand is elastic with respect to quality. In dialysis, however, this assumption fails to hold: patients are not very responsive to changes in quality and rarely switch facilities, mainly due to high travel costs. We therefore find similar qualitative and quantitative results across all outcomes when comparing acquisitions that increased market concentration to those that did not. As such, changes in market power cannot explain the decline in dialysis quality that occurs after a takeover, which implies that the strategy of the acquiring chain, rather than the subsequent concentration of the market, largely determines how patients fare following an acquisition.

Since an increase in local market power does not explain the changes we observe following an acquisition, we conclude our analysis by considering other explanations for why independent facilities do not typically imitate the more-profitable strategies of the large chains before being acquired. Although we assess a host of possible reasons, only two withstand scrutiny. First, and most importantly, the largest for-profit chains benefit from greater economies of scale, such as the volume discounts they receive for purchasing injectable drugs, which influences their behavior. Second, we find some limited evidence that non-profit facilities change more following an acquisition than for-profit facilities do, suggesting that for-profit acquirers' explicit mandate to maximize profits may lead them to sacrifice patient outcomes in favor of higher reimbursements.

Our paper contributes to several bodies of literature. The first studies the effects of mergers and acquisitions, both in health care and more generally.[1] Much of this literature has focused on how mergers affect prices through changes in market power.[2] The literature examining the effects of mergers and acquisitions on quality is more limited.[3] Even in regulated markets, the net effect is theoretically

[1]This is an extensive literature that cannot be fully reviewed here. For a thorough review in the context of health care, see Gaynor, Ho and Town (2015).

[2]In health care, these studies have primarily considered hospital mergers, broadly finding that they result in higher prices paid by insurers (e.g., Dafny, Ho and Lee, 2016; Dafny, 2009; Gowrisankaran, Nevo and Town, 2015).

[3]A number of papers study the effect of market concentration on hospital quality but do so without focusing explicitly on mergers and acquisitions (e.g., Kessler and McClellan, 2000; Gaynor, Moreno-Serra and Propper, 2013).

ambiguous. On the one hand, standard models without merger efficiencies (e.g., Gaynor, 2004) show that acquisitions leading to increased market power reduce the incentive to deliver high-quality care.[4] On the other hand, mergers that result in efficiency gains, such as through economies of scale, may lead to better outcomes.

Our paper also contributes to the somewhat limited literature on how "roll-up" strategies, where large firms gradually increase their market share by acquiring many of their much-smaller competitors, affect industry performance and outcomes. This "whale eats krill" pattern of consolidation has occurred in industries as varied as physician practices (Capps, Dranove and Ody, 2017) and funeral homes (Wollmann, 2019), as well as packaged ice companies, breweries, hairdressers, vending machines, medical devices (Dunn, 2016), automotive suppliers (Kocourek, Chung and McKenna, 2000), solar power (*Seeking Alpha*, 2015), and many others (*The Economist*, 2015).

Finally, our paper contributes to a recent literature specifically focused on the economics of the dialysis industry (e.g., Dai, 2014; Cutler, Dafny and Ody, 2017; Dai and Tang, 2015; Grieco and McDevitt, 2017; Eliason, 2019; Gaynor, Mehta and Richards-Shubik, 2018; Wilson, 2016a,b). Within this literature, our paper is most closely related to Cutler, Dafny and Ody (2017), who study how market concentration in the dialysis industry impacts quality and the price charged to privately insured patients. Using data from the Health Care Cost Institute and Dialysis Facility Compare (DFC), they exploit mergers of national dialysis chains as shifters in local market concentration and find no effect of concentration on quality and a weakly positive effect on prices. This differs substantially from our paper in a number of ways. First, they perform their analysis at an aggregate level because they do not observe patient-level data and are unable to match data from private insurers to facilities from DFC. By contrast, much of our analysis is performed at the patient level, allowing us to control for a large set of patient covariates and to observe how quality and treatment change within a facility — and even within a patient — over time. Moreover, our paper focuses on the role of a chain's strategy in treatment decisions, which is less likely to be influenced by local market competition. Also, some prior work has studied the effect of facility ownership on patients' treatments, but to our knowledge ours is the first to directly consider how acquisitions change firm strategies and the causal mechanisms through which

[4]Bloom et al. (2015) find empirical support for this by showing that U.K. public hospitals improve their quality when patients can more easily switch from low-quality to high-quality providers. More directly, Ho and Hamilton (2000) compare quality measures at hospitals before and after being acquired or merging with another hospital, finding that quality deteriorates along some dimensions following acquisition, especially in more-concentrated markets. Hayford (2012) and Capps (2005) also investigate the direct impact of mergers on hospital quality.

they affect patient outcomes.[5]

The rest of the paper proceeds as follows. Section II summarizes important institutional details of the dialysis industry. Section III describes our data. Section IV presents our main results on the effects of dialysis facility acquisitions. Section V shows that these effects do not vary based on market concentration. Section VI considers other explanations for why independent facilities behave differently than chains. Section VII concludes. The online appendices contain further details on the data, the sample construction, and analyses that illustrate the robustness of our findings.

II. Background on the Dialysis Industry

II.A. Medical Background

The kidneys perform two primary functions in the human body: they filter wastes and toxins out of the blood and produce erythropoietin, a hormone that stimulates red blood cell production. The diagnosis for patients experiencing chronic kidney failure, where their kidneys no longer adequately perform these functions, is called end-stage renal disease (ESRD). To survive, ESRD patients must either receive a kidney transplant or undergo dialysis, a medical treatment that mechanically filters wastes and toxins from a patient's blood. Although a transplant is considered the best course of treatment, it is often not possible, either due to a lack of available kidneys or the patient's poor physical condition. Fewer than 20% of dialysis patients are currently on a kidney waitlist, and for those who are, the median wait time for a transplant is 3.6 years (United States Renal Data System, 2014). As a result, most patients with kidney failure rely on dialysis, either permanently or for an extended period.

Those with ESRD may receive one of two types of dialysis, hemodialysis or peritoneal dialysis. Hemodialysis uses a machine (also referred to as a station and designed to treat one patient at a time) to circulate blood through a filter outside the body, which can be performed at the patient's home or at a dialysis center, whereas peritoneal dialysis uses the lining of the patient's abdomen to filter blood

[5]Garg et al. (1999), Zhang et al. (2014), and Thamer et al. (2007) study the effect of facility ownership on patients' treatments. The first two of these papers provide descriptive evidence that for-profit facilities and chain-owned facilities, respectively, are less likely to refer patients to the transplant waitlist, with Garg et al. also finding lower mortality rates at for-profit facilities. Zhang, Cotter and Thamer (2011) further show that chain-owned facilities have higher mortality rates than independent facilities, while Thamer et al. (2007) find that patients at non-profit dialysis facilities receive lower EPO doses than those at for-profit chain facilities.

inside the body.[6] Because over 90% of dialysis patients choose in-center hemodialysis, we focus on this modality for our analysis.

In addition to dialysis, most ESRD patients also receive treatment for anemia because they do not naturally produce enough erythropoeitin, which leads to a deficiency of red blood cells (Besarab et al., 1998). Anemia is treated with a cocktail of injectable drugs, most commonly the erythropoietin stimulating agent (ESA) known as Epogen (EPO), along with an intravenous iron analog, such as Venofer or Ferrlecit. Patients most commonly receive these drugs while being treated at a dialysis facility.

A dialysis facility's quality of care may be assessed through both clinical indicators and patient outcomes. Among the clinical measures, the two most prominent are the urea reduction ratio (URR) and hemoglobin (HGB) levels. The first, URR, measures the percent of primary waste (i.e., urea) filtered out of a patient's blood during dialysis, which increases as a patient spends more time on a machine. Although patients vary in how long it takes them to achieve a given URR, the standard of care is that a dialysis session should continue until a patient achieves a URR of at least 0.65 (Owen et al., 1993; NIH, 2009).

The second, a patient's HGB level, measures the onset or severity of anemia. During the period of our study, the FDA recommended EPO doses be such that HGB levels fall between 10 and 12 grams per deciliter (g/dL) (Manns and Tonelli, 2012). On the lower end, patients with HGB below 10g/dL are anemic and suffer from symptoms such as fatigue, dizziness, headaches, and, in some severe cases, death. On the other side of this range, high levels of HGB can result in serious complications, such as cardiovascular events (Besarab et al., 1998; Singh et al., 2006).

Along with these clinical measures, patient outcomes such as mortality and hospitalization represent additional indicators of a facility's quality. Of particular concern are hospitalizations for septicemia and cardiovascular events (Schrier and Wang, 2004). Septicemia, an infection of the blood for which dialysis patients are especially susceptible due to their weakened immune systems and frequent connection between the dialysis machine and their bloodstream, poses a severe risk for patients. Providers can reduce infections by properly cleaning machines between patients (Patel et al., 2013), but this is costly since it takes up to an hour to adequately sanitize a dialysis station (Grieco and McDevitt, 2017). ESRD patients also face an elevated risk for cardiovascular events such as myocardial infarction and stroke, a

[6]For more information, see `https://www.niddk.nih.gov`.

risk made worse through excessive use of EPO (Besarab et al., 1998; Singh et al., 2006).

II.B. The Role of Medicare in Dialysis

A defining feature of the dialysis industry is that 90 days after being diagnosed with ESRD, all patients become eligible for Medicare coverage, regardless of age, which makes Medicare the primary payer for most ESRD patients. In 2014, over 80% of the 460,000 ESRD patients receiving dialysis treatments in the U.S. were enrolled in Medicare. As a result, Medicare spends more than $33 billion each year for costs associated with ESRD, approximately 1% of the entire federal budget (Ramanarayanan and Snyder, 2014).

Throughout the time period of our study, Medicare used a blended payment policy to reimburse dialysis providers.[7] Specifically, Medicare paid a composite rate of around $128 per dialysis treatment, up to three times per week for each patient. For injectable drugs, providers were reimbursed separately on a fee-for-service basis depending on the quantity of drug administered, a crucial feature of the industry that we study below.[8]

Prior to 2011, fee-for-service injectable drugs generated considerable revenue for dialysis providers. In our analysis, we focus on the three most prevalent injectable anemia drugs: EPO, Venofer, and Ferrlecit. More than 90% of dialysis patients received EPO in the mid 2000s, and annual expenditures reached $2 billion in 2010, making it the largest prescription drug expense for CMS (U.S. Government Accountability Office, 2012). Administering EPO proved lucrative for providers, accounting for as much as 25% of DaVita's revenue and up to 40% of its accounting profits (DaVita, 2005). Many patient advocates questioned such pervasive use of EPO, however, as several studies linked excessive EPO doses to an increased risk of mortality and cardiovascular events (Besarab et al., 1998; Singh et al., 2006; Brookhart et al., 2010).

