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The Effect of Entry Regulation in the Health Care Sector: the Case of Home Health

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Abstract

The consequences of government regulation in the post-acute care sector are not well understood. We examine the effect of entry regulation on quality of care in home health care by analyzing the universe of hospital discharges during 2006 for publicly insured beneficiaries (about 4.5 million) and subsequent home health admissions to determine whether there is a significant difference in home health utilization, hospital readmission rates, and health care expenditures in states with and without Certificate of Need laws (CON) regulating entry. We identify these effects by looking across regulated and nonregulated states within Hospital Referral Regions, which characterize well-defined health care markets and frequently cross state boundaries. We find that CON states use home health less frequently, but system-wide rehospitalization rates, overall Medicare expenditures, and home health practice patterns are similar. Removing CON for home health would have negligible system-wide effects on health care costs and quality.

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competition; certificate of need; quality of care; home health care JEL Classification Codes: I1; K2; L1

1. INTRODUCTION

The consequences of creation and implementation of government regulation in the post-acute care sector are not well understood. In particular, the quality of care implications of policies aiming to slow the growth of health care costs by limiting firm entry and thus competition are unclear. One such policy tool are Certificate of Need (CON) laws designed to provide states with control over entry, expansions, and substantial capital investments by health care facilities.

CON laws exist for various types of health care providers including hospitals, nursing homes, rehabilitation centers and home health agencies. CON for hospitals, and to a lesser extent for nursing homes and rehabilitation centers, give state governments the authority to restrict major capital investment such as the construction or expansion of facilities and the purchasing of expensive technology (MHCC, 2001). Hence, CON imposes restrictions on both incumbent hospitals and potential entrants. This is not the case in home health, a labor-intensive industry with no major capital investment, where CON operates exclusively as a mechanism to restrict entry of new home health agencies. However, restricted entry leads to markets with fewer providers and, thus, reduced market competition among agencies. In a market with regulated prices, such as in home health, reduced competition may have a negative effect on the quality of home health care delivered.

There may also be secondary demand effects if indeed CON markets have lower quality of care. For example, home health under CON may be a less desirable post-acute care option, thus reducing the rate of hospital discharges to home health. Given that home health following a hospitalization for those who qualify for home health is thought to lower the likelihood of a rehospitalization (Sochalski, et al. 2009, Naylor, et al. 2004, Kane, et al. 2000, Penrod, et al. 1998, Penrod, Kane and Kane 2000, Hadley, et al. 2000), CON's discouragement of home health may have broader health care quality implications. In this case, CON for home health may increase rehospitalization rates and expenditures for all post-hospitalization care.

This paper provides a framework for thinking about whether or not the government should use CON regulation in post-acute care markets through the lens of economic efficiency and equity. We have two main objectives. First, we evaluate whether there are significant differences in the quality of home health care for hospitalized patients generally and home health patients specifically, and whether these quality differences translate into differences in overall health care expenditures. Second, we explore patterns of care in home health as a potential mechanism for quality differences resulting from CON regulation.

2. BACKGROUND

Home care services of all types accounted for \$68.3 billion in annual expenditures in 2009, about 3% of all personal health care spending (Martin, et al. and the National Health Expenditure Accounts Team 2011). Home health services are also an important and growing part of the Medicare budget. Home health spending among the publicly insured elderly represents 35% of Medicare post-acute care expenditure and 4% of total Medicare expenditure.¹

This paper focuses on the Medicare service line, which is the largest segment of home health care services.² Medicare home health services consist of skilled nursing care by a registered nurse or licensed practical nurse with supporting services by home health aides; therapy services including physical therapy, occupational therapy, and speech-language therapy; medical social services, and medical supplies. These Medicare services are reimbursed through a Prospective Payment System (PPS) designed specifically for home health services. Under this system, the reimbursement amount is a per-episode fixed rate set at admission according to the severity of the patient's condition and thus independent of the quantity of service provided.³ Episodes of care can last up to 60 days.⁴ To determine severity, each Medicare episode is classified into one of 80 mutually exclusive severity groups, called Home Health Resource Groups (HHRGs), which determine the payment rate. Each episode payment is adjusted for differences in labor costs across geographic areas. About 30% of episodes are initiated within 3 days of a hospitalization, and home health visits typically last about 45 minutes. In 2010, there were 3.4 million users of home health care in Medicare receiving an average of 2.0 episodes with an average payment per 60-day episode of \$2,839 (MedPAC, 2012).

In 2011 there were 12,026 Medicare-certified home health agencies (HHAs) (MedPAC 2012), which are the home health service agencies that offer the Medicare service line. Home health care agencies are distinct from other home care organizations such as hospices, home care aide agencies, and home care equipment providers. Hospices focus on care of terminally ill patients and their families, and home care aide agencies focus on assistance with activities of daily living. In contrast, the primary service line of home health agencies is the Medicare-covered services to treat an illness or injury to regain independence. However, home health agencies may also have service lines that include personal care services such as homemaking, bathing & dressing when there is no concurrent need for skilled care. These alternative service lines are more likely to be covered by Medicaid. Medicare is the primary payer of home health care services, accounting for 41% of the total, while Medicaid covers an additional 24%. The remainder is a mix of other government sources, private insurance, and out-of-pocket expenditure (Martin, et al. 2011).

Hospital expansion in the 1970s, associated with excess bed capacity (Joskow 1980) and higher costs of production (Robinson and Luft 1985), led to the 1974 Federal Health Planning and Resources Development Act, which mandated states to develop CON to control utilization and third-party expense by controlling or reducing supply. When states universally adopted this policy for hospitals in the 1970s, 38 states also applied CON regulation to the home health care sector. When the federal mandate was repealed in 1987, only 18 states continued active CON regulations for home health care (AHPA 2005, MHCC 2001).

The idea behind CON regulation was that it would prevent unnecessary duplication of services and ensure appropriate care by concentrating the location of sophisticated medical services to high-volume regional facilities with sufficient expertise and resources (Smith-Mello 2004). Proponents of CON laws view restrictions on acquisitions and expansions of hospitals as a way to achieve this goal (Ho 2004). Nevertheless, evidence on the effectiveness of CON in lowering hospital costs of care, procedure volume and mortality is

¹The breakdown of Medicare fee-for-service spending on post-acute care in 2010 includes \$19.3 billion for home health agencies, 26.4 billion for skilled nursing facilities, 6.4 billion for inpatient rehabilitation hospitals, and 5.1 billion for long-term care hospitals. (MedPAC, 2012).

²Within this service line of post-acute home health care, Medicare payments to home health represent about 80% of payments.

³While, in general, the amount of service provided does not affect the amount of reimbursement, certain extremely high-cost episodes receive outlier payments.

⁴10% of patients are recertified for additional 60-day episodes.

mixed (Salkever 2000, Popescu, Vaughan-Sarrazin and Rosenthal 2006, Ho 2006, Ho, Kugoto and Jollis 2009).

In home health markets, where labor is the dominant input and where there is little to no capital investment (CMS 2003), the potential for cost savings from major capital expansions by incumbent agencies is nonexistent. A dated report (Anderson and Kass, 1986) found fixed costs incurred in operating a home health firm to be quite modest, about \$15,000 based on a firm cost equation. Such a small estimated value for fixed or capital costs is not surprising given the low-tech quality of home health care. Furthermore, while CON concentrates volume at fewer agencies, it does not result in a volume-outcome relationship (Kass, 1987). Such a relationship, if it existed, would have provided a mechanism for a home health CON to enhance quality. In home health, service delivery is decentralized and provided by individuals as opposed to teams; therefore individual-nurse volume is more relevant for outcomes than agency volume. However, since nurses tend to work at full capacity even in small-scale agencies, there is little rationale for concentrating volume at a small number of agencies through entry restrictions. An alternative rationale for CON programs in home health is that they can enforce appropriate standards of care through enhanced ability to monitor agencies. However, to date there is no evidence to suggest CON in home health care is quality enhancing.

While the effect of CON on quality of home health care is not clear, the ability for CON regulations to effectively limit entry of new agencies into the market is evident. Most states with CON regulations follow specific policies and guidelines for the approval of additional home health agencies in a given market, but in practice new agencies are rarely approved. Therefore, markets in CON-regulated states are not contested, as potential entrants do not threaten incumbent agencies.⁵ Based on 2006 data, we estimate that CON states have almost half the number of agencies for their Medicare population as non-CON states (10 vs. 19 per 1,000,000 Medicare beneficiaries) and are therefore more concentrated as measured by an agency-specific Herfindahl-Hirschman Index (HHI) (3,256 vs. 2,259).⁶

Since prices are regulated and fixed through the PPS system in home health, home health agencies cannot compete for patients based on price of services and instead must compete for patients on other dimensions of their services such as the intensity of the care delivered or the quality of that care. If the regulated price is set above marginal cost for some baseline level of quality, then firms will continue to improve service delivery to try to attract more of the available pool of patients until marginal cost of delivering care equals the regulated price. Thus, economic theory suggests that market competition in the presence of regulated prices can lead to quality improvements.⁷ Empirically, studies of the relationship between competition and quality under regulated prices have found more competition to result in higher quality, as measured by lower mortality (Kessler and McClellan 2000, Gowrisankaran and Town 2003, Held and Pauly 1983, Kessler and Geppert 2005, Tay 2003, Sari 2002, Shen 2003, Shortell and Hughes 1988).

While the effect of market concentration on quality has been studied extensively in the hospital sector, this relationship has received no attention in the home health care industry.

⁵These states include: Alabama, Alaska, Arkansas, Georgia, Hawaii, Kentucky, Maryland, Mississippi, Montana, New Jersey, New York, North Carolina, South Carolina, Tennessee, Vermont, Washington, West Virginia, and District of Columbia.

⁶The Agency HHI measures the degree of concentration for each agency in our sample. Competitive markets are defined separately for each agency based on a weighted average of the agency's market concentration in the zip-codes of the clients they serve (zip-code level HHIs are calculated by squaring the market share of each firm competing in the zip-code and then summing the resulting numbers).

⁷There is an extensive literature in this area including the following: Beitia 2003, Brekke, Nuscheler and Straume 2006, Brekke, Nuschler and Straume 2007, Calem and Rizzo 1995, Karlsson 2007, Gravelle and Masiero 2000, Gravelle 1999, Lyon 1999, Wolinsky 1997, Ma and Burgess 1993, Allen and Gertler 1991, Held and Pauly 1983, Pope 1989.

The case of competition in a hospital market will not necessarily apply to home health. Unlike hospitals, where location provides a degree of market power, home health agencies deliver services at the patient's residence. Without location as a natural barrier to competition, we might expect home health markets to be a highly competitive. Similarly, unlike hospitals and other facilities that require major capital investments in order to become operational, home health care is labor intensive and expected to be highly competitive absent of entry regulation.

However, states have imposed an artificial barrier on the number of competitors in a given market by restricting the creation of new home health agencies through CON regulation. While regulation may be more effective with fewer agencies to regulate, the limited number of evidence-based standards of care in home health on which effective service regulation can be based suggests that market competition may provide a superior (self-enforcing) mechanism for promoting quality. With CON regulation creating potentially opposing effects on quality, the net effect becomes an empirical question.

3. EMPIRICAL FRAMEWORK

Following Gaynor (2006), we base our empirical specification on the equilibrium level of quality (in a market with regulated prices). We assume that firms either maximize profit or rely on surplus to support other objectives (Lakdawalla and Philipson 2006, David 2009)). In addition, we assume that a welfare-maximizing regulator and utility-maximizing consumers imperfectly observe the quality of home health services.

The equilibrium level of firm quality becomes

$$q^* = f\left(\bar{p}, c(q^*), ms(q^*), demand(dq^*)\right)$$

where $\bar{p}$ is the administratively set price per home health episode, c is the cost of a home health episode at quality level q^* , and ms is the firm's market share. The right hand side variables are a function of q^* because the quality level chosen by an agency is likely to affect its market share, cost, and the willingness-to-pay for its services. That is, higher quality firms will have higher costs, but at the same time are likely to attract more customers, which in turn would lead to commanding a higher market share. To estimate quality with independent right hand side variables, we replace the endogenous variables with their exogenous determinants and estimate a reduced form equation. We replace cost with cost shifters, demand with demand shifters, and measures of competition with CON regulation for home health agencies.

Thus the econometric specification is:

$$q^* = f\left(\bar{p}, CS, DS, CON, \right)$$

where CS and DS are cost and demand shifters respectively. Price is the fixed Medicare price; cost shifters include market level variables that might influence factor prices such as wages, patient-to-agency distance, availability of labor, and density of customer base; demand shifters include patient-level variables that characterize patient illness severity and service needs as well as market-level variables that capture general service demand. Importantly, we are able to control for observed individual patient illness severity using patient-level data where both patient baseline illness and quality outcomes are observed.

Of concern are omitted variables that could be correlated with CON and independently influencing the quality indicators. The two most important are unobserved patient characteristics such as illness severity and area-level characteristics such as geographic variation in service use. If competition affects the severity of patients admitted to the home health agency, unobserved severity may be an issue if it independently influences the resource intensity of home health service use and health outcomes. This may occur if home health agencies that face less competitive pressure are more likely to refuse complicated cases and hence, attract low-severity cases on average. Geographic variation may be an issue if those areas that are more likely to have CON are the same areas that are more likely to otherwise utilize more health care services.

We address both of these concerns with a specification that includes market-level fixed effects (v_m).

$$q_i^* = \alpha + \beta_{CS} CS_i + \beta_{DS} DS_i + \beta_{CON} CON_s + v_m + \varepsilon_i$$

This specification has observations for each patient i , and is identified by the markets (m) that include parts of multiple states (s), when those states vary in their CON status. We used the Dartmouth Atlas for Health Care's Hospital Referral Region (HRR) (Wennberg et al. 2004) as the market of interest because it defines a contiguous locality within which most tertiary hospital care referrals are contained and because it is the area most linked to geographic variation. Our focus on clinical outcomes for patients discharged from and readmitted to hospitals makes HRRs a natural geographic unit for defining markets. Approximately 22% of patients in our sample reside in the 33 HRRs that cross state boundaries where CON rules are different. These 33 HRRs are listed in the Appendix, Table A1 and they represent 11% of the 306 HRRs in the U.S. As illustrated in Figure 1, these HRRs are well spread across the U.S. in that they are in 32 of the 48 states in the analysis and 14 of the 18 CON states. We will explore the external validity of this strategy, which will depend on whether these particular HRRs are representative of the U.S.

Figure 1 also illustrates more closely the source of our identification for the case of Pennsylvania, a non-CON state, in which 9 of 17 HRRs cross state boundaries. Six of these HRRs cross into CON states (New Jersey, New York, and West Virginia). The strength of this identification depends on the strength of how strictly regulations are enforced at the state line. Leakage would weaken the ability of the fixed effect identification strategy to pick up differences in rates of home health use. However, leakage is minimized by the fact that home health nurses can only visit homes within the state where they are licensed unless states have a reciprocal agreement in place. We tested for leakage in our data by counting the number of patient addresses that were in different states from the home health agency state in the sub-sample of HHRs crossing CON – Non-CON states. We find only 1.1% of agency clients with addresses in a different state when the parent home health agency was on the non-CON side of the HRR and 2.5% when the parent home health agency was on the CON side of the border. These numbers are negligible and support state boundaries as a useful instrument, since frictions from the licensing requirements appear to be substantial.

This within-HRR variation excludes fixed unobserved factors tied to competition within HRRs and differential patterns of health care service use across HRRs. The exclusion restriction depends on the different states within these markets being otherwise the same. Obviously, other factors may vary across CON and non-CON states within HRR and thus balancing the states on observable characteristics remains important, as does qualified statements regarding any remaining unobserved differences between states within HRRs.

4. METHODS

4.1. Data Sources

We constructed a data set uniquely suited for this study by linking the 100% Medicare Provider Analysis and Review (MedPAR)⁸ file to the Medicare Home Health Agency SAF (HHA-SAF)⁹ file for 2005 and 2006. These data contain diagnoses, procedures, dates of admission and discharge, expenditures, and basic demographic information. The HHA-SAF also includes detailed home health utilization information such as the number and type of visits (skilled nursing care, home health aides, physical therapy, speech therapy, occupational therapy, and medical social services). We augmented our data with county-level market characteristics from the Area Resource File and hospital-level characteristics from the American Hospital Association (AHA) file for 2005 and 2006.

4.2. Study Sample

Our primary sample consists of hospitalizations in acute care hospitals in the 48 contiguous states in fiscal year 2006 (October 2005 – September 2006) among fee-for-service Medicare beneficiaries over 65.5 enrolled in Medicare between July 2005 and December 2006.¹⁰ We exclude hospitalizations preceded by an acute or post-acute care stay in the 90 days prior to avoid the endogeneity of including hospitalizations that may be rehospitalizations resulting from home health care. We also exclude in-hospital deaths and discharges to various low volume hospital types that are not substitutes for home health: hospice, long-term acute care, and inpatient rehabilitation. In sensitivity analyses, these non-substitute discharges are added back as a test of robustness. The final hospital discharge sample contains 4,448,479 hospital discharges.

We then construct a sample based on discharges to home health from these hospitalizations. To be included in this sample, the home health admission must occur within 3 days of the hospital discharge data.¹¹ There are 522,232 records in this sample. The episode of these home health admissions lasts until a home health discharge or until 60 days from the time of the admission.¹² In sensitivity analyses we analyzed a sample that defined a home health admission as taking place within 2 weeks of the hospital discharge.

4.3. Variables

To achieve the goal of assessing the implications of home health care, we measure the rate of home health admissions, rehospitalization rates and total Medicare expenditures. For the sample of home health admissions, we also measure patterns of care within home health.

⁸The MedPAR file contains claims data for Medicare fee-for-service (FFS) beneficiaries admitted to Medicare-certified inpatient hospitals and skilled nursing facilities (SNF).

⁹The HHA-SAF contains claims data for Medicare home health admissions.

¹⁰Despite the fact that the hospitalizations and home health admissions for the 15% of Medicare beneficiaries in Medicare Advantage plans are not recorded, this is a comprehensive record of hospitalizations and home health admissions for Americans over 65 given that 95% are covered by Medicare.

¹¹The 3-day cutoff is used because the accepted practice pattern of home health agencies is to visit the home within 3 days if the admission to home health comes from a hospital referral rather than from the community. We also use the three-day cutoff for a practical reason: it would be difficult to assign rehospitalizations between days 3-14 when comparing analyses using the home health sample and the all hospital discharge sample. Since a negligible number of rehospitalizations occur within 3 days, this short cutoff avoids this problem.

¹²It is possible, though unlikely, for someone to be in the sample multiple times as only patients with an “index” hospitalization enter the sample. That is, an “index” hospitalization does not include hospitalizations that were preceded by a post-acute episode or a hospitalization in the 90 days prior to the hospitalization. Therefore, the multiple events for the few subjects with separate 60-day home health episodes more than 90 days apart with a hospitalization in between are treated as independent events.

We define the outcome of home health admission within the full hospital discharge sample as home health admissions identified in the home health claims with an admission date within 3 days of hospital discharge.

We identify readmissions rates to be our key quality-related outcome measure. Given the fact that avoiding rehospitalization is a primary goal of home health care among those who enter home health from the hospital, readmission is generally viewed as the critical outcome of home health. Moreover, mortality rates are too low in this population to be measured as a reliable outcome. Shaughnessy and colleagues (2002) found hospitalization rates after home health admission to be a valid and significant indicator of quality of home health care. We classified the timing of rehospitalizations into 60-day intervals following a hospital discharge (0-60 days and 60 to 120 days). For rehospitalization measures, subjects are censored in the rare event of death and after their first rehospitalization.

We also defined the subset of rehospitalizations with admitting diagnoses that qualified those rehospitalizations to be potentially preventable (AHRQ, 2006). These “ambulatory sensitive conditions”, conditions for which good outpatient care can potentially prevent the need for hospitalization, were developed to provide insights into the quality of the health care system outside the hospital setting using inpatient data.

Medicare expenditures were defined as the amount that Medicare actually paid for care as recorded in claims records. We included Medicare-financed care in inpatient, skilled nursing facility (SNF), and home health. Because payments for these types of care are made for care received over an interval of days, we assign the expenditure to the 60-day interval associated with the first day of that episode of care and define expenditures for the intervals 0 to 60 days and 60 to 120 days. All expenditures are expressed in constant 2006 dollars.

We include measures of the resources used during a home health episode for the sample of home health admissions. The resource measures include the total number of visits, weighted by the skill level of the provider conducting the visit,¹³ the proportion of visits by skill type (skilled nursing, home health aide, and all therapists), the length of service (number of days between the first and last visit), and the frequency of visits (weighted visits divided by length of service). We measure resource utilization within the first 60-day episode of home health care, as only 10% of these index episodes of care are recertified for additional episodes beyond the first 60 days on service.

In addition to our key explanatory variable indicating which states have CON regulations, our control variables are at the patient, hospital, county, and state level. Patient level variables (demand shifters) include age, gender, race and measures of patient clinical severity, using 104 diagnoses for the hospitalization variables and 28 patient comorbidities variables.¹⁴ Hospital-level variables (supply shifters) include ownership status, medical school affiliation, number of licensed hospital beds, and hospital CON regulation status. County-level variables capture both demand and supply shifters. These variables include factors that capture potential variation across counties in the availability of both acute and post-acute outlets (i.e., hospital beds per 100 persons, nursing home beds per 100 persons),

¹³There are six different home health care visit types: skilled nursing, physical therapy, occupational therapy, speech language pathology, medical social services, and home health aide. Since these represent different intensities of care and, hence different costs of resource use, we adjusted the count of all visits for the relative value of each unit type (Welch, Wennberg and Welch 1996). The relative value is based on the federally reported relative value units (RVUs) (Hsiao et al 1988). Our results are robust to using the raw number of visits.

¹⁴We track the 103 most frequent DRGs and code them as categorical variables while characterizing the remaining 10% into an “other” category. In addition, we have dummy variables for 28 comorbidities using the Elixhauser method (Elixhauser et al., 1998).

HMO enrollment rate, population size, density, urban status education, income, and percentage of population over age 65.¹⁵¹⁶

At the level of the state, there is variation in whether, and the extent to which, Medicaid covers home health use as a substitute for nursing home care through waivers for Medicaid home and community-based services (HCBS). We used data on program participants to construct a state-level variable of the fraction of home health participants that were supported by the Medicaid HCBS home health program.¹⁷

4.4. Analyses

We conducted HRR fixed-effect multivariable regression analysis of home health resource utilization, rehospitalization, and expenditures, as a function of CON and the covariates related to use and outcomes. The model used varied by outcome. We used ordinary least squares for home health services: number of visits, length of service, frequency of visits, and percent of visits by provider type. We used a GEE logistic model for the estimation of home health admissions following hospital discharge. We estimated a fully interacted discrete time Cox model for rehospitalizations. For Medicare expenditures, because of the cluster of zero expenditures and the heavy right tail, we estimated a two-part model where the first part was a logistic GEE and the second part was a generalized linear model with a log link and gamma family (Bough, Madden and Hornbrook, 1999). In all regressions we adjusted standard errors for clustering at the HRR level. Model results are all expressed in terms of their marginal effects.

To better understand the contribution of adjustments for observable and unobservable factors we estimate the marginal effect of CON without any adjustment, with adjustments for observable factors without fixed effects, and with HRR fixed effects. One potential limitation of the fixed-effect model is that, while improving the internal validity of our estimates, the identification comes only from those HRRs that cross state boundaries between states with different CON status. These 33 HRRs represent approximately 22% of the full sample. Nevertheless, to assess the external validity of this subset, we estimate the adjusted subsample marginal effects for comparison to the adjusted effects for the whole sample.

5. RESULTS

There were 4,448,479 Medicare fee-for-service hospital discharges in 2006 that met our inclusion criteria with 31.9% occurring in CON states. From the patient characteristics in Table 1, we see a similar risk profile of patients hospitalized in CON and non-CON states. Patients in CON states were more likely to be female and black, but there were few meaningful differences in their comorbidities. The diagnoses of hospitalizations did differ slightly, with CON states more likely to see patients with chronic pulmonary disease and heart failure. There were more meaningful differences in the hospitals and market characteristics. Hospitals in CON states were less likely to be for-profit and more likely to be affiliated to a medical school. Markets were similar in terms of education and income

¹⁵We do not include nursing home CON as a control variable due to the lack of variation as virtually all states have CON for nursing homes.

¹⁶We did not add salary data on home health registered nurses as a control in our main analysis for two reasons. First, it was a time consuming effort to scrape zip-code specific salary information from the salary survey information available on salary.com so we only collected the information for the HRR subsample. Second, when we added this variable as a control in sensitivity analyses within the HRR subsample, we found no change in our results. As a note, the salary data collected for this paper were collected in October 2011 and included median salary information for both base pay (salary) and additional cash compensation (bonus or annual incentives).

¹⁷The data was made available by state in 2003 from the "Medicaid 1915(c) Home and Community-Based Service Programs: Data Update", Kaiser Commission on Medicaid and the Uninsured, December 2006, Washington, DC.

levels, but CON states were more densely populated, had more hospital beds per population, and were more likely to have CON for hospitals. Given the high correlation between CON in hospitals and CON in home health we look at the sensitivity of this control variable in our sensitivity analyses. When the 522,232 patients that transitioned from their hospital discharge to home health are compared between those in CON and non-CON states, we see the same patterns of similarities and differences as in the full hospital discharge sample, suggesting that there was not a large differential selection into home health between CON and non-CON states. In the Appendix Table A2 a similar comparison among the subgroup of HRRs that cross state boundaries is provided.

Figure 2 highlights differences between CON states and non-CON states in the number of home health agencies per 100,000 Medicare beneficiaries and market concentration. Non-CON states have roughly twice as many agencies per Medicare beneficiary and the Herfindahl Index is approximately 1,000 points lower. These differences are very similar in the subsample of patients residing in HRRs that cross state boundaries and include both a CON and a non-CON state. Figure 3 presents overall differences between CON and non-CON states for Medicare aged beneficiaries in hospital discharges and rates of Medicare Advantage¹⁸ penetration for the U.S. and for the HRR subsample. CON states have more hospital discharges and are also substantially less likely to have aged Medicare Advantage beneficiaries. The lower panels of Figure 3 show total home health admissions per beneficiary and home health admissions from hospital per hospital discharge. The differences are more pronounced in home health admissions from the hospital. The right set of bars, which show these critical market summary statistics for the subset of HRRs that cross state boundaries, can be compared to the bars summarizing the U.S. sample to determine whether the subsample is comparable to the U.S. as a whole. The differences between CON and non-CON are relatively stable, though slightly larger in terms of home health differences and slightly smaller in terms of hospital utilization.

The results from our analyses evaluating the marginal effect of CON across measures of both practice patterns and outcomes are displayed in Table 2. The top panel displays the results of our fixed effects model for the entire hospital discharge sample. We show raw means for non-CON states to benchmark the magnitudes of the marginal effects. We first measure whether there are differences in the rate of discharge to home health and find a large and statistically significant difference in the number of discharges to home health. In the raw data, 12.1% of hospital discharges go to home health in non-CON states and 11% of hospital discharges go to home health in CON states. The marginal difference measured in the fixed effects model is 1.6 percentage points, which represents 13.7% fewer home health admissions from hospitals in CON states.

While home health discharges represent only 11.7% of hospital discharges, we start by analyzing outcomes among the full sample of hospital discharges because this sample is independent of differential selection into home health. None of the marginal effects are statistically significant in the hospital discharge sample. For example, rehospitalizations are higher by 0.0038 (p-value=0.119) in the first 60 days. While this effect is in the hypothesized direction, it is not statistically significant and represents only 2% of rehospitalizations. Taken on its own, this is not a large effect. We also note that the medical expenditures are lower by \$87 (p-value=0.291). This small difference in costs is a balance between the greater number of rehospitalizations in home health and the fewer number of home health admissions. With a typical home health episode costing \$2,500, a lower

¹⁸Medicare Advantage, also known as Medicare Part C, is optional managed care insurance provided by private insurance companies that seniors can opt into in lieu of traditional fee-for-service Medicare. These companies contract with CMS to provide all Medicare Part A (inpatient) and Part B (outpatient) services to seniors.

discharge rate to home health of 0.016 saves \$40 per hospital discharge. A typical hospitalization costs \$10,000, so a higher rehospitalization rate of 0.0038 costs \$38 per hospital discharge. These two effects cancel out. Other expenditures, or statistical noise, drive the small \$87 difference.

The second panel in Table 2 presents the marginal effects of CON within the sample of patients discharged to home health. In the fixed effects model, resource use in home health did not differ significantly by CON status. Although the point estimate suggests slightly fewer home health visits (down by 1.27%), fewer visits per week (down 1.75%), and a lower proportion of those visits by skilled nurses (down by 1.12%), these results are slight and not statistically significant. Outcomes, in contrast to resource use, do show larger effects of marginal statistical significance. The rehospitalization rate within 60 days among patients admitted to home health increases by 0.0085, which is a 5% increase from the 0.1685 rate for non-CON. The p-value on this estimate is 0.066, which is only significant at a 10% threshold of significance. Yet this effect is not sustained in the next 60 days. In fact, the rate in the next 60 days drops by 0.0059 or 6.8%. This results in an unchanged rehospitalization rate of the full 120-day interval following a hospital discharge. While the measured effect is weak, it appears that home health in non-CON states can delay, but not prevent hospital readmission.

This pattern is stronger in magnitude in the results for preventable readmissions. These readmissions make up less than ¼ of all readmissions, but capture the majority of the marginal effect in the first 60 days: 0.0049 of 0.0085. This effect of 0.0049 has a p-value of 0.056, marginal significance, and is of a meaningful size as it represents 13% more preventable readmissions in CON states compared to non-CON states. Again, this rehospitalization effect is not sustained and in fact there is a slight decline in the subsequent 60 days.

Given the expectation that home health would have a greater impact on preventable hospitalizations, and the fact that a home health episode is a maximum of 60 days in length and averages 32 days, these findings provide suggestive evidence that the mechanism is indeed related to the differences in home health between CON and non-CON states. Most of the effect is seen among preventable hospitalizations and within the time of home health care. If the effect was driven by differential selection of patients into home health, it is unlikely that we would have observed a dip in the marginal effect after the first 60 days. Nevertheless, we cannot eliminate the possibility that unobserved differences remain, as the patients in CON states are indeed observed to be sicker. We do not observe evidence of an obvious mechanism for generating these differences, because we did not find meaningful differences in the practice patterns of home health agencies in these two types of states. Attributing the differences in outcomes to home health would require that the effect is generated by the quality of the home health delivered rather than the number of visits or the skill of the provider delivering the service.

We then look at Medicare expenditures, and are unable to detect a difference in total Medicare expenditures. This is somewhat surprising given that if there are 8.5 more hospitalizations per 1000 home health admissions in a CON state that would save Medicare \$85 per case given that a hospitalization averaged \$10,000. However, given the noise in the modeled cost data, our estimate of \$2 in the first 30 days is not distinguishable from \$85. An alternative explanation is that there are other Medicare costs in non-CON states that offset the savings from fewer hospitalizations.

We begin to explore the robustness of our findings in Table 3 by displaying the sensitivity of our full set of outcomes to risk adjustment. Given that our fixed effects model can control

for regional variation, but cannot control for the differences that might remain between states within a geographic region, it is important to assess the influence of the higher risk patients in the CON states and the extent to which our models control for this differential risk. For example, in the unadjusted analysis, expenditure in CON states for patients discharged to home health is more than \$500 higher than in non-CON states over the 120 day interval, but is reduced to \$100 in the adjusted model and to close to zero in the fixed effects model. This suggests that the higher risks in CON states do affect outcomes, but the fixed effects substantially address these differences and controls within the fixed effects are less important. On the other hand, for expenditures in CON states among all hospitalizations, there are savings of \$416 in the unadjusted fixed effects model that mostly go away when covariate adjustments are added.

To the extent that unobserved factors that relate to outcomes remain different between the states within HRRs, our models may not have removed all potential bias from unobservables. These concerns are mostly within the full hospital discharge sample. The results for the home health subsample are more robust to whether observable characteristics are controlled or not. The fact that the point estimates recede to zero in the fixed effects model when covariates are added is likely due to unmeasured fixed differences between CON and non-CON states such as difference in the mix of patients which might be less acute and have greater long-term care needs. We explored a more detailed series of robustness checks in Table 4 for our main results relating to rehospitalization rates among hospital discharges to home health. For the sake of comparison, the first column of results is the main fixed-effect result from Table 2. The next two sets of columns assess whether the results are robust to the definitional aspects of our analysis. We added the few discharges to hospice, long-term acute care, and inpatient rehabilitation and found our results to be robust to this change. The second analysis redefines the sample by including patients who had up to 2 weeks between hospital discharge and home health admission, as oppose to 3 days. The results are qualitatively similar. The third specification drops our indicator variable for hospital CON in the state, as states with hospital CON are more likely to have home health CON. In this case, the results are slightly weaker, but the difference between the first 60 days and the subsequent 60 days remains.

There is modest attenuation of the main results when we consider possibly endogenous covariates. When we add the number of agencies in the county as a control variable, CON status would represent the influence of CON status independent of the number of agencies in the market. The fact that the results barely shift suggests that the effect of CON may be a result of factors outside of the number of agencies. Finally, we add in other agency characteristics such as ownership status, vertical integration of the hospital and the agency, and the length of time the agency has been in existence. Although potentially endogenous to CON status, adding these variables do little to our overall estimates.

Another area of potential endogeneity is the role of fraud and abuse with respect to CON. On the one hand, for those states where fraud and abuse has been frequently cited, such as Texas and Florida (MedPAC, 2012), it is possible that the low quality that results may be driving down the average quality for the non-CON states since these two states in particular are non-CON states. What we cannot determine is whether the fraud and abuse in these states is partially a result of the lack of CON regulation or whether it is an independent phenomenon. However, to assess whether Texas and Florida drive down quality in the non-CON states, we run a sensitivity analysis removing these non-CON states. The results of this sensitivity analysis are notably stronger, suggesting that lower quality from lower competition in CON states and higher quality from less fraud and abuse in these same states may partially explain the weak results, since they these effects may be canceling each other

out. However, we suggest this with the caution, as we cannot determine whether fraud and abuse is indeed deterred by CON.

Finally, we performed a falsification test by using all HRRs that cross state boundaries where there is no change in CON status and assign a pseudo-CON status variable based on the number of home health agencies per beneficiary within each state's portion of the HRR. The state region that has fewer agencies is assigned to CON and the one with more agencies is assigned to non-CON. This assignment is not random, but biased in the direction of finding an effect similar to our main analysis. The fact that we still find no difference, as shown in Table 5, suggests that our results are not generated simply from crossing state boundaries within an HRR, but rather generated by the presence or absence of CON regulation.

One potential limitation of the fixed-effect model is that, while improving the internal validity of our estimates, the identification comes from only those HRRs that cross state boundaries between states with different CON status. Therefore, to mitigate concerns regarding the generalizability of our results from our sample of 33 HRRs (22% of observations) to the full sample, we have, in Appendix Table A3, introduced an intermediate step where we use the smaller sample in conjunction with the full set of covariates used in the full sample analysis, yet without fixed-effects, the ‘adjusted subsample’. The results in the appendix indicate that our subsample of 33 HRRs is, to a large extent, indeed representative.

6. DISCUSSION

Many states use a one-size-fits-all regulatory approach across different segments of the health care industry. Regulation of resource utilization, such as CON laws, while used predominantly to regulate capital expansions in the hospital sector, is also commonly used in labor-intensive environments such as the home health sector. Instead of regulating capital investment, home health CONs take the form of entry restrictions.¹⁹ As a consequence, it is nearly impossible for a potential home health entrant to demonstrate “need”, as incumbent agencies are not constrained by capacity and face few hurdles when it comes to expansion of services. Therefore, not surprisingly, CON regulation of home health leads to concentrated markets with about half the number of agencies compared with states where entry is not regulated using CON.

We find entry regulation in home health results in 13.7% fewer home health admissions from hospitals. Even with a less intensive use of home health on the extensive margin there is little or weak evidence that this has a detrimental effect on the quality of health care. There is no meaningful change in the rate of rehospitalization among all hospital discharges and among home health admissions. We could not detect an effect of CON on health care expenditures; this might be a consequence of a balance between the savings from fewer home health admissions and the higher costs from small number of additional rehospitalizations.

Among home health admissions, we do find weak evidence of a delay in rehospitalizations in the non-CON states from the marginally lower rates of rehospitalizations in the first 60 days that reverses in the subsequent 60 days. It is important to note that, while these effects

¹⁹This is not to say that the reasoning behind hospital CON makes practical sense. Many states dropped their hospital CONs as it created wasteful bureaucratic pressure and most importantly, failed to slow the growth in health care spending (Thorpe 1999, Salkever 2000, Field 2007).

are robust, they are small and not accompanied by a more intensive use of home health resources during a home health admission.

These findings are consistent with the bulk of the literature on hospital CON, where no studies detect a meaningful change in patient outcomes (Ho et al, 2004; Popescu, 2006; and Ho and Ku-Goto 2012). Hospital CON can reduce expenditure in the hospital sector (Hellinger, 2009), but not all studies support this finding (Lanning et al. 1991, Conover and Sloan 1998.) Similarly, Grabowski et al., (2003) studied states that repealed their nursing home CON regulation, and found no association between CON and nursing home expenditures or utilization.

There are several limitations to our analysis. As with any fixed effects analysis, we cannot rule out unobserved factors that differ between states and relate to outcomes. For example, the risk of the patients may differ between CON and non-CON states within HRRs in unobservable ways. These differences could affect outcomes in ways that should not be attributed to CON. If risks are greater in CON states, we thus take precautions not to overstate the meaning of the small number of additional rehospitalizations in CON states. However, with respect to rehospitalization delays, we are more confident that this is unlikely to be driven by risk differences due to the stronger result within preventable rehospitalizations, which is consistent with the mechanism of home health driving results rather than the risks of the patients.

We find that CON states use home health less frequently, but this less frequent use does not affect system-wide rehospitalization rates. The savings from frequent use of home health was balanced by more spending on other providers, and there was no meaningful effect on overall Medicare expenditures. We therefore conclude that removing CON for home health would have negligible system-wide effects on health care costs and quality.

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Appendix

Table A1

List of HRRs that span more than one state, the number of patients in our sample, and the percent of population under CON

Hospital Referral Region	Non-CON State(s)	CON State	N	%CON
Albany	MA	NY	34,285	94%
Allentown	PA	NJ	27,027	5%
Billings	WY	MT	9,045	91%
Dothan	GA / FL	AL	9,860	94%
Durham	VA	NC	24,665	82%
Erie	PA	NY	14,415	11%
Evansville	IN / OH	KY	12,127	8%
Fort Smith	OK	AR	5,865	87%
Jacksonville	FL	GA	28,023	13%

Hospital Referral Region	Non-CON State(s)	CON State	N	%CON
Jonesboro	MO	AR	6,094	94%
Kingsport	VA	TN	8,929	53%
Lebanon	NH	VT	4,569	13%
Louisville	OH	KY	31,702	84%
Morgantown	PA	WV	9,260	97%
New Haven	CT	NY	26,509	5%
Norfolk	VA	NC	19,784	8%
Paducah	IN	KY	10,487	89%
Pensacola	FL	AL	15,533	9%
Philadelphia	PA	NJ	63,470	15%
Pittsburgh	PA	WV	45,421	9%
Portland	OR	WA	16,364	24%
Roanoke	VA	WV	15,576	17%
Salisbury	DE	MD	8,523	60%
Sayre	PA	NY	4,527	17%
Slidell	LA	MS	2,593	12%
Spokane	ID	WA	20,044	81%
Springfield	MO	AR	15,914	17%
Tallahassee	FL	GA	11,456	60%
Texarkana	OK / TX	AR	5,864	5%
Wilmington	DE	MD	15,869	13%
Winchester	VA	WV	6,135	20%
Winston-Salem	VA	NC	17,955	96%

Table A2

Baseline characteristics by CON status for the HRR Subsample

	Hospital discharges HRR subsample N=992,702			Home Health Admissions HRR subsample N=115,467		
	CON (n = 443061)	non-CON (n = 549641)	diff [*]	CON (n = 44978)	non-CON (n = 70489)	diff [*]
Patient characteristics						
Age, years	77.5	78.0	-0.5	78.3	78.5	-0.2
Male, %	40.5	40.7	-0.2	37.2	38.9	-1.6
Race						
White, %	89.0	90.6	-1.6	89.0	90.3	-1.3
Black, %	9.6	8.0	1.6	9.8	8.3	1.4
# Elixhauser comorbidities	1.46	1.46	0.00	1.55	1.53	0.02
Selected comorbidities (out of 28), %						
CHF	9.4	9.3	0.1	11.0	10.2	0.8
Chronic pulmonary disease	20.6	19.5	1.0	22.3	21.3	1.1
Diabetes	3.0	3.0	0.0	3.6	3.2	0.4

	Hospital discharges HRR subsample N=992,702			Home Health Admissions HRR subsample N=115,467		
	CON (n = 443061)	non-CON (n = 549641)	diff *	CON (n = 44978)	non-CON (n = 70489)	diff *
Fluid and electrolyte disorders	18.7	18.1	0.6	20.9	19.4	1.5
Deficiency Anemias	10.4	10.1	0.3	11.7	11.4	0.3
Selected DRGs (out of 103), %						
Disorders of the biliary tract	0.32	0.33	-0.01	0.21	0.23	-0.02
Simple pneumonia & pleurisy	4.39	4.06	0.33	4.52	4.27	0.25
Heart failure & shock	3.91	3.90	0.01	4.90	5.06	-0.16
Chronic pulmonary disease	3.53	3.01	0.52	3.17	3.02	0.15
Lower extrem proc	0.32	0.32	0.00	0.42	0.36	0.06
Discharging hospital characteristics						
Hospital type						
for-profit, %	10.4	7.7	2.7	9.2	6.5	2.7
government, %	12.2	6.3	5.9	11.8	5.2	6.6
Total beds	383	415	-32	395	438	-43
Length of stay of hosp admission	4.5	4.4	0.2	6.1	5.6	0.5
Medical school affiliation, %	21.7	27.5	-5.8	24.8	31.2	-6.5
Market characteristics						
College education, %	20.7	22.1	-1.4	21.3	23.0	-1.7
Median household income, \$	42,444	45,645	-3201	43,163	46,799	-3635
County Population (000)	214	380	-167	229	430	-201
Population density, /sq mile	560	1038	-479	571	1184	-613
Population 65+, %	13.4	14.0	-0.6	13.5	14.0	-0.5
Hospital beds/100 pop	0.41	0.36	0.05	0.41	0.36	0.05
SNF certified beds/100 pop	0.63	0.74	-0.11	0.63	0.73	-0.10
Hospital CON state, %	88.9	47.9	40.9	91.3	50.3	40.9
Medicare Advantage, %	11.4	17.1	-5.7	12.2	18.4	-6.2
Home health Medicaid waivers, %	23.6	22.2	1.4	23.7	22.2	1.5
Agency characteristics						
ownership type						
for-profit, %	29.0	28.7	0.4	29.0	29.0	0.0
government, %	12.1	3.5	8.6	12.0	3.0	9.0
hospital-based	33.0	33.0	0.0	33.0	33.0	0.0

* All differences statistically significant at .05 level given large sample sizes.

Table A3

Marginal effects of CON status by outcome - Generalizability of subsample

adjusted		adjusted subsample *		baseline fixed effects model	
marginal effect	P value	marginal effect	P value	marginal effect	P value
Hospital discharge Sample (N=4,448,479 - 31.9% CON)					

	adjusted		adjusted subsample*		baseline fixed effects model	
	marginal effect	P value	marginal effect	P value	marginal effect	P value
home health	-0.023	<0.001	-0.024	<0.001	-0.016	<.0001
Rehospitalization Rate						
0 - 60	0.0007	0.727	0.0029	0.327	0.0038	0.119
60 - 120	-0.0006	0.460	0.0017	0.141	0.0018	0.306
0 - 120	0.0002	0.945	0.0042	0.216	0.0050	0.119
Preventable Rehospitalization Rate						
0 - 60	-0.0006	0.255	-0.0007	0.432	-0.0004	0.674
60 - 120	0.0001	0.806	0.0006	0.390	0.0010	0.255
0 - 120	-0.0005	0.566	-0.0001	0.929	0.0006	0.724
Medicare expenditure (\$2006)						
0 - 60	-101	0.165	-206	0.018	-87	0.291
60 - 120	-10	0.930	-11	0.783	16	0.515
0 - 120	-105	0.30	-207	0.07	-62	0.656
Home Health Admissions Sample (N=522,232 - 30% CON)						
Practice Patterns						
Total home health care visits	-0.189	0.306	-0.119	0.558	-0.135	0.539
Length on Service (days)	0.268	0.601	-0.025	0.973	-0.014	0.980
Frequency of visits (visits per week)	-0.115	0.011	-0.028	0.574	-0.047	0.267
Visits by provider type (proportion)						
Skilled nursing	-0.043	0.000	-0.021	0.099	-0.007	0.594
Home Health aide	0.013	0.002	0.004	0.508	0.003	0.447
All therapy	0.029	0.015	0.018	0.214	0.003	0.792
Rehospitalization Rate						
0 - 60	0.0038	0.041	0.0110	0.002	0.0085	0.066
60 - 120	0.0007	0.580	-0.0008	0.761	-0.0059	0.191
0 - 120	0.0039	0.090	0.0092	0.024	0.0026	0.668
Preventable Rehospitalization Rate						
0 - 60	0.0019	0.024	0.0031	0.028	0.0049	0.056
60 - 120	0.0015	0.042	0.0024	0.136	-0.0015	0.483
0 - 120	0.0033	0.007	0.0052	0.012	0.0033	0.319
Medicare expenditure (\$2006)						
0 - 60	64	0.234	106	0.123	2	0.979
60 - 120	26	0.239	-3	0.941	-38	0.857
0 - 120	103	0.149	109	0.291	1	0.994

Control variables: Patient demographics are age, sex, race. Patient case-mix are 28 comorbidities and 103 DRGs. Hospital Characteristics are hospital type, bed size, and medical school affiliation. Market characteristics are percent college educated, median household income, population, % population over 65, density, hospital beds, SNF certified beds, and Hospital CON. Use of home health by Medicaid, % HMO beneficiaries in the county.

Regression models: Resource intensity outcomes and rehospitalizations are analyzed with an ordinary least squares regression and the hospital discharge to home health is analyzed with a logistic GEE model. Standard errors adjusted for clustering at the HRR level. Medicare expenditure is estimated with a two-part model where the first part is a logistic regression and the second part is a GLM model with a log link and a gamma family.

* Subsample are those HRRs that have CON in only part of the HRR because the HRR crosses state borders between states that have and don't have CON regulations. This subsample is 22.3% of the full sample and has an N of 992,702 with 44.6% in CON states. For hospital discharges to home health the N of this subsample is 115,467 (22.1% of original sample) with 39% in CON states.

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Research Highlights

The Effect of Entry Regulation

- We find entry regulation in home health via Certificate of Need laws (CON) results in 13.7% fewer home health admissions from hospitals.
- Even with a less intensive use of home health on the extensive margin there is little or weak evidence that CON has a detrimental effect on the quality of health care. There is no meaningful change in the rate of rehospitalization among all hospital discharges and among home health admissions.
- We could not detect an effect of CON on health care expenditures; this might be a consequence of a balance between the savings from fewer home health admissions and the higher costs from small number of additional rehospitalizations.
- Among home health admissions, we find weak evidence of a delay in rehospitalizations in the non-CON states from the marginally lower rates of rehospitalizations in the first 60 days that reverses in the subsequent 60 days. While these effects are robust, they are small and are not accompanied by a more intensive use of home health resources during a home health admission.
- While a system with delayed hospitalizations is preferable, all else equal, removing entry regulations for home health would have negligible system-wide effects on health care costs and quality.

Figure 1.
States with CON and Hospital Referral Regions (HRRs) that cross between CON and non-CON states

Figure 2.

Number of Home Health Agencies and Market Concentration by CON Status

Source: Authors' calculations from admissions in FY 2006 in the Home Health Agencies – Standard Analytical File

Figure 3.
 Characteristics of CON States and non-CON states, overall and within the HRR subsample
 Source: Authors' calculations from admissions in FY 2006 in the Home Health Agencies
 - Standard Analytical File.

Table 1

Baseline characteristics by CON status

	Hospital discharges N=4,448,479			Home Health Admissions N=522,232		
	CON (n = 1419632)	non-CON (n = 3028847)	diff *	CON (n = 154501)	non-CON (n = 367731)	diff *
Patient characteristics						
Age, years	77.7	77.8	-0.2	78.6	78.4	0.2
Male, %	40.3	41.8	-1.4	36.9	39.5	-2.7
Race						
White, %	85.3	89.2	-3.9	84.9	89.3	-4.4
Black, %	12.0	6.5	5.5	12.1	6.4	5.7
# Elixhauser comorbidities	1.44	1.44	0.00	1.52	1.51	0.01
Selected comorbidities (out of 28), %						
CHF	9.1	9.1	0.0	10.7	10.0	0.7
Chronic pulmonary disease	19.1	19.0	0.1	20.5	20.8	-0.3
Diabetes	2.9	2.9	0.0	3.4	3.2	0.2
Fluid and electrolyte disorders	18.7	18.6	0.1	20.5	20.1	0.4
Deficiency Anemias	10.4	10.5	-0.1	11.7	12.1	-0.4
Selected DRGs (out of 103), %						
Disorders of the biliary tract	0.32	0.31	0.01	0.24	0.21	0.03
Simple pneumonia & pleurisy	4.14	4.03	0.11	4.31	4.13	0.18
Heart failure & shock	3.80	3.58	0.22	4.85	4.42	0.43
Chronic pulmonary disease	3.20	2.83	0.37	3.02	2.88	0.14
Lower extrem proc	0.31	0.34	-0.03	0.42	0.40	0.02
Discharging hospital characteristics						
Hospital type						
for-profit, %	11.0	14.5	-3.5	9.5	14.6	-5.1
government, %	16.6	10.2	6.4	15.7	9.1	6.6
Total beds	404	387	17	427	396	31
Length of stay of hosp admission	4.6	4.3	0.3	6.2	5.6	0.6
Medical school affiliation, %	23.5	21.3	2.2	26.9	22.3	4.5
Market characteristics						
College education, %	23.0	23.0	0.0	23.8	23.6	0.3
Median household income, \$	46,224	46,475	-251	47,355	47,183	172
County Population (000)	451	947	-496	518	988	-470
Population density, /sq mile	3259	1032	2226	4216	1122	3094
Population 65+, %	12.9	13.6	-0.7	12.9	13.8	-0.9
Hospital beds/100 pop	0.37	0.33	0.04	0.37	0.32	0.05
SNF certified beds/100 pop	0.58	0.63	-0.05	0.58	0.60	-0.02
Hospital CON state, %	93.0	37.9	55.1	94.7	44.2	50.6
Medicare Advantage, %	12.1	16.7	-4.6	13.2	17.5	-4.3
Home health Medicaid waivers, %	23.0	21.8	1.2	23.1	21.8	1.3
Agency characteristics						

	Hospital discharges N=4,448,479			Home Health Admissions N=522,232		
	CON (n = 1419632)	non-CON (n = 3028847)	diff [*]	CON (n = 154501)	non-CON (n = 367731)	diff [*]
ownership type						
for-profit, %	38.5	38.2	0.3	38.1	38.0	0.1
government, %	10.2	4.3	5.9	10.0	4.0	6.0
hospital-based	33.0	30.0	3.0	33.0	30.0	3.0

* All differences statistically significant at .05 level given large sample sizes.

Table 2

Marginal effect of CON status by outcome, fixed effects

	<u>raw mean</u>	<u>fixed effects model</u>		
	non-CON	marginal effect	P value	%Δ
Hospital discharge Sample (N=4,448,479 - 31.9% CON)				
discharge to home health	0.121	−0.016	<.0001	13.66
Rehospitalization Rate				
0 - 60	0.1688	0.0038	0.119	2.26
60 - 120	0.0874	0.0018	0.306	2.07
0 - 120	0.2415	0.0050	0.119	2.08
Preventable Rehospitalization Rate				
0 - 60	0.0328	−0.0004	0.674	1.34
60 - 120	0.0219	0.0010	0.255	4.56
0 - 120	0.0540	0.0006	0.724	1.08
Medicare expenditure (\$2006)				
0 - 60	4732	−87	0.291	1.84
60 - 120	1424	16	0.515	1.14
0 - 120	6156	−62	0.656	1.01
Home Health Admissions Sample (N=522,232 - 30% CON)				
Practice Patterns				
Total home health care visits	10.57	−0.135	0.539	1.27
Length on Service (days)	31.464	−0.014	0.980	0.05
Frequency of visits (visits per week)	2.684	−0.047	0.267	1.75
Visits by provider type (proportion)				
Skilled nursing	0.597	−0.007	0.594	1.12
Home Health aide	0.048	0.003	0.447	6.93
All therapy	0.345	0.003	0.792	0.82
Rehospitalization Rate				
0 - 60	0.1684	0.0085	0.066	5.04
60 - 120	0.0869	−0.0059	0.191	6.80
0 - 120	0.2406	0.0026	0.668	1.07
Preventable Rehospitalization Rate				
0 - 60	0.0366	0.0049	0.056	13.36
60 - 120	0.0224	−0.0015	0.483	6.54
0 - 120	0.0581	0.0033	0.319	5.67
Medicare expenditure (\$2006)				
0 - 60	4526	2	0.979	0.05
60 - 120	1390	−38	0.857	2.73
0 - 120	5916	1	0.994	0.02

Control variables: Patient demographics are age, sex, race. Patient case-mix are 28 comorbidities and 103 DRGs. Hospital Characteristics are hospital type, bed size, and medical school affiliation. Market characteristics are percent college educated, median household income, population, % population over 65, density, hospital beds, SNF certified beds, and Hospital CON. Use of home health by Medicaid, % HMO beneficiaries in the county.

Regression models: Resource intensity outcomes and rehospitalizations are analyzed with an ordinary least squares regression and the hospital discharge to home health is analyzed with a logistic GEE model. Standard errors adjusted for clustering at the HRR level. Medicare expenditure is estimated with a two-part model where the first part is a logistic regression and the second part is a GLM model with a log link and a gamma family.

Table 3

Marginal effects of CON status by outcome - Sensitivity of risk adjustment

	<u>unadjusted</u>		<u>adjusted</u>		<u>unadjusted fixed effects</u>		<u>adjusted fixed effects</u>	
	marginal effect	P value	marginal effect	P value	marginal effect	P value	marginal effect	P value
Hospital discharge Sample (N=4,448,479 - 31.9% CON)								
home health	-0.010	0.000	-0.023	<0.001	-0.017	<.0001	-0.016	<.0001
Rehospitalization Rate								
0 - 60	0.0066	0.015	0.0007	0.727	0.0066	0.002	0.0038	0.119
60 - 120	0.0032	0.007	-0.0006	0.460	0.0023	0.199	0.0018	0.306
0 - 120	0.0086	0.009	0.0002	0.945	0.0079	0.008	0.0050	0.119
Preventable Rehospitalization Rate								
0 - 60	0.0028	0.000	-0.0006	0.255	0.0013	0.278	-0.0004	0.674
60 - 120	0.0024	0.000	0.0001	0.806	0.0022	0.037	0.0010	0.255
0 - 120	0.0050	0.000	-0.0005	0.566	0.0035	0.100	0.0006	0.724
Medicare expenditure (\$2006)								
0 - 60	-29	0.869	-101	0.165	-416	0.011	-87	0.291
60 - 120	79	0.257	-10	0.930	-84	0.095	16	0.515
0 - 120	50	0.837	-105	0.30	-501	0.016	-62	0.656
Home Health Admissions Sample (N=522,232 - 30% CON)								
Practice Patterns								
Total home health care visits	0.360	0.000	-0.189	0.306	-0.138	0.596	-0.135	0.539
Length on Service (days)	1.477	0.000	0.268	0.601	0.437	0.474	-0.014	0.980
Frequency of visits (visits per week)	-0.105	0.000	-0.115	0.011	-0.012	0.136	-0.047	0.267
Visits by provider type (proportion)								
Skilled nursing	-0.045	0.000	-0.043	0.000	-0.006	0.675	-0.007	0.594
Home Health aide	0.028	0.000	0.013	0.002	0.008	0.196	0.003	0.447
All therapy	0.017	0.000	0.029	0.015	-0.001	0.936	0.003	0.792
Rehospitalization Rate								
0 - 60	0.0117	0.002	0.0038	0.041	0.0104	0.030	0.0085	0.066
60 - 120	0.0056	0.003	0.0007	0.580	-0.0077	0.126	-0.0059	0.191
0 - 120	0.0153	0.001	0.0039	0.090	0.0030	0.647	0.0026	0.668
Preventable Rehospitalization Rate								
0 - 60	0.0056	0.000	0.0019	0.024	0.0059	0.038	0.0049	0.056
60 - 120	0.0041	0.000	0.0015	0.042	-0.0014	0.545	-0.0015	0.483
0 - 120	0.0095	0.000	0.0033	0.007	0.0044	0.229	0.0033	0.319
Medicare expenditure (\$2006)								
0 - 60	311	0.071	64	0.234	52	0.645	2	0.979
60 - 120	180	0.059	26	0.239	-85	0.253	-38	0.857
0 - 120	491	0.062	103	0.149	-33	0.853	1	0.994

Control variables: Patient demographics are age, sex, race. Patient case-mix are 28 comorbidities and 103 DRGs. Hospital Characteristics are hospital type, bed size, and medical school affiliation. Market characteristics are percent college educated, median household income, population, % population over 65, density, hospital beds, SNF certified beds, and Hospital CON. Use of home health by Medicaid, % HMO beneficiaries in the county.

*Subsample are those HRRs that have CON in only part of the HRR because the HRR crosses state borders between states that have and don't have CON regulations. This subsample is 22.3% of the full sample and has an N of 992,702 with 44.6% in CON states. For hospital discharges to home health the N of this subsample is 115,467 (22.1% of original sample) with 39% in CON states.

Regression models: Resource intensity outcomes and rehospitalizations are analyzed with an ordinary least squares regression and the hospital discharge to home health is analyzed with a logistic GEE model. Standard errors adjusted for clustering at the HRR level. Medicare expenditure is estimated with a two-part model where the first part is a logistic regression and the second part is a GLM model with a log link and a gamma family.

Robustness of marginal effect of CON status on rehospitalization rate outcomes for home health admissions sample

Table 4

	main result		definitional issues		key control		robustness to potentially endogenous control variables		add set of variables: agency characteristics [*]		fraud and abuse	
	adjusted with HRR fixed effects		excluded hospital discharges: add back excluded discharges	home health admission definition: 2-week window	drop hospital CON variable	add LOS in preceding hospitalization variable	add variable: # agencies in the county	add set of variables: agency characteristics [*]	exclude HRRs in states with frequent irregularities: FL, TX			
	marginal effect	P value	marginal effect	P value	marginal effect	P value	marginal effect	P value	marginal effect	P value	marginal effect	P value
(N=522,232)												
(N=586,795)												
(N=523,987)												
(N=522,232)												
(N=522,232)												
(N=451,491) (28 HRRs)												
Rehospitalization rates by days from hospital discharge												
0 - 60 days	0.0085	0.066	0.0084	0.089	0.0069	0.113	0.0077	0.110	0.0076	0.125	0.0076	0.128
60 - 120 days	-0.0059	0.191	-0.0047	0.307	-0.0087	0.069	-0.0061	0.188	-0.0063	0.183	-0.0061	0.198
0 - 120 days	0.0026	0.668	0.0035	0.576	-0.0011	0.861	0.0017	0.788	0.0014	0.831	0.0016	0.811
Preventable rehospitalization rates by days from hospital discharge												
0 - 60 days	0.0049	0.056	0.0054	0.043	0.0040	0.070	0.0046	0.074	0.0047	0.071	0.0047	0.079
60 - 120 days	-0.0015	0.483	-0.0011	0.570	-0.0024	0.247	-0.0015	0.473	-0.0016	0.435	-0.0018	0.367
0 - 120 days	0.0033	0.319	0.0041	0.231	0.0016	0.599	0.0030	0.372	0.0030	0.392	0.0027	0.428

Control variables: Patient demographics are age, sex, race. Patient case-mix are 28 comorbidities and 103 DRGs. Hospital Characteristics are hospital type, bed size, and medical school affiliation. Market characteristics are percent college educated, median household income, population, % population over 65, density, hospital beds, SNF certified beds, and Hospital CON. Use of home health by Medicaid, % HMO beneficiaries in the county.

Regression models: Rephospitalizations are estimated with a linear probability model with HRR fixed effects and standard errors estimated based on clustering by HRR.

* Agency characteristics are ownership, facility based, Medicare program tenure.

Table 5

Falsification test of rehospitalization rates using pseudo-CON status

	<u>raw mean</u>		<u>adjusted</u>		<u>baseline fixed effects model</u>		
	non-CON		marginal effect	P value	marginal effect	P value	%Δ
<u>Rehospitalization by days from hospital discharge</u>							
<i>Rehospitalization Rate for hospital discharges to home health (N=89,989 - 88.2% CON, 56 HRRs)</i>							
0 - 60	0.1709		-0.0035	0.461	0.0002	0.965	0.1%
60 - 120	0.0896		-0.0020	0.556	-0.0008	0.822	-0.9%
0 - 120	0.2451		-0.0051	0.382	-0.0005	0.936	-0.2%
<i>Preventable Reprehospitalization Rate</i>							
0 - 60	0.0406		-0.0029	0.311	-0.0023	0.425	-5.5%
60 - 120	0.0241		-0.0020	0.295	-0.0022	0.227	-9.1%
0 - 120	0.0638		-0.0048	0.223	-0.0043	0.228	-6.7%

Control variables: Patient demographics are age, sex, race. Patient case-mix are 28 comorbidities and 103 DRGs. Hospital Characteristics are hospital type, bed size, and medical school affiliation. Market characteristics are percent college educated, median household income, population, % population over 65, density, hospital beds, SNF certified beds, and Hospital CON. Use of home health by Medicaid, % HMO beneficiaries in the county.

Regression models: Reprehospitalizations are estimated with a linear probability model with standard errors estimated based on clustering by HRR.