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The Impact of Nurse Turnover on Quality of Care and Mortality in Nursing Homes: Evidence from the Great Recession

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ABSTRACT

We estimate the causal effect of nurse turnover on mortality and the quality of nursing home care with a fixed effect instrumental variable estimation that uses the unemployment rate as an instrument for nursing turnover. We find that ignoring endogeneity leads to a systematic underestimation of the effect of nursing turnover on mortality and quality of care in a sample of California nursing homes. Specifically, 10 percentage point increase in nurse turnover results in a facility receiving 2.2 additional deficiencies per annual regulatory survey, reflecting a 19.3 percent increase. Not accounting for endogeneity of turnover leads to results that suggest only a 1 percent increase in deficiencies. We also find suggestive evidence that turnover results in lower quality in other dimensions and may increase mortality. An implication of our mortality results is that turnover may be a mechanism for the procyclicality of mortality rates.

JEL Classification Codes: I11, J21, E24

Key Words: Employee turnover, unemployment rate, quality of care, nursing home

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New employees can be costly, as new hires need to be trained to become familiar with the procedures and operations of a firm. Thus, excessive employee turnover can be a source of concern for a firm. The health care industry is one profession in which turnover is potentially an important determinant of firm output, but it has received little attention from economists. Turnover in health facilities reduces the effectiveness and productivity of delivering care, and may also increase operating cost (Squillace et al. 2008). In addition, when nurses are assigned to the same patients, they can form personal bonds, which may lead to better health outcomes (Thomas et al. 2013). For this reason, policymakers and trade associations have made efforts to identify and address turnover, particularly in the nursing home industry. For example, in 2012, the American Health Care Association (2012) announced a three year goal to reduce staff turnover in nursing homes by 15 percent. And in the state of Ohio, the state legislature passed the Long-Term Care Quality Initiative, which pays nursing homes higher Medicaid reimbursement rates for meeting certain quality goals, including reducing staff turnover.[1]

While there are many calls and efforts made to improve healthcare worker turnover, it is not fully understood if turnover directly impacts quality. Most research on turnover in the health care sector has focused on the determinants of staff retention (Elliott et al. 2009; Frijters, Shields, and Price 2007) or cites turnover as a potential explanation for a result, but it does not directly examine turnover. For example, Propper and Van Reenan (2010) suggest that turnover may be a reason for poor hospital quality. And more recently, turnover of staff in nursing homes has been suggested as a mechanism for why mortality rates are procyclical. Specifically, Miller et al. (2009) find that most of the improvement in health during recessions occur among those older

[1] See Ohio Senate Bill Number 264, available at http://archives.legislature.state.oh.us/bills.cfm?ID=129_SB_264. (accessed May 19, 2015), and the Staff Retention section of Ohio's Department of Aging Nursing Home Quality Incentive website, available at https://aging.ohio.gov/ltcquality/nfs/qualityincentives.aspx (accessed May 19, 2015).

than 85, with much of the variation coming from the elderly in nursing homes (Stevens et al. 2015). While not directly explored, the results from these two papers suggests that recessions lead to poor job prospects for low-skilled direct care workers in nursing homes, which then results in lower turnover rates. These lower turnover rates may translate into better quality and mortality outcomes for nursing home residents.

While there are a number of studies outside the economics literature that have examined whether staff turnover in nursing homes is associated with quality of care, most of these studies report results that are not statistically significant but suggest an association between turnover and health outcomes (see Castle and Anderson 2011; Castle and Engberg, 2005; Castle, Enberg, and Men 2007; Lerner et al. 2014; Thomas et al. 2013). More importantly, the existing literature does "not convincingly establish causality running from turnover to outcomes" (Stevens et al. 2015, p. 301). The methods employed in these studies are generally not designed to find causal relationships, as many studies use only one year of data, use data from self-collected surveys with low response rates, econometrically dichotomize turnover and quality outcomes, and/or ignore unobserved heterogeneity. Of greatest concern is unobserved heterogeneity. Failing to account for unobserved factors that influence quality and are correlated with turnover can result in biased estimates of the effect of turnover on quality. To illustrate, nursing homes with poor quality of care may have bad management or be poor places to work, which are variables that are unobserved to the researcher and can be correlated with turnover, leading to omitted variable bias. A few studies have used multiple years of data and employed fixed effects to handle time-invariant omitted variable bias (Castle and Anderson 2011; Thomas et al. 2013), but the current

literature that examines quality outcomes has ignored the endogeneity of turnover that may arise due to simultaneity or time-varying omitted variable bias.[2]

This paper directly assesses whether employee turnover in nursing homes impact patient quality and mortality after accounting for the endogeneity of turnover. We utilize administrative data for all nursing homes in California. We chose California because it had available information on turnover for various types of nursing home staffing, and it has a large nursing home industry, with about 8 percent of all nursing home facilities in the United States. We examine from the period 2005 to 2011, during which California's economy saw significant growth and contraction. We use this variation in the economy's strength over time and geographically across the state as our exclusion restriction in an instrumental variables (IV) approach. Specifically, the exclusion restriction is the unemployment rate in the nursing home's county. Identification relies on the assumption that changes in county unemployment rates affect quality of care only through turnover. As Shapiro and Stiglitz (1984) note, when the unemployment rate is high, the threat of firing improves the quality through lower turnover. Because many nursing home residents are on Medicaid or are expected to remain in a nursing home for the rest of their lives, their personal health and hence quality of care is unlikely to be impacted by the state of the local economy once other factors are accounted for in the model.[3]

Using panel data constructed by merging data from the Online Survey Certification and Reporting System (OSCAR), Office of Statewide Health Planning and Development (OSHPD) in California, the Bureau of Labor Statistics (BLS) and the Area Health Resource File, we find that ignoring endogeneity leads to a systematic underestimation of the effect of nursing turnover

[2] One paper outside of the economics literature used IVs to examine how turnover impacts nurse staffing levels (Kash et al. 2006). The paper used training expense ratio, benefits expense ratio, professional staff ratio and contracted staff ratio as instruments. These ratios are likely to impact turnover but may also influence staffing levels, potentially undermining these ratios as valid instruments.

[3] We test this formally in the section titled "Exclusion Restriction Variable."

on the quality of care and mortality. We find that a 10 percentage point increase in nursing turnover leads to an additional 2.2 deficiency citations to a nursing home per annual regulatory survey. This represents a 19.3 percent increase in deficiency citations. Not accounting for endogeneity leads to results that suggest that nurse turnover leads to a facility receiving 0.12 more deficiency citations, or a 1 percent increase in citations. For most of our other quality measures, we find that nursing turnover leads to worse quality of care, though this effect is not statistically significant at conventional levels in some specifications. We also find suggestive evidence that as turnover increases, a greater percentage of discharged nursing home residents are discharged because of patient death.

This paper contributes to our understanding of the relationship between turnover and outcomes. First, to the best of our knowledge the existing literature on the impact of turnover on outcomes in nursing homes is noncausal. While some studies use panel data with fixed effects to account for any unobserved heterogeneity, fixed effects cannot handle omitted time-invariant factors. The changing policies and advocate efforts to improve the quality of nursing homes, along with personal hiring/firing decisions that align with nursing home quality, make turnover endogenous even though fixed effects are included in a model. By using fixed effect panel IV regression, endogeneity bias from a number of factors is accounted for in our regressions. Second, this paper expands the existing literature on the business cycle and health (Ruhm 2000). With recent work (Stevens et al. 2015) finding that elderly mortality in nursing homes are driving the procyclical nature of mortality, nurse turnover may be a leading causal factor driving this result. And finally, the nursing home industry is large, with revenues equivalent to nearly 2 percent of GDP, and much of the turnover is among lower-skilled workers. Therefore, understanding turnover in this industry may provide insight into other industries.

CONCEPTUAL MODEL OF TURNOVER AND NURSING HOME QUALITY

Prior research outside of the health care sector has found that high employee turnover can lead to lower productivity, diminished profits, and poor customer service (Eckardt, Skaggs, and Youndt e2014; Siebert and Zubanov 2009; Ton and Huckman 2008). One argument for these results is that a lack of room for promotion or higher wages from outside options may encourage workers with desirable traits to seek outside employment (Mas 2006; Munasinghe 2006). When motivated workers and those with desirable traits leave, the quality of employees who remain employed is lower. In contrast, firing workers may improve outcomes by enhancing the average traits of employees that are retained (Jovanovic 1979; Weiss 1980). This implies that turnover of employees can be a positive or negative for outcomes depending on the economics of the particular industry.

In the case of the nursing home industry, the primary caregivers and those most responsible for resident outcomes are nurses and nurse aides, which are collectively referred to as nurses. These nurses come in three types based on the level of education, training, and licensure: 1) registered nurses (RNs), 2) licensed practical nurses (LPNs), and 3) certified nurse aides (CNAs). RNs and LPNs are considered licensed nurses because they have some postsecondary education and are required to pass licensing exams. Licensed nurses coordinate care, administer medicines and treatment ordered by physicians, and ensure professional oversight of care directly provided to residents. In contrast to licensed nurses, CNAs provide the majority of direct care to residents. Federal standards only require CNAs to have at least 75 hours of training, which includes 35 hours of classroom instruction and 50 hours of clinical training.

The economics of employment in nursing homes lend the industry to experience high turnover, over 50 percent annually, and in some facilities exceed 100 percent (Banaszak-Holl and Hines 1996). Broken down by type of nurse, annualized turnover rates for RNs, LPNs, and CNAs are estimated to be as high as 56, 51, and 75 percent, respectively (Donoghue 2009). One of the key drivers of turnover is that wages at nursing homes tend to be lower than in other health care settings, and often the job is not considered as "glamorous" as those in other health care industries, such as working in hospitals. For example, the hourly mean wage for an RN in a nursing home in 2013 was $29.81 compared to $33.94 for similar work in hospital. In fact, RN wages in nursing homes were the lowest wage among the five settings where the Bureau of Labor and Statistics (BLS) measured RN wages.[4] This drives licensed nurses to look for employment in other health care settings. For CNAs, who are often considered unskilled or low-skilled workers, the average wage at nursing homes ($12.01 on average in 2013) is similar to employment in similar skill-level jobs in retail, tourism, or other growing industries (Grabowski et al. 2011). Additionally, these other jobs do not have the same mental cost of caring for individuals who are physically dependent or have severe cognitive impairment.

We expect nurse turnover to be countercyclical, as poor economic environments make it harder for existing employees to find jobs in other industries. This implies that economic conditions may indirectly impact nursing home quality and mortality outcomes through turnover for a number of reasons. First, when the economy is strong it may be harder to fill each additional vacancy. This implies that for each subsequent nurse hired, the nursing home may need to look deeper into their applicant pool and may be required to hire individuals that have less desirable traits (e.g., less reliable, less caring, less experienced). Second, nurse staffing

[4] Based on May 2013 BLS data for occupation 29-1141 – registered nurses, mean hourly wages are as follows: nursing homes, $29.81; physician offices, $30.22; home health care services, $32.17; general medical and surgical hospitals, $33.94; and outpatient care centers, $35.62.

levels are known to be associated with higher nursing home quality (Cohen and Spector 1995; Lin 2014), and lower turnover can lead to more consistent staffing levels. Third, when turnover rates are lower, each nurse has more experience in knowing how to provide highquality, meet regulatory standards, and build stronger personal relationships with residents (Thomas et al. 2013). Such familiarity might decrease the likelihood of using less evasive care practices, such as catheters or physical restraints.

Overall, these mechanisms suggest that reducing turnover should result in improved health outcomes, and that higher unemployment rates would impact outcomes through reductions in nurse turnover. While a few studies have found that higher nurse turnover can lead to worse quality, the vast majority of studies do not find a statistically significant relationship (Castle and Anderson 2011; Castle and Engberg 2005; Castle et al. 2007; Lerner et al. 2011; Thomas et al. 2013). The lack of using causal identification by the current literature may explain why most studies find statistically insignificant effects. Our contribution to the literature is to use causal identification techniques, specifically to use the local unemployment rate as an instrument to determine how turnover impacts nursing home outcomes.

DATA AND METHOD

Data Sources and Sample Selection

This study uses data from four sources for nursing homes in the state of California. The first is utilization and financial information on long-term care facilities obtained from the California OSHPD. On an annual basis, OSPHD collects information on various measures such as patient census, patient demographics, major capital expenditures, wages and salaries, case-mix, and most importantly for this study labor turnover. We merge OSHPD data with data from

the OSCAR data set. OSCAR, maintained by the Centers for Medicare and Medicaid Services (CMS), is a uniform database of yearly regulatory reviews of all nursing homes that receive payments from Medicare or Medicaid. These reviews are completed by a government survey team that assesses nursing home quality and validates all the data reported in OSCAR. Reviews of nursing homes are completed every 9–15 months with an average of 12 months between reviews. OSCAR contains data on the number of regulatory deficiencies each nursing home receives, staffing levels, case-mix, and multiple measures of quality. Finally, these two data sources are supplemented with information about the annual county unemployment level and demographic information from the Bureau of Labor Statistics and Area Health Resource File, respectively.

The sample used in this analysis is free-standing nursing homes in the state of California from 2005 through 2011. The resulting sample consists of 5,992 facility-year observations of 980 unique nursing homes.[5] We examined the state of California because OSHPD data contain multiple measures of nursing and employee turnover, the key variable in this analysis. We selected the study period 2005—2011 for three reasons. First, the study period includes economic growth and contraction associated with the Great Recession. This provides temporal and regional variation in the economic growth that aids in the identification of the effect of turnover in nursing homes. Second, California implemented a minimum nurse staffing ratio in hospitals that became effective in January 2004. Many hospitals were required to increase nurse staffing levels (Cook et al. 2012), potentially impacting turnover in nursing homes. By starting

[5] While the vast majority of nursing homes have data for all years, some nursing homes may only have partial data because they entered or exited the market. To determine if entry or exit is a concern, we estimated models for nursing homes that appear in the sample each year. Our results are not overly sensitive to entry or exit and are discussed in the "Robustness Tests" section.

the study in 2005, any impact of this change would have worked its way through the system.[6] Finally, the Medi-Cal Long Term Care Reimbursement Act of 2004 (Act AB1629) increased reimbursement to nursing homes for the state's Medicaid program starting in 2005 (California Assembly Bill 1629). Since all nursing homes are affected by this legislation, using data starting in 2005 minimizes the potential impact that the changes in reimbursement might have on turnover and quality of care by examining a study period that traverses 2005.[7]

Key Dependent and Explanatory Variables

The OSHPD provides data on the key explanatory variable of interest, staff turnover. Staff turnover is available for three types of employees: 1) all employees; 2) all nursing staff (RNs, LPNs, and CNAs); and 3) CNAs. While historically most turnover in nursing homes is among CNAs, our main focus is on turnover rates for all nurses as the three available turnover rates are highly correlated as shown in Figure 1.[8] Turnover rates are measured annually and are defined as the number of times an employee is replaced in a year divided by the average number of people employed during the year. All turnover rates are measured as percentages with 0 percent indicating no turnover during the year and 100 percent indicating the average employee was replaced once during the year. The average annual turnover rate regardless of the measure used is approximately 50 percent, though some facilities report zero turnover in some years and others have turnover rates of over 200 percent (See Table 1).

The dependent variables are a series of quality measures and two mortality measures. Information on quality is obtained from OSCAR, which is considered one of the most reliable

[6] We also examined slightly later starting years and found little difference in our results.

[7] We also conducted a robustness check that accounts for this change in reimbursement. Results are qualitatively identical to our main results and are discussed in the "Robustness Tests" section with other robustness checks.

[8] The correlation between the three measures of turnover ranges from 0.80 to 0.89. In the robustness check section, we present results for the other turnover measures.

sources of quality of care in nursing homes and has been used in studies on the nursing home industry in California (Harrington et al. 2000; Matsudaira 2014). The first measure utilized is the number of regulatory deficiencies a facility received during their federal regulatory inspection. We also follow the research of Harrington et al. (2000) by classifying each deficiency into three mutually exclusive categories: quality of care, quality of life, and other deficiencies.[9] As per the State Operations Manual, surveyors examine whether the facility is meeting each of over 180 federal regulatory standards.[10] If the facility is found to fail to meet a standard, the inspection team will issue a deficiency indicating that a quality problem exists. For example, under regulation §483.13, residents have the right to be free from physical restraints unless medically necessary. If a nursing home uses physical restraints for discipline or convenience, then the nursing home would receive a deficiency for improper physical restraint use. For our study period, the average nursing home received 11.5 deficiencies, though the range is 0–51 (See Table 1).

The second and third set of quality measures are resident outcomes and care practices utilized by the nursing home. The two resident outcome measures we examine are the percentage of residents with bedsores and the percentage of residents with contractures. Bedsores are an injury to the skin and tissue caused by lack of blood supply induced by constant pressure. A contracture is a shortening of the soft tissue caused by lack of movement of a joint. These two measures are good measures of quality of care because both conditions are preventable and treatable (Bowblis, Meng, and Hyer 2013; Grabowski 2001). Two measures of care practices are

[9] *Quality of care* included 72 specific items in the following federal survey categories: resident assessment, quality of care, nursing services, dietary services, physician services, rehabilitative services, dental services, pharmacy services, and infection control. The *quality of life* category included 77 specific items on resident's rights; admission, transfer, and discharge rights (including resident rights); resident behavior and facility practices (includes resident rights); quality of life; and physical environment. *Other deficiencies* included 30 specific items on administration, lab services and other activities.

[10] The State Operations Manual is available at: http://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_pp_guidelines_ltcf.pdf.

also utilized: the percentage of residents with catheters and percentage physically restrained. Care practices are associated with quality of life and may impact the physical and emotional health of residents (Bowblis and Lucas 2012). For instance, the insertion of catheters places the resident at greater risk for urinary tract infection (Cawley, Grabowski, and Hirth 2006; Park and Stearns 2009). Physical restraints, on the other hand, may increase the risk of bedsores