[7]Beginning in 2011, Medicare made a number of changes to the way it reimburses dialysis providers. In particular, it substantially changed its reimbursement policy by bundling dialysis and anemia treatment (including injectable drugs) into a single prospective payment, changing the case-mix adjustments to those payments, and introducing the Quality Incentive Program. Because these reforms likely had many confounding effects on the dialysis industry, in this paper we restrict our analysis of facility acquisitions to the years spanning 1998 to 2010 and study the effects of the 2011 reform in a separate paper (Eliason et al., 2019).

[8]For these drugs, providers were reimbursed at a rate equal to 95% of their average wholesale price prior to 2005. This was reduced to 85% in 2004. After investigations by the Centers for Medicare and Medicaid Services (CMS) found that providers were being reimbursed much more than they were spending, Congress altered the payment scheme to be 106% of the average sales price, a more accurate reflection of the drugs' true costs for providers.

The other two anemia drugs, Ferrlecit and Venofer, are intravenous iron supplements used to treat iron-deficient anemia patients; they are essentially substitutable (Kosch et al., 2001) and both offered generous reimbursements. In 2007, total Medicare expenditures for these two drugs were $68 million and $166 million, respectively, making them the fourth and sixth most highly reimbursed drugs under Medicare Part B. Both are sold by their manufacturers in single-use vials, and any amount of the drug left over in a vial must be discarded to reduce the risk of infection, with CMS reimbursing facilities for the amount in the vial rather than the amount actually administered to the patient. Although Ferrlecit and Venofer had nearly identical per-milligram reimbursement rates during our study period, Venofer was produced exclusively in 100mg vials, while Ferrlecit was produced in 62.5mg vials. As a result, facilities could effectively receive higher reimbursements per vial for Venofer because they could, for example, use 25mg from four vials rather than one 100mg vial but still bill CMS for four 100mg vials, discarding 75mg from each of the four (i.e., under this scheme they could bill for 400mg of Venofer as opposed to 250mg of Ferrlecit). One company accused of engaging in this practice paid $450 million to settle a whistleblower lawsuit (Pollack, 2011; Stempel, 2015).

Although Medicare covers the vast majority of dialysis patients in the U.S., those who have private insurance and become eligible for Medicare solely due to ESRD retain that coverage for the first 30 months of treatment before Medicare becomes the primary payer.[9] Reimbursements from private insurers tend to be much higher than those from Medicare, with estimates suggesting that the average private insurance rates are anywhere from 2.1 times (United States Renal Data System, 2013) to 4.5 times (Boyd, 2017) as generous as Medicare.[10]

II.C. The Market for Dialysis

Dialysis patients choose their provider much like they do in other segments of the U.S. health-care system, with those covered under Medicare able to receive treatment at any facility that has an opening. Patients primarily receive dialysis at one of the more than 6,000 dedicated dialysis facilities across the country, where they typically go three times per week for treatment that lasts 3-4 hours each visit.[11]

[9] Including the 90-day waiting period for Medicare eligibility, private insurance coverage may last up to 33 months.

[10] According to DaVita's 2007, 10-K the average patient with private insurance generated 3.8 times more revenue than the average Medicare patient.

[11] Unless otherwise specified, for the rest of the paper when we use the term "dialysis" we are referring to in-center hemodialysis.

These facilities are run by a mix of for-profit and non-profit firms, and over the past three decades the two largest for-profit chains, DaVita and Fresenius, have grown to the point where they now control over 60% of facilities and earn 90% of the industry's revenue (United States Renal Data System, 2014; Baker, 2019). The remainder of the market comprises smaller chains as well as independent facilities that are often run by nephrologists.

Dialysis chains potentially have a number of advantages over independent facilities. Large chains, for example, may have lower average costs due to volume discounts for pharmaceuticals as well as centralized clinical laboratories; they may have a stronger bargaining position with commercial insurance companies (Pozniak et al., 2010); and their national brand and network may make them more attractive to patients.

Chains also stand apart from independent facilities by having firm-wide standards that they implement across their facilities. Notably, large chains have operation manuals that dictate each of their facilities' procedures during treatment. We see evidence of this standardization in the predictability of a patient's EPO dose: an acquired facility's use of EPO becomes nearly twice as predictable — and twice as high — compared to its pre-acquisition doses.[12] The use of these manuals represents a clear channel through which an acquisition could alter patients' treatments and outcomes, which we study at length below.

Chains' system-wide standards may not universally lead to higher-quality care, however, as anecdotal evidence presented by the media, as well as some governmental reports, have raised concerns about practices and outcomes at both independent and chain facilities. For example, an investigative journalist from ProPublica examined the inspection records of more than 1,000 facilities and found that surveyors came across filthy or unsafe conditions in almost half the units they checked (Fields, 2010).[13] Similarly, *The New York Times* and *Washington Post* have both reported on the excessive use of injectable drugs at dialysis facilities, noting that despite the billions spent on anemia drugs, there is little evidence that they improve patients' quality of life (Berenson and Pollack, 2007; Whoriskey, 2012). Multiple reports by the Office of the Inspector General have also scrutinized dialysis facilities' drug use and acquisitions.[14] In addition to bad press, extreme cases of poor conditions and treatment quality have led to a number of

[12]These statements about predictability are based on comparing R^2 from regressions of EPO dose per patient on patient characteristics interacted with year fixed effects estimated separately using observations from facilities that are acquired either pre- or post-acquisition. See results in Appendix M.

[13]At some facilities, blood was found encrusted on patients' treatment chairs or even splattered around the room. At a unit in Durham, N.C., ants were reportedly so common that staffers would simply hand a can of bug spray to patients who complained.

[14]See OEI-03-06-00200 or OEI-03-06-00590 for two examples.

lawsuits against providers.[15] Moreover, the media has reported claims that chains potentially provide worse care by discouraging their patients from seeking kidney transplants (Matthews, 2017; Oliver, 2017).[16] In the analysis below, we will move beyond such anecdotes by using our comprehensive claims data to consider directly how a firm's strategy affects patient outcomes.

III. Data and Descriptive Statistics

A primary contribution of our paper is to show how acquisitions affect the quality of care provided by dialysis facilities, which we accomplish in part by tracking patients' treatments and tests before and after their facilities are acquired. The micro-level data we use in our analysis are essential for observing any changes in a facility's strategic choices and how these choices subsequently impact patients' outcomes and overall Medicare spending. In this section, we describe our data and provide descriptive results for the most-prominent changes in firm strategy.

III.A. Data Sets

For our analysis, we use patient- and facility-level data from the United States Renal Data System (USRDS). The USRDS is a data clearing house funded by the National Institute of Diabetes and Digestive and Kidney Diseases and the National Institute of Health that collects and stores data related to chronic kidney disease. They combine data from a variety of sources, including Medicare administrative files, Medicare claims, annual facility surveys, and clinical surveillance data, to create the most-comprehensive data set for studying the U.S. dialysis industry.[17] Appendices A and L provide more details on the data sets and how we constructed our sample.

The USRDS uses a number of data sources to create an exhaustive treatment history for almost all

[15] As an example, in 2008 Fresenius Medical Care North America agreed to settle a wrongful-death lawsuit brought by a deceased patient's survivors. According to a federal inspection report, during treatment the patient's bloodline became disconnected and, contrary to emergency standing orders, the dialysis technician reconnected the line to the patient's catheter, "infusing him with 'potentially contaminated blood'." He was later taken to a hospital where tests showed that his catheter had become infected with antibiotic-resistant staph. The infection moved to his heart and brain and he died a few days later.

[16] Although patients can self-refer for a transplant, they often lack adequate information about the procedure and fail to understand its risks and benefits. Facilities thus play an important role in a patient's decision to pursue a transplant, and some have allegedly discouraged patients from seeking one out to avoid losing their reimbursements (OPTN Minority Affairs Committee, 2015).

[17] For a more thorough description of USRDS, see the *Researcher's Guide to the USRDS System* at USRDS.org.

dialysis patients in the U.S. since at least 1991, allowing us to observe each patient's sex, race, BMI, cause of ESRD, payer, measures of kidney failure, comorbidities (e.g., diabetes and hypertension), residential ZIP Code, facility of treatment, and mortality data. We combine these data with institutional claims from Medicare, which provide a more granular view of the dialysis treatments received by Medicare patients. Providers submit line-item claims for services other than dialysis. These include all injectable drugs administered during treatment and clinical measures related to dialysis care (urea reduction ratio) and anemia treatment (hemoglobin levels) at a monthly frequency, making them among the more-detailed claims data available to researchers. These data also identify if and when a patient is hospitalized. Finally, we observe a patient's transplant and waitlist status, including their listing date and the transplant center.

Detailed data on dialysis facilities come from the Annual Facility Survey, which is required by CMS to maintain certification and receive Medicare reimbursements for ESRD treatment. From these surveys, we observe a facility ID, address, chain affiliation, labor inputs, number of dialysis stations, for-profit status, and types of treatment offered (e.g., hemodialysis, peritoneal dialysis, or transplant). These data allow us to construct a yearly panel of chain ownership for each facility. We enrich this panel and construct a monthly panel of chain ownership using precise acquisition dates for each facility from the Provider of Service files and annual cost reports submitted to CMS. This process enables us to find precise acquisition dates for 1,055 of the 1,236 acquisitions we observe.[18]

In addition to the Annual Facility Survey, providers must submit certified financial statements to CMS each year that detail their costs of providing care as part of the Healthcare Cost Reporting Information System (HCRIS), which CMS reserves the right to audit. We use these reports to construct measures of per-treatment variable costs and per-unit EPO acquisition costs.[19]

We combine these data sets and drop any patient who is missing demographic or comorbidity data. We also drop observations at facilities that are acquired but do not have reliable dates of acquisition, as well as the 12-month window surrounding an acquisition to reduce measurement error in the timing of acquisition.[20]

[18] A more-detailed description of this matching process is available in Appendix L.

[19] These data allow us to net rebates out of the total acquisition costs for EPO. We validated the fidelity of these data by comparing them to an independent audit of dialysis facility drug costs conducted by the Office of the Inspector General (OIG Report OEI-03-06-00590) in 2006 and found that the mean acquisition costs for EPO was very similar in the two sources.

[20] Our qualitative results are robust to the inclusion of this time period, though quantitative results are somewhat attenuated due to the introduction of measurement error in the timing of acquisitions. See Appendix F.

III.B. Descriptive Statistics

Figures Ia-Ib illustrate the significant change in the dialysis industry's market structure over our sample period. The number of acquisitions has varied between 50 to 150 each year, and by 2010 we observe over 1,200 first-time acquisitions of independent facilities, providing us a large sample to conduct our analysis. Consolidation increased sharply during our sample period. Figure Ia shows the extent of this change, with DaVita and Fresenius owning the majority of facilities by 2010 and the other chains collectively commanding a somewhat smaller market share. The two biggest mergers during this time period are DaVita and Fresenius' acquisitions of the large chains Gambro and Renal Care Group, respectively. We exclude these large acquisitions from our analysis, however, because we are primarily interested in understanding how the transition from a fragmented industry comprised of independently owned and operated facilities to one predominately controlled by large chains affects both patients' outcomes and Medicare's expenditures. Moreover, by focusing exclusively on the acquisitions of independent facilities, we can cleanly link changes in ownership to the resulting changes in behavior and outcomes, whereas any effects stemming from an acquisition of one large chain by another may be confounded by issues such as the integration of different corporate cultures or policies, as well as the impact of nationwide market forces. Figure Ib depicts how the acquisitions of independent facilities have contributed to each chain's overall growth during our sample period.[21] Despite the large number of acquisitions during this time, the number of independent facilities has declined only modestly, from approximately 1,500 in 1998 to 1,300 in 2010. The vast majority of this decline came from acquisitions: only 404 independent facilities exited, fewer than half the number acquired by chains.

[FIGURE Ia and Ib comes here.]

Table I presents descriptive statistics at a patient-month level, split by acquisition status (Appendix B includes an expanded version of this table that shows, for example, more of the clinical characteristics that we use in our analysis below). The first three panels describe the patient population in some detail. In addition to comorbid conditions, our data include important blood chemical tests that indicate the

[21] As Wollmann (2019) points out, one reason why such consolidation is possible is that most of the acquisitions that led to these firms' growth were exempt from the Hart-Scott-Rodino's pre-merger notification program due to the relatively small size of the target firms.

severity of each patient's kidney failure, such as the glomerular filtration rate (GFR) that measures residual kidney function. Specifically, it measures how much blood passes through the glomeruli, tiny filters in the kidneys, each minute, with a GFR below 15 possibly indicating kidney failure (Stevens et al., 2006). Of the comorbid conditions, cardiovascular conditions are widespread among dialysis patients. In total, approximately 50% of patients have at least one cardiovascular condition, with congestive heart failure the most common. The prevalence of such conditions makes any increase in EPO doses especially hazardous due to the concern that it elevates a patient's risk of cardiovascular events (Besarab et al., 1998; Singh et al., 2006). Dialysis patients are also disproportionately African-American, comprising over 30% of our sample compared to less than 15% of the U.S. population. In our analysis, we also include demographic characteristics that vary both across ZIP Codes and within a ZIP Code over time. In our regressions we control for the age of the facility and, in specifications without facility fixed effects, the facility's elevation, as medical evidence suggests that elevation influences a patient's need for EPO.[22] We also note that acquirers are more like to be for-profit firms. To summarize patient health, in the fifth panel we combine the clinical characteristics into a measure of predicted mortality by taking the fitted values from regressing an indicator for patient death on patient characteristics.[23] The table shows that, according to this measure, patient health is fairly constant across the four types of facility ownership.

[TABLE I comes here.]

Table I also allows us to investigate the potential identification challenges that we must address with our empirical strategy. Namely, patients at acquired facilities may be inherently different from patients at facilities that are not acquired, and the patient mix at acquired facilities could change after an acquisition. For many attributes, we observe no systematic differences across facility-types (e.g., GFR and congestive heart disease). We also see no meaningful difference in the share of privately insured patients across each type of facility. We do observe differences in racial composition and the rates of ischemic heart disease, however, with these differences largely coming from long-run trends in patient characteristics, as the pre-acquisition column tends to sample from earlier years and the post-acquisition column from later years. For example, the prevalence of ischemic heart disease among dialysis patients

[22] At higher elevations, the richness of oxygen in the blood decreases and tissue-hypoxia sets in, which causes the body to produce more endogenous erythropoietin (Brookhart et al., 2011) reducing the need for ESAs. Eliason et al. (2019) exploit this feature of anemia treatment to study the effect of the 2011 dialysis payment reforms on patient and market outcomes.

[23] See Appendix C for details on the construction of this measure.

has declined from 21.8% in 1998 to 10.6% in 2010. Reflecting this, when we consider only those patients treated within 12 months of the acquisition window, we find no meaningful difference between the pre- and post-acquisition groups (see Appendix D). This further suggests that any meaningful differences in demographics are driven by time trends, not changes in the mix of patients treated at facilities following an acquisition.

Nevertheless, in the analysis that follows, we directly consider the possibility that an acquisition may affect the mix of patients in ways that could bias our results. To ensure that time trends and selection bias do not confound our analysis, we control for detailed patient characteristics and include month-year fixed effects in our regressions. To further address any concerns that our findings may be driven by changes in patient unobservables, we show that our results are robust to including patient fixed effects in Appendix G. Additionally, in Section IV.D we present evidence that patients starting dialysis at acquired facilities may be healthier than those beginning treatment at the same facility before acquisition, suggesting that the deterioration in outcomes we estimate may actually be understating the true decline.

These descriptive statistics also highlight stark differences in the treatments received by patients at each type of facility. As the bottom panel of Table I clearly shows, patients at chain-owned facilities receive substantially more EPO per session and are much more likely to receive Venofer than Ferrlecit. As a result, payments per session (all Medicare payments to the dialysis facility including injectable drugs per session) jump by about 7% at facilities acquired by a chain.

Facilities' operations also change following an acquisition. Table II shows that chain-owned facilities have more stations per facility, substitute towards lower-cost technicians and away from higher-cost nurses, and generally stretch resources further by treating more patients per employee. All of these differences are consistent with a firm strategy that prioritizes profits over patient outcomes, which we consider in greater detail in the next section.

[TABLE II comes here.]

IV. The Impact of Acquisitions on Firm Strategy, Patient Outcomes, and the Cost of Dialysis Care

In this section, we show how independent facilities change their behavior after being acquired by a chain and how these changes then impact the quality and cost of care. To do so, we use a differences-in-differences research design that compares independent facilities acquired by chains to those that are never acquired:

$$Y_{ijt} = \beta^{Pre} D_{jt}^{Pre} + \beta^{Post} D_{jt}^{Post} + \beta^{Chain} D_{jt}^{Chain} + \alpha X_{ijt} + \epsilon_{ijt}, \tag{1}$$

where Y_{ijt} is the outcome of interest for patient i at facility j in month t; D_{jt}^{Pre} and D_{jt}^{Post} are indicators for whether facility j in month t will be acquired in the future or has already been acquired; and D_{jt}^{Chain} is an indicator for whether facility j is always owned by a chain. The excluded category comprises independent facilities that are not acquired during our sample period. Although X_{ijt} varies by specification, in our preferred specification it includes a host of facility and patient controls, including age, comorbidities, race, sex, time on dialysis, and facility age[24]; X also includes year, state, and facility fixed effects. Without facility fixed effects, β^{Post} would capture the mean difference in Y for facilities that have been acquired relative to facilities that are never acquired in our sample, conditional on other covariates. To avoid measurement error in the date of acquisition, and to allow enough time for a firm's strategy to be fully implemented at an acquired facility, we exclude all observations within a six-month window on either side of the acquisition date.[25] In all specifications, we cluster standard errors at the facility level.[26]

The primary threat to identification in this setting is that chains may acquire independent facilities whose patients have certain characteristics that affect Y through channels other than a change in ownership. As shown in Table I, however, patients treated at independent facilities acquired by chains

[24]Specifically, controls include: sex, race, BMI, kidney function, diabetes, hypertension, cancer, drug use, alcoholism, smoker, requiring assistance with daily activities, chronic obstructive pulmonary disease, atherosclerotic heart disease, peripheral vascular disease, ischemic heart disease, congestive heart failure, facility for-profit status, income quintile, % of those between 18-24 with just a college degree, % of those between 18-24 with just a high-school diploma, patient age, facility elevation, and facility age.

[25]As shown in Appendix F, however, our main results are robust to including this period, although slightly attenuated due to the introduction of measurement error in the timing of acquisitions.

[26]Clustering at the patient level yields standard errors 25-75% smaller than those clustered at the facility level, so we report standard errors clustered by facility as the more conservative of the two approaches.

are not systematically different along observable characteristics than those treated at other independent facilities. Additionally, the richness of our data allows us to control for all clinically relevant covariates, making this an even smaller concern. Lastly, to make a causal claim about acquisitions from a specification that includes facility fixed effects requires only that chains do not systematically change the mix of patients along unobservable dimensions when they acquire a facility, a relatively weak assumption. Moreover, our results are robust to the inclusion of patient fixed effects, which further limits this concern. Nevertheless, in Section IV.D we also explore the possibility that patient selection may be a part of the strategy chains implement post acquisition and find that new patients at acquired facilities may be slightly healthier than those who were at the same facilities before they were acquired. These findings, if anything, suggest that our results may understate the true effects of an acquisition. In short, the rich data of our empirical setting allow us to cleanly identify the effects of acquisitions on facilities' practices and patients' outcomes, affording us a unique opportunity to disentangle the otherwise opaque nature and effects of firms' corporate strategies. It is also worth noting that even though our research design exploits within-patient changes at the same facility before and after acquisition, chains may target certain areas for potential growth, and so it is possible that acquisitions in these areas may not be independent of one another. We have explored whether there is any noticeable change in the behavior of facilities of the same chain when a nearby independent joins the chain and failed to find any. Relatedly, we have found that neighboring competing facilities do not noticeably change their behavior in response to a nearby acquisition. Thus, there do not appear to be "spillover" effects from acquisitions on neighboring facilities. Additionally, in our discussions with nephrologists, we have been told that independent acquisitions are often driven by idiosyncratic reasons on the part of facility owners, such as retirement.

IV.A. Drug Doses

We first consider the use of EPO at dialysis facilities due to its importance for firms' profits, its outsize effect on Medicare's total spending on drugs, and its potential for abuse by providers. The first two columns of Table III presents estimates of equation (1) where the dependent variable is the log of EPO doses per treatment.[27] Column (1) shows that although acquired facilities were already using slightly more EPO per treatment than independent facilities that are never acquired, they experience

[27]Dependent variable is log(1+Dose) in cases where the dose is 0.

such a substantial increase following an acquisition that their levels converge to those of facilities always owned by a chain. Column (2) adds facility fixed effects and suggests that acquisitions cause EPO doses to more than double for patients at the same facility with the same observable characteristics.

[TABLE III comes here.]

By interpreting this estimate as the causal effect of an acquisition on EPO doses, we are relying on the assumption that an acquisition creates a discontinuous change in facility behavior and that any trends in dosing during the period surrounding an acquisition are common to all of the facilities in the control group. To support this assumption, in Figure II we plot EPO doses during the time period around acquisition, where the horizontal axis has the quarters relative to acquisition, quarter 0 is the quarter of acquisition denoted by a vertical dashed line, and the omitted category is the quarter prior to acquisition. The graph plots coefficients from estimating

$$Y_{ijt} = \sum_{s} \delta^s D^s_{jt} + \alpha X_{ijt} + \epsilon_{ijt}, \tag{2}$$

where D^s_{jt} is a dummy variable for facility j being acquired at time $t+s$ and X_{ijt} includes the same set of controls as equation (1), including facility fixed effects. We find no evidence of a pre-trend. We do see a short adjustment period of approximately 6 months following acquisition where facilities gradually adjust EPO doses upwards before leveling off. For this phenomenon to arise due to selection bias (in the sense that chains acquire facilities that were going to increase EPO doses irrespective of being acquired), acquiring firms would need to observe some indication of a looming increase in doses when negotiating the sale of the facility. This strikes us as implausible given that negotiations occur many months prior to the date of acquisition.

[FIGURE II comes here.]

We extend our baseline analysis to study the effect of acquisitions on the use of two other commonly used intravenous drugs given to patients with anemia, the iron-supplement drugs Ferrlecit and Venofer. The last four columns of Table III repeats the research design to focus on these drugs, with the number of observations differing across the columns because Ferrlecit and Venofer did not receive FDA approval until 1999 and 2000, respectively, whereas EPO was in use at the start of our sample in 1998. Due

to delays in the creation of HCPCS codes, we have Ferrlecit doses since 2001 and Venofer doses since 2002. The results in Table III show that acquired facilities substantially increase their use of Venofer and decrease their use of Ferrlecit.

The switch from Ferrlecit to Venofer reflects the profits at stake. As discussed in Section II.B, Ferrlecit and Venofer are essentially substitutes for one another and are reimbursed by Medicare at nearly the same per-unit rate, but differences in how manufacturers package the two drugs make Venofer a potentially more lucrative drug for providers because it allows them to bill for more "unavoidable" waste. To illustrate the onset of these strategies at newly acquired firms, we replicate Figure II for both Venofer and Ferrlecit in Appendix K.[28]

IV.B. Facility Inputs

The results in Section IV.A clearly show that chains strategically alter the drug doses of patients at newly acquired facilities. In this subsection, we investigate how they alter the input choices of their targets following takeovers in ways that reduce costs. To do so, we modify our baseline specification (1) to analyze data at the facility-year level, as data for many of the inputs (e.g., staff and the number of dialysis stations) are only available annually. Specifically, we include facility fixed effects and estimate specifications of the form

$$Y_{ijt} = \gamma^{Post} D_{jt}^{Post} + \delta X_{jt} + \nu_{jt}. \tag{3}$$

Aside from the change in the unit of observation, this analysis is very similar to our patient-level analysis and relies on similar identifying assumptions. Namely, for a causal interpretation of γ^{Post}, we require that the acquisition results in a discrete change in the environment determining facilities' input choices. With annual data, measurement error for the timing of acquisitions is an even greater concern because some inputs (e.g., staff) may change part way though the year, but we would not observe the new levels until the following year's report. To remedy this, we drop the entire year of acquisition for each facility that changes ownership, keeping only observations where a facility has the same ownership for the entire year.

Table IV displays the effect of acquisitions on facility-level labor and capital decisions. These

[28]This appendix also contains event studies for the other dependent variables analyzed in this section.

estimates show a consistent shift in the use of certain inputs by chains, with acquired facilities decreasing their use of nurses while increasing their use of dialysis technicians. Such a switch reduces facilities' costs because technicians have less training and are therefore paid less than nurses.[29] Upon acquisition, the target firm decreases its nurse-technician ratio by roughly 15.1%. Newly acquired facilities also stretch their resources by increasing their patient-to-employee ratio by 11.7% and their patient-to-station ratio by 4.5%. Taken together, we find that acquiring firms adjust the inputs of their targets by substituting away from more-experienced, higher-cost labor and by increasing both the number of patients per employee and station.

Although these changes reduce the acquired facilities' operating costs, patients may have worse outcomes if being treated by busier employees with less training diminishes their quality of care. Moreover, if the number of patients per station increases because the time each patient spends on a machine decreases, or because machines are not adequately cleaned between patients, this, too, may result in worse outcomes for patients, as shown in Grieco and McDevitt (2017).

[TABLE IV comes here.]

IV.C. Patient Outcomes

The richness of our data, along with the clinical and operational links between drugs and facility inputs, allows us to connect the changes in strategy at an acquired facility to its effects on patient outcomes. In this way, we can demonstrate how acquisitions directly impact the quality of care received by patients and the cost of this care for Medicare.

We begin by considering a number of clinical outcomes. The first three columns of Table V show the effect of acquisitions on patients' urea reduction ratio (URR) and hemoglobin (HGB) levels, two important diagnostic measures for dialysis patients. The dependent variable in column (1) of Table V measures the probability that a patient's URR reaches 0.65, the lower bound of how much urea should be removed from a patient's blood during a dialysis session according to accepted standards of care (see Section II.A for details). We find a 2.1% increase in the probability that a patient has an adequate URR following acquisition, one of the few cases where quality improves at independent facilities after being acquired by a chain.

[29]Dialysis technicians typically require only 12 months of training, much of which is done on the job. By contrast, nurses are typically required to pass an RN licensure exam.

In columns (2) and (3) of Table V, we examine how acquisitions affect patients' management of anemia. Consistent with patients' higher doses of EPO, we find that hemoglobin levels at acquired facilities rise, with a 10.0% increase in the likelihood that patients have HGB in excess of the recommended range and a 5.1% decrease in the likelihood that patients have HGB within the recommended range. In Appendix E, we expand Table V to show that the average HGB level increases and the number of patients with low HGB declines post acquisition.

[TABLE V comes here.]

Hospitalizations represent another indicator of a facility's overall quality. Column (4) of Table V shows the results from estimating our primary specification where the dependent variable is equal to 1 if a patient was hospitalized for any reason during the month and 0 otherwise.[30] Hospitalizations increase 4.2% after acquisition, with patients becoming specifically more likely to be hospitalized for septicemia and cardiac events (see Appendix E). For septicemia, the blood infection common among dialysis patients, we find that patients are 10.0% more likely to be hospitalized following an acquisition. Because these infections are avoidable through the proper cleaning and disinfecting of dialysis machines between patients (Patel et al., 2013), we consider the two most likely explanations for the higher rate of infections following a takeover to be (i) the decrease in per-patient staffing levels at acquired facilities, which leave employees with less time to properly clean machines between patients (column (7) of Table IV) and (ii) the relative increase in the use of lower-skilled employees who may be less likely to follow proper cleaning and treatment protocols (column (5) of Table IV). Patients are also 2.1% more likely to be hospitalized for an adverse cardiac event following acquisition, although this effect is not statistically significant (p-value of 0.298).[31] Such an increase would be expected given the larger EPO doses received by patients post acquisition (Table III), as the principal risk of elevated hemoglobin values (Table V) is a higher incidence of adverse cardiovascular events.

The number of patients referred for a kidney transplant represents another important measure of a facility's quality.[32] The first two columns of Table VI presents results from estimating equation (1) with an indicator for whether an incident patient was waitlisted or transplanted within a given time frame as the dependent variable. After acquisition, new patients are less likely to be placed on a transplant

[30]Episodes of hospitalization are assigned to the month in which they begin.

[31]It is worth noting that the estimate is statistically significant when we include patient fixed effects, suggesting that unobservable patient characteristics play an important role in cardiac events. See Table G1 in Appendix G.

[32]See Patzer et al. (2015) for much more on the relationship between kidney transplants and dialysis facilities.

waitlist or to receive a transplant during any of the time frames we study. One year after starting dialysis, a new patient at an acquired facility is 8.5% less likely to receive a transplant or be on the waitlist for a transplant than he or she would have been at the same facility before it was acquired. After 730 days patients are 9.0% less likely to be placed on the waitlist or receive a transplant.

[TABLE VI comes here.]

As a final measure of quality, we consider patients' survival rates. The last two columns of Table VI presents estimates of an acquisition's effect on patients' survival rates after 365 and 730 days since starting dialysis. We restrict our attention to patients starting dialysis at facilities that do not change ownership or for whom the entire observation window is before or after acquisition (e.g., to be included in the 365-day specification, a patient must start dialysis more than 365 days prior to the acquisition date). We further restrict our attention to those patients who remain at the same facility until their date of death or the end of the observation window.[33] We find that patients' 365-day survival rate decreases by 1.27 percentage points, or 1.7%. After 730 days patient survival rates fall by 2.9%.

When considering the totality of our results for clinical outcomes, hospitalizations, transplants, and survival, the overarching finding is that acquisitions result in worse care for patients. But providing high-quality care is costly, so it remains possible that these acquisitions could reduce overall spending on dialysis, making the overall impact on welfare inconclusive. We do not find evidence that acquisitions reduce Medicare expenditures in the dialysis industry, however, as the final column of Table V shows that acquired facilities increase their per-session Medicare reimbursements by 6.9%, amounting to $252.4 million in additional spending for Medicare throughout our sample. In short, we find that acquisitions lead to clear changes in firm strategy that substantially worsen the quality of care received by patients and increase the cost of care borne by Medicare.

IV.D. Patient Selection

Although the results above are robust to controlling for patient observables and (where feasible) patient fixed effects, we also consider whether a facility changes its mix of patients following an acquisition for two reasons. First, if observable patient attributes at a facility change post acquisition, it may

[33] We have done robustness checks estimating these effects including all patients as well as those who return to the facility within 30 or 60 days, finding similar results.

suggest that selection on unobservables could be biasing our results. Second, the ability of chains to selectively treat desirable patients may be an important strategy in and of itself, often referred to as "cream skimming."

To conduct this analysis, we estimate a series of differences-in-differences specifications with facility and time fixed effects, where the dependent variables are the patient-level controls from the previous specifications, as displayed in equation (4):

$$X_{ijt} = \beta^{Post} D_{jt}^{Post} + \gamma_j + \delta_t + \epsilon_{ijt}. \tag{4}$$

We estimate this specification for both the main patient-month sample as well as a sample restricted to patients in their first month on dialysis, with the results presented in Figure III. Each plot displays the coefficient estimates of β^{Post} along with 95% confidence bands, all rescaled by the mean of their respective variables.

As shown in Figure IIIa, we do not find any systematic evidence of cream skimming in the monthly data. In Figure IIIb, however, we do find some slight evidence that the characteristics of new patients change following an acquisition. In both cases, the changes are unequivocally in the direction of facilities treating healthier patients despite our finding of worse patient outcomes overall. For example, new patients at acquired facilities are less likely to have a variety of comorbid conditions, such as diabetes, hypertension, cancer, and heart disease. If these observable patient attributes are correlated with unobservable attributes, then our results suggest that selection would likely bias our findings of worse outcomes towards zero, making them conservative.

[FIGURE III comes here.]

V. The Effect of Competition on Firm Behavior

In this section, we investigate whether competition from other dialysis firms can discipline the behavior of newly acquired facilities. With the price for most dialysis treatments fixed by Medicare, facilities may compete for patients by offering higher-quality treatments or other services. Such competition may prevent the acquirer from implementing its strategies to increase profits if patients respond to the

corresponding decline in quality by defecting to a rival facility. In what follows, we find no evidence that market concentration mitigates the transference of firm strategy in the dialysis industry. In this way, our findings echo those of Cutler, Dafny and Ody (2017), who, using a different identification strategy and more-aggregate data, also find no evidence that increased concentration from national mergers affects the quality of care received by dialysis patients. We argue below that a key reason that competition does not affect facilities' behavior is that patients rarely respond to differences in quality, as reflected in the low number of patients who switch facilities each year.

To investigate the effect of concentration on firm behavior, we must first establish a relevant geographic market and then select an appropriate measure of concentration. The existing literature lacks a clear consensus on how to define markets for the dialysis industry — Cutler, Dafny and Ody (2017) and Grieco and McDevitt (2017) define markets as Hospital Service Areas (HSAs); Wilson (2016a) and Dai (2014) use counties; and Wilson (2016b) and Eliason (2019) develop facility-specific markets using distance bands around each facility. In light of this, we focus below on a specification that defines markets as HSAs and uses HHI to measure concentration but show in Appendix I that our results are robust to a variety of other market definitions and measures of concentration.

V.A. Most Acquisitions Do Not Change Market Concentration

We begin by examining whether the acquisitions of independent facilities by chains actually affect market concentration. We first locate market-months where an acquisition will occur in the following month, finding 891 such instances.[34] We then calculate the HHI for that market and what the HHI would have been if the acquisition had already occurred.[35]

Figure IV shows a scatterplot of pre- and post-acquisition HHI for each HSA-month where an acquisition is about to occur (we reduced the transparency of each dot to 30% so that darker regions imply more overlapping markets or more mass in that area). HHI increases in only 34.4% of HSA-months following an acquisition.[36]

[FIGURE IV comes here.]

[34]This is less than the total acquisitions due to HSA-months where multiple facilities are acquired.

[35]We use this as our definition of post-acquisition HHI to avoid confounding the effect of acquisition with the entry of new dialysis facilities.

[36]Note that 32.6% of markets where acquisitions occur have only one facility, denoted by the mass at (1,1) in the figure.

That HHI increases in so few markets following a takeover strongly suggests that changes in facility behavior and patient outcomes are not driven by changes in market concentration. To this point, we find that our results are quantitatively very similar to those in Section IV when we restrict our sample to markets with only one facility, meaning that the results for these markets could not possibly be explained by changes in concentration.[37] Rather, firm strategy appears to be the main determining factor.

V.B. Acquisitions That Increase HHI Have Similar Effects

Next, we show in Table VII that the outcomes in markets where an acquisition increased concentration do not differ from those where an acquisition did not affect market concentration. To do so, we modify our baseline specification by interacting our post-acquisition dummy variable with a dummy variable for whether the acquisition of that facility increased HHI in the market, defined here as an HSA.[38] Formally, this estimating equation is

$$Y_{ijt} = \beta^{Post} D_{jt}^{Post} + \gamma D_{jt}^{Post} \times IncreasesHHI_j + \alpha X_{ijt} + \epsilon_{ijt}, \tag{5}$$

where $IncreasesHHI_j$ is a dummy variable indicating if the acquisition of facility j increased the market's HHI. The effects in Table VII are not substantially different from our baseline results, either qualitatively or quantitatively. In addition, we see no effect on the indicator variable for acquisitions that increase HHI, implying that the changes in outcomes we see after an acquisition are not driven by changes in market concentration, leaving changes in management practices as the most likely explanation. As mentioned above, we provide further support for this result in Table I9 in Appendix I, which shows in a sample restricted to markets with only one facility (so that there can be no change in concentration following an acquisition) that the effects of acquisitions are very similar to the baseline results. Further, Table I10 in Appendix I shows that even in markets that are deemed "non-worrisome" by antitrust agencies due to either their low levels of concentration or small changes in HHI post acquisition, we find very similar effects.

A noteworthy implication of these results is that consolidation can have detrimental effects irrespec-

[37] See Table I9 in Appendix I.

[38] In Appendix I, we show that our results are robust to other measures of concentration beyond HHI, a continuous measure of the change in HHI, and other market definitions.

tive of market concentration. As acquisitions lead to fewer active firms nationwide, the strategies and management practices of the expanding firms may increasingly affect aggregate outcomes. In this case, acquisitions drive both concentration and a decrease in the quality of care, but the channel through which the latter occurs is the transference of firm strategy, not an increase in market power.

[TABLE VII comes here.]

V.C. Why Competition Does Not Discipline Provider Behavior

In regulated markets, standard models of competition with endogenous provider quality predict that quality will increase with the extent of competition in the market (e.g., Gaynor (2004) and the models discussed therein). This theoretical result relies on the assumption that demand increases with product quality, which in our setting would mean that patients are more likely to choose a high-quality facility, all else equal, and thus facilities would compete for patients by offering higher-quality care. In practice, patient demand in the U.S. dialysis market does not respond to the decline in quality following an acquisition. As suggested in column (7) of Table IV, acquired facilities actually increase the number of patients they treat per machine despite providing lower-quality treatments.

We look more directly at this result by considering whether patients are more likely to switch away from a facility after it is acquired, finding that they are not. In general, it is uncommon for dialysis patients to switch providers, with 98.4% of patient-months in our sample such that the patient visits the same facility the following month. For patients who have completed 12 months of dialysis, only 1.3% of patient-months represent a permanent switch away from a facility.

In addition to the low absolute levels of switching among patients, we show in Table VIII that patients do not become more likely to switch after their facility is acquired. For the full sample of patients, our point estimate of the effect of acquisition on switching is -0.06 percentage points, which is small economically and not statistically significant at conventional levels. In addition, we find that acquisitions do not have a meaningful impact on patients' likelihood of switching in their first year or if we only include facility switches where the patient does not return to his or her initial facility.

[TABLE VIII comes here.]

A host of institutional and behavioral factors explain why patients do not switch from low-quality providers. In many markets, patients may not have a valid outside option, as one-third of markets

in our sample have only 1 facility. Our findings are unchanged, however, if we repeat the analysis in Table VIII but restrict our sample to include only markets with at least two facilities.[39] Moreover, even patients who live in markets with multiple facilities face significant travel costs due to the frequency of visits required for dialysis, as documented in Eliason (2019). These travel costs are exacerbated by comorbidities that make travel difficult as well as the low income of most dialysis patients. As such, travel costs may outweigh concerns about a facility's quality for most patients. Behavioral inertia likely also plays a significant role in this market, as it does in other health-care settings (e.g., Handel, 2013; Tilipman, 2018).

VI. Understanding Pre-Acquisition Differences Across Chain and Independent Facilities

In the analysis above, we find that the effects of an acquisition persist even when it is not accompanied by a change in market structure. In almost all cases, independent facilities acquired by chains had better patient outcomes but lower profits than chain facilities prior to being acquired. Shortly after acquisition, the chains implement new policies regarding, for instance, the facilities' drug doses and staffing levels, which then lead to higher profits but worse outcomes for patients. Because competitive pressure does not explain why independent facilities do not imitate the behavior of the more-profitable chain facilities before acquisition, as shown in Section V, in this section we explore several alternative explanations. We find the most prominent reason relates to differences in the potential tradeoffs facilities face regarding maximizing their own profits and maintaining high standards of care, which stem primarily from differences in economies of scale for purchasing injectable drugs.

To conduct this analysis, we supplement the USRDS data with data from HCRIS that include accounting costs for key facility inputs, such as EPO, which allows us to better understand the differences in facilities' costs and why some might behave differently. We estimate the impact of an acquisition on total variable profits per dialysis session and several variables related to EPO using the following specification:

$$Y_{jt} = \beta^{Pre} D_{jt}^{Pre} + \beta^{Post} D_{jt}^{Post} + \beta^{Chain} D_{jt}^{Chain} + \alpha X_{jt} + \epsilon_{jt}, \tag{6}$$

[39] Results available upon request.

where X includes state and year fixed effects. From the results presented in Table IX, we find no evidence that chains disproportionately acquire the least-sophisticated or worst-performing independent facilities to turn around, unlike in other settings where sharply declining financial performance prompts an ownership change (Brav, Jiang and Kim, 2015). That is, acquired independents are no less profitable than the independents that are not acquired.[40] Column (1) shows that, on average, independent facilities that are eventually acquired earned a statistically insignificant $1.36 more in variable profits per session (these exclude fixed costs such as rent) before acquisition compared to the omitted group, independent facilities that are never acquired. After acquisition, per-session variable profits increase by $16.81 (= $18.17 – $1.36) at the acquired independent facilities.[41] This suggests that chains do not selectively acquire low-performing independent facilities; rather, both acquired and not-acquired independent facilities had similar profits prior to acquisition. After acquisition, the new owners then improve the financial performance of their targets, similar to what Braguinsky et al. (2015) found for Japanese cotton mills and Natividad (2014) found for a large fishing firm that acquired some of its suppliers.

[TABLE IX comes here.]

Most of the increase in per-session profits at acquired facilities comes from EPO. Column (2) of Table IX shows that the profits from EPO increase by $8.43 per session, or 50.1% of the total increase in profits shown in column (1). EPO is more profitable for chains in part because they pay lower prices for the drug, as shown in column (3), which reflects the volume discounts they negotiate with drug suppliers. For example, in DaVita's 2005 Annual Report, the company writes, "Our agreement with Amgen for the purchase of EPO includes volume discounts and other thresholds which could negatively impact our earnings if we are unable to meet those thresholds." Also, "Our contract with Amgen provides for specific rebates and incentives that are based on ... purchase volume growth." Facing lower costs for EPO, chains use more of it, as shown in column (4), so total EPO expenditures differ little after acquisition, as shown in column (5).

[40] If anything, acquired independents were behaving slightly more like for-profit chains prior to acquisition with respect to EPO doses, as shown in column (1) of Table III, meaning that there were likely fewer profitable opportunities to increase patients' doses following acquisition.

[41] The difference is $17.73 based on a specification with facility fixed effects. We focus on the specifications without facility fixed effects because they allow us to compare the pre-acquisition profits of acquired facilities to the profits of facilities that were never acquired.

The scale economies stemming from buyer power are not available to smaller independent facilities, and this is a key reason why their behavior differs from chains' prior to acquisition. If independent providers treated patients with the same doses that the largest chains do, they would earn only 55% of the profits due to their higher wholesale costs for EPO.[42] If providers balance the financial gains of giving patients larger EPO doses against the risks and non-pecuniary costs of doing so, such as an elevated risk of cardiac events for patients, this difference in per-unit costs may lead chains to administer more EPO to their patients. That is to say, these cost differences may induce different dosing strategies even if chains and independents are both seeking to maximize their profits.[43]

Another possible explanation for why independent and chain facilities behave differently is that chains may have different underlying objectives, perhaps focusing more on financial performance than on patient outcomes. One way to proxy for the incentives that a firm faces is its for-profit status. Because the largest chains are for-profit firms and many independent facilities are non-profit, the change in for-profit status following an acquisition may explain the changes in behavior and outcomes rather than the change in ownership itself. A related argument is made by Eaton, Howell and Yannelis (2018), who show that the high-powered incentives introduced by private equity owners following takeovers in higher education lead to better financial performance but worse student outcomes. We explore this possibility in Appendix H, finding in Tables H1 and H2 that the post-acquisition changes across most of our measures are largely the same for all acquired independent facilities, regardless of whether they were previously non-profit or for-profit. There are a few notable exceptions to this: the effects of acquisition on EPO and Venofer doses, as well as the use of technicians, are all smaller in the case of for-profit independent facilities. The effect is diminished primarily because for-profit independent facilities were already behaving more like chains along these dimensions before they were acquired, suggesting that changes in for-profit status may account for some portion of our results. At the same time, these differences are relatively small, suggesting that the effects arising from a change in for-profit status are secondary to the effects from a change in ownership.[44]

In addition, chains' behavior might seem risky given the potential negative impacts on patient care

[42]This assumes that Medicare reimburses $10 per 1000 IUs of EPO, which is a close approximation of the actual rate during the study period: $\frac{10-(9.19-0.37)}{10-(9.19-1.34)} = 0.5488$.

[43]The result that newly acquired independents benefit from chain-level economies of scale contrasts somewhat with the results of Blonigen and Pierce (2016), who find little evidence of merger efficiencies in U.S. manufacturing.

[44]These results are in line with those of Duggan (2000), who finds evidence that non-profit hospitals are no more altruistic than for-profit ones.

resulting from excessive drug doses or low staffing levels. Chains may be more willing than independent facilities to accept this risk if they have large financial reserves to pay for any future litigation, allowing them to behave in ways that increase their profits even if it makes it more likely they will face malpractice lawsuits. Perhaps reflecting this, DaVita has made at least four settlements exceeding $100 million in the last 10 years.

Other possible explanations for the differences in behavior between independent and chain facilities lack empirical support. For example, we showed above in Section IV.D that chain and independent facilities treat a very similar distribution of patients, so it is unlikely that a change in patient mix following a takeover alters a target's behavior. Another possible explanation is that chains may be subject to different regulations than independent facilities, but both types of facilities face the same regulatory environment, such as Medicare reimbursement rates and certification standards. Given the lack of support for these alternative explanations, we conclude that a leading explanation for why independent facilities do not employ the same strategies as chains is that they face different tradeoffs when balancing profits and patient care, the majority of which arise from differences in economies of scale.

VII. Conclusion

Changes in ownership affect the treatment and outcomes of patients at independent dialysis facilities acquired by chains. Our results show that acquired facilities change their behavior in three broad ways, each of which either increases their revenue or decreases their operating costs. First, acquired facilities capture higher per-session reimbursements from Medicare by increasing drug doses and shifting to more-lucrative drugs. Second, acquired facilities stretch their resources by treating more patients relative to the number of staff and stations at the facility. Third, acquired facilities reduce their costs of providing dialysis by replacing high-skill nurses with lower-skill technicians.

Adopting the acquirer's strategies causes the acquired facility's quality of care to decline. Along almost every dimension we measure, patients fare worse at the target facility after acquisition, most prominently in terms of fewer kidney transplants, more hospitalizations, and lower survival rates. Because Medicare spends more after acquired facilities implement their strategic changes, we interpret the diminished quality to represent an unambiguous decline in the overall value of dialysis treatments, at

least in the short run.[45] More research is needed to understand the implications for total welfare, as these acquisition may promote access to dialysis in underserved markets.

Our findings have important policy implications, as most of the acquisitions we study fall outside the scope of current antitrust laws, which prohibit acquisitions if "the effect of such acquisition may be substantially to lessen competition, or to tend to create a monopoly" (U.S. Department of Justice and Federal Trade Commission, 2010). To the extent that the diffusion of firm strategy, rather than a change in market concentration, causes the quality of dialysis care to decline, minor adjustments to the current antitrust statutes may do little to prevent the harmful effects of these acquisitions.

One policy prescription would be to avoid enacting regulations that could unintentionally spur consolidation, such as certificate of need laws that make new entry more difficult for expanding health-care providers and lead them to favor acquisitions instead (Pozniak et al., 2010). Others have raised concerns that policies that increase the administrative burdens for facilities may inadvertently increase consolidation (Gaynor, 2018), along with certain aspects of Medicare's reimbursement policies. By tying each firm's reimbursements to the costs of comparable firms, regulators encourage cost minimization through "yardstick competition" (Shleifer, 1985), which may increase the pressure to consolidate if greater economies of scale are necessary to decrease costs and maintain high profit margins. Similarly, the uniform fee-for-service reimbursement policy for injectable drugs may also contribute to consolidation, as it favors large firms that can negotiate lower prices for drugs. Although each of these policies likely has beneficial aspects, their tendency to drive consolidation should nevertheless be viewed as a tradeoff against those benefits.

Our results also illustrate the importance of well-designed payment systems in controlling health-care costs and improving patient outcomes. As we show in the case of EPO, poorly structured reimbursement schemes can induce provider behavior that not only wastes resources, but also harms patients. By improving the design of Medicare's payment systems, policymakers can simultaneously reduce costs and improve outcomes. Some changes in this direction have already occurred. In 2011, for example, Medicare bundled payments for dialysis treatments and their associated injectable drugs into a single

[45] A possible benefit from the cost-cutting strategies of chains is that they may be eventually incorporated into the reimbursement rate, resulting in lower costs for Medicare. Although we cannot rule out this possibility due to the fact that we do not observe the counterfactual reimbursement rate, this effect seems likely to be small. Over the period of our study, the dialysis reimbursement rate rose steadily. Furthermore, when Medicare combined payments for injectable drugs and dialysis into a single prospective payment in 2011, the new payment rate was designed to be approximately budget neutral, based on historic EPO usage. Thus, the high use of EPO by chains resulted in higher prospective payments for all providers after 2011.

Prospective Payment System, which effectively reduced providers' financial incentives to overuse EPO. To address the resulting incentive to use too little EPO, the Quality Incentive Program initiated in 2012 allows Medicare to penalize providers that fail to meet certain quality standards: providers that have too many patients below the benchmark for hemoglobin levels, for example, could lose up to 2% of their entire reimbursement from Medicare. Although these changes would seem to improve facilities' incentives for providing high-quality and cost-effective care, more research is needed to understand how they have changed the industry and affected patients (Eliason et al., 2019).

Finally, because dialysis is a market in which the government, via Medicare, plays an outsize role in subsidizing care and in which patients may find it difficult to observe their facilities' quality, competition may be unlikely to discipline providers' behavior. Our findings are therefore likely to be applicable to similar settings in other areas of health care or higher education. Indeed, Eaton, Howell and Yannelis (2018) show that private equity buyouts in higher education lead to higher tuition and per-student debt, while at the same time resulting in lower graduation rates, loan repayment rates, and earnings among graduates. Complementing this result, Bernstein and Sheen (2016) find that private equity buyouts of restaurants lead to better health safety ratings, arguably a very visible measure of quality for consumers. As such, future work should consider how the effects of acquisitions differ in markets characterized by extensive government intervention, such as health care and education, compared to those without it, such as restaurants, as well as how these effects differ depending on how well patients or consumers can observe quality.

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Supplementary Material

An Online Appendix for this article can be found at The Quarterly Journal of Economics online.

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Tables

Table I
Patient and Treatment Descriptive Statistics by Facility Type

	Always Independent	Pre-Acquisition	Post-Acquisition	Always Chain
Clinical Characteristics				
GFR	7.92	7.74	7.99	7.71
Hemoglobin	7.68	7.67	7.73	7.56
Atherosclerotic Heart Disease (%)	5.74	7.18	4.76	4.77
Peripheral Vascular Disease (%)	13.44	14.33	12.53	11.47
Ischemic Heart Disease (%)	17.25	20.58	14.84	13.75
Congestive Heart Failure (%)	31.07	32.04	30.29	28.56
Demographics				
Male (%)	53.87	53.18	52.93	52.15
Non-Hispanic White (%)	48.56	53.42	44.41	40.44
Black (%)	32.30	30.65	36.23	39.98
Hispanic (%)	13.06	10.03	13.79	14.77
Asian (%)	3.33	2.57	2.62	2.41
Other Race (%)	5.61	5.33	4.91	4.52
Age (Years)	64.31	64.53	64.02	63.38
Months With ESRD	35.83	31.75	37.06	36.88
Distance (Mi.)[b]	4.93	5.36	5.11	5.00
Area Demographics				
% 18-24 with only High School	31.79	33.24	33.19	32.90
% 18-24 with only Bachelors	9.10	7.81	7.46	7.76
Median Income ($)	50,404.87	48,202.46	47,441.34	47,637.76
Facility Characteristics				
Facility Age (Years)	14.08	12.02	10.10	13.86
Facility Elevation (ft.)	195.54	198.65	211.42	192.58
For-Profit (%)	40.99	64.09	96.40	88.70
Patient Health				
Predicted Mortality (%)	1.03	1.07	1.06	1.17
Treatment				
EPO Per Session ('000 IU's)	4,495.66	4,728.87	6,223.04	6,259.82
Venofer Per Session (mg)	7.95	7.60	15.93	14.86
Ferrlecit Per Session (mg)	6.49	7.22	4.65	4.86
Payments Per Session	179.22	171.79	184.58	183.15
Waitlist or Transplant[a] (%)	10.92	9.63	9.76	9.52
Patient-Months	2,880,503	1,483,917	1,960,286	7,836,538
Incident Patients	235,144	142,815	126,582	400,161

Notes: See text for more detail.
[a] Dummy variable for being waitlisted or transplanted within 1 year for incident patients only.
[b] Median distance is displayed instead of mean.

TABLE II
FACILITY SUMMARY STATISTICS

	Always Independent	Pre-Acquisition	Post-Acquisition	Always Chain
Stations	14.30	16.63	18.39	17.92
	(8.63)	(7.82)	(8.13)	(7.39)
Hemodialysis (%)	89.90	91.69	92.36	94.22
	(19.25)	(15.92)	(14.76)	(13.06)
Privately Insured (%)	6.52	7.43	6.66	6.79
	(6.17)	(5.85)	(4.12)	(5.38)
Nurses	5.61	5.14	4.23	3.70
	(4.06)	(3.76)	(2.63)	(2.26)
Technicians	4.95	6.20	6.65	6.22
	(5.09)	(4.77)	(4.53)	(4.12)
Nurses/Techs	1.62	1.08	0.77	0.72
	(2.21)	(1.17)	(0.70)	(0.59)
Patients/Employee	4.14	4.75	5.84	5.52
	(2.76)	(2.14)	(2.09)	(2.34)
Has Night Shift (%)	24.85	23.85	23.88	18.47
	(43.22)	(42.62)	(42.64)	(38.81)
For-Profit (%)	35.15	66.48	94.12	88.10
	(47.75)	(47.21)	(23.53)	(32.37)
Facility Elevation (ft.)	251.24	205.88	209.83	229.52
	(359.41)	(242.46)	(282.05)	(342.04)
Facility Age (Years)	12.93	9.11	9.74	10.98
	(9.71)	(8.61)	(7.11)	(8.50)
Facility-Years	7,824	4,063	4,137	16,459

Notes: An observation is a facility-year. Standard deviations are in parentheses.

Table III
Acquisition Effects on Drug Doses

	(1) Epogen	(2) Epogen	(3) Ferrlecit	(4) Ferrlecit	(5) Venofer	(6) Venofer
Pre-Acquisition	0.270*		-0.0188		0.0650	
	(0.124)		(0.0558)		(0.0604)	
Post-Acquisition	1.350***	0.829***	-0.351***	-0.303***	0.784***	0.612***
	(0.0822)	(0.0725)	(0.0466)	(0.0627)	(0.0555)	(0.0751)
Always Chain	1.343***		-0.335***		0.722***	
	(0.0775)		(0.0391)		(0.0454)	
Observations	14,161,244		12,473,162		11,595,400	
Dep. Var. Mean	7.538		0.589		1.337	
Units	log(IU)		log(mg)		log(mg)	
Year x Month FE	X	X	X	X	X	X
Controls	X	X	X	X	X	X
Facility FE		X		X		X

Notes. Facility-clustered standard errors in parentheses. An observation is a patient-month. Venofer and Ferrlecit specifications have different observations due to the availability of the two drugs. Ferrlecit was introduced in 1999 and Venofer in late 2000. Sample includes hemodialysis patients who have complete covariates and are treated at facilities involved in an independent-to-chain acquisition or that are independent or owned by the same chain for the entirety of our sample. We drop observations within 6 months of the month of acquisition. Drug doses are winsorized at the 99th percentile. *, ** and *** indicate significance at the 5%, 1% and 0.1% level, respectively. Controls include patient and facility characteristics.

Table IV
Acquisition Effects on Facility Input Choices

	(1) Nurses	(2) Technicians	(3) HD Patients	(4) Total Stations	(5) Nurses per Tech	(6) Patients per Employee	(7) Patients per Station	(8) Employees per Station
Post-Acquisition	-0.0204	0.0456*	0.134***	0.0210	-0.146***	0.599***	0.179*	-0.0289
	(0.0194)	(0.0230)	(0.0187)	(0.0410)	(0.0410)	(0.107)	(0.0825)	(0.0185)
Observations	24,868	24,868	42,944	43,046	23,217	24,868	43,046	24,868
Dep. Var. Mean	1.548	1.703	61.554	18.574	0.969	5.129	3.992	0.814
Units	log(FTE)	log(FTE)	log(Patients)	log(Stations)	-	-	-	-
Year FE	X	X	X	X	X	X	X	X
Facility FE	X	X	X	X	X	X	X	X

Notes. Facility-clustered standard errors in parentheses. An observation is a facility-year. Sample includes facilities involved in an independent-to-chain acquisition and facilities which are independent or owned by the same chain for the entirety of our sample. We drop observations in the year of acquisition. FTE are Full-Time Equivalents. *, ** and *** indicate significance at the 5%, 1% and 0.1% level, respectively.

TABLE V
ACQUISITION EFFECTS ON OUTCOMES

	(1) URR Good	(2) HGB Good	(3) HGB High	(4) Hospitalized Any Cause	(5) Payments Per-Session
Post-Acquisition	0.0183***	-0.0266**	0.0382***	0.00599***	0.0665***
	(0.00496)	(0.00825)	(0.00899)	(0.00170)	(0.00617)
Observations	14,161,244	13,271,104	13,271,104	14,161,244	14,161,243
Dep. Var. Mean	0.881	0.523	0.382	0.141	5.150
Units	pp	pp	pp	pp	log($)
Year x Month FE	X	X	X	X	X
Pat. & Fac. Controls	X	X	X	X	X
Facility FE	X	X	X	X	X

Notes. Facility-clustered standard errors in parentheses. An observation is a patient-month. Hemoglobin specifications have different observations because it is not submitted with non-ESA claims for some of our sample. Sample includes hemodialysis patients who have complete covariates and are treated at facilities involved in an independent-to-chain acquisition or that are independent or owned by the same chain for the entirety of our sample. We drop observations within 6 months of the month of acquisition. Payments are winsorized at the 99th percentile. *, ** and *** indicate significance at the 5%, 1% and 0.1% level, respectively.

TABLE VI
ACQUISITION EFFECTS ON TRANSPLANTS AND MORTALITY

	Waitlisted or Transplanted Within:		Survives for:	
	(1) 365 Days	(2) 730 Days	(3) 365 Days	(4) 730 Days
Post-Acquisition	-0.0108*	-0.0188*	-0.0127**	-0.0174**
	(0.00468)	(0.00738)	(0.00476)	(0.00654)
Observations	610,955	498,056	539,487	457,184
Dep. Var. Mean	0.127	0.208	0.746	0.597
Units	pp	pp	pp	pp
Year FE	X	X	X	X
Pat. & Fac. Controls	X	X	X	X
Facility FE	X	X	X	X

Notes. Estimates from OLS regression. Facility-clustered standard errors in parentheses. An observation is a new dialysis patient. Sample includes new patients starting dialysis at facilities involved in an independent-to-chain acquisition or that are independent or owned by the same chain for the entirety of our sample. For the mortality specifications we drop any patients who start dialysis at facilities acquired within six months of acquisition. We only include those patients who remain at their original facility until death or the end of the observation window. *, ** and *** indicate significance at the 5%, 1% and 0.1% level, respectively.

TABLE VII
ACQUISITION EFFECTS BY CONCENTRATION INCREASE: HSA MARKETS

	Drugs			Clinical Outcomes			Hospitalized
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Epogen	Venofer	Ferrlecit	HGB High	HGB Good	URR Good	Any Cause
Post-Acquisition	0.808***	0.553***	-0.286**	-0.0313**	-0.0123*	0.0174*	0.00800**
	(0.0752)	(0.123)	(0.100)	(0.0112)	(0.00533)	(0.00708)	(0.00250)
Post-Acquisition ×	-0.0486	0.0891	-0.0267	0.00747	0.00120	0.00156	-0.00318
Increases HSA HHI	(0.0823)	(0.151)	(0.124)	(0.0153)	(0.00614)	(0.00893)	(0.00324)
Patient-Months	14,161,244	11,595,400	12,473,162	13,271,104	13,271,104	14,161,244	14,161,244
Units	log(UI)	log(mg)	log(mg)	pp	pp	pp	pp
Pat. & Fac Controls	X	X	X	X	X	X	X
Year x Month FE	X	X	X	X	X	X	X
Facility FE	X	X	X	X	X	X	X

Notes. Facility-clustered standard errors in parentheses. An observation is a patient-month. Sample includes hemodialysis patients who have complete covariates and are treated at facilities involved in an independent-to-chain acquisition or that are independent or owned by the same chain for the entirety of our sample. We drop observations within 6 months of the month of acquisition. Drug doses are winsorized at the 99th percentile. The number of observations differs from the baseline specification due to missing ZIP Code-to-market crosswalk data. *, ** and *** indicate significance at the 5%, 1% and 0.1% level, respectively.

TABLE VIII
EFFECT OF ACQUISITION ON FACILITY SWITCHING

	All		First Year	
	(1) Any	(2) Never Return	(3) Any	(4) Never Return
Post-Acquisition	-0.000707	-0.000467	-0.000384	-0.000300
	(0.000507)	(0.000454)	(0.000847)	(0.000772)
Observations	13,898,240	13,898,240	3,416,860	3,416,860
Dep. Var. Mean	0.016	0.013	0.024	0.020

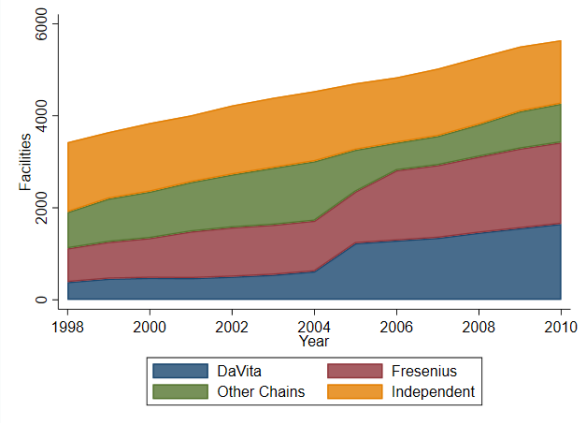
Notes. Facility-clustered standard errors in parentheses. An observation is a patient-month. Sample includes hemodialysis patients who have complete covariates and are treated at facilities involved in an independent-to-chain acquisition or that are independent or owned by the same chain for the entirety of our sample. We drop observations within 6 months of the month of acquisition. Columns (3) and (4) include only patients in their first 12 months on dialysis. The dependent variable in columns (1) and (2) is 1 if the patient is on dialysis the next month at a different facility and 0 if they remain on dialysis at their current facility. The dependent variable in columns (2) and (4) is 1 only for those patients who do not return to the initial facility at any point in our sample. *, ** and *** indicate significance at the 5%, 1% and 0.1% level, respectively.

TABLE IX
EFFECT OF CHAIN ACQUISITION ON PROFIT MEASURES

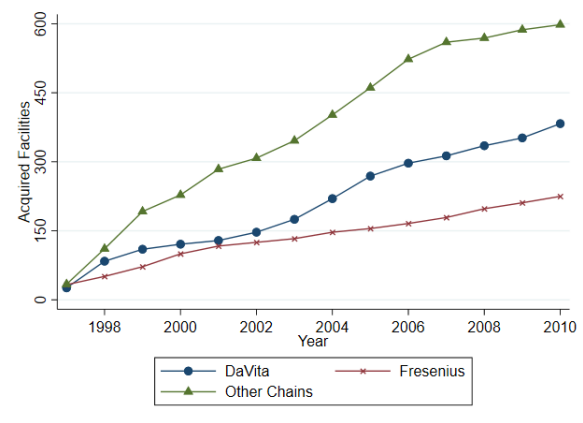
	(1) Variable Profits per Session	(2) EPO Margin	(3) EPO Cost Per 1000 IUs	(4) EPO Units per Session	(5) Total EPO Costs
Pre-Acq	1.360	-0.581	-0.371**	222.5	-0.451
	(2.497)	(1.652)	(0.141)	(204.1)	(1.723)
Post-Acq	18.17***	7.851***	-1.237***	778.8***	0.965
	(2.205)	(1.334)	(0.145)	(171.9)	(1.464)
Always Chain	22.16***	7.975***	-1.340***	812.2***	0.745
	(2.344)	(1.626)	(0.156)	(193.4)	(1.724)
Constant	30.60***	1.113	9.190***	3835.8***	35.36***
	(3.704)	(3.399)	(0.205)	(265.7)	(2.833)
Year FE	X	X	X	X	X
State FE	X	X	X	X	X
Observations	25,934	25,934	25,934	25,934	25,934
Post - Pre	16.81	8.432	-0.866	556.3	1.416
P-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.0720]
Always Chain - Post	3.993	0.123	-0.103	33.42	-0.220
P-value	[0.002]	[0.880]	[0.000]	[0.732]	[0.806]

Notes. Facility-clustered standard errors in parentheses. An observation is a facility-year. Sample includes facilities involved in an independent-to-chain acquisition and facilities that are independent or owned by the same chain for the entirety of our sample. We drop observations in the year of acquisition and those cost reports that are for fewer than 365 days. EPO margin is calculated as the average national payment rate per 1000 IU less the costs from the cost reports. Top panel shows coefficient estimates from equation (6). Bottom panel shows estimated difference between post-acquisition and pre-acquisition coefficients and always chain and post-acquisition coefficients, along with p-values. *, ** and *** indicate significance at the 5%, 1% and 0.1% level, respectively.

Figures



(a) Market Evolution, 1998-2010



(b) Acquisitions by Major Chains, 1998-2010

Figure I
Dialysis Market Evolution and Facility Acquisitions by Major Chains Over Time

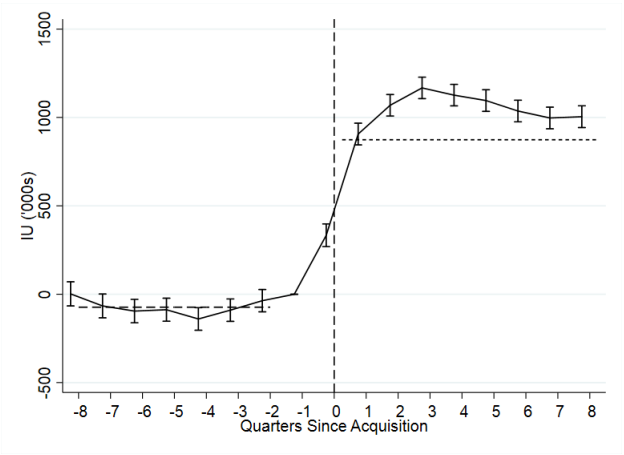
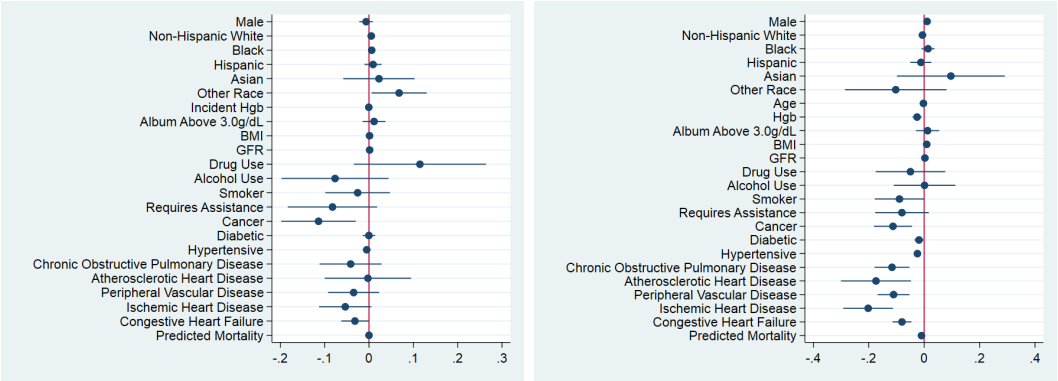


FIGURE II
EPO Dosing Dynamics at Acquired Firms

Notes. Months outside the 48 month window are included in the regression but not shown here. Observations are binned by quarter to reduce noise. Error bars are 95 percent confidence intervals. Observations within 6 months of acquisition are included in this plot.



(a) Monthly Patients (b) New Patients

FIGURE III
Changes in Patient Mix After Acquisition

Notes. Depicts differences-in-differences estimates of the changes in covariates after acquisition. Estimates are acquisition effects from equation (4). All values are rescaled by the sample mean of their respective covariates. Bars are 95% confidence bands. Standard errors are clustered at the facility level.

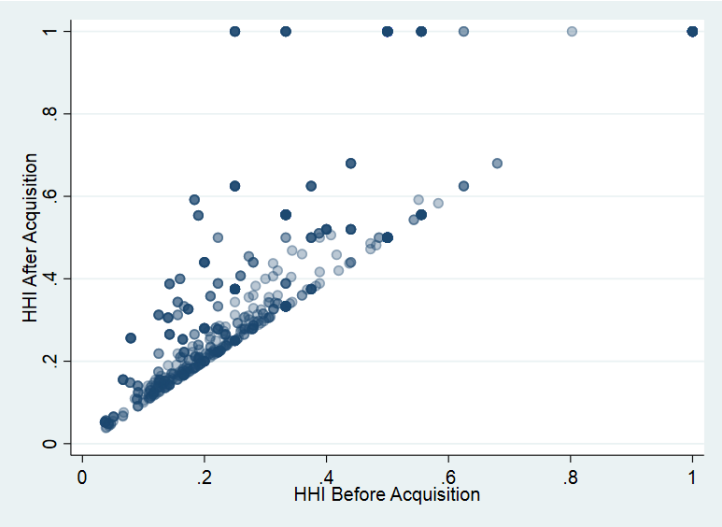


FIGURE IV
Changes in Concentration Across Markets

Notes. An observation is an acquisition. The horizontal axis depicts the Hospital Service Area's HHI before acquisition. The vertical axis depicts what the Hospital Service Area's HHI would have been in the month before acquisition had the facility already been acquired. Opacity is reduced to 30%, so darker regions represent regions of more mass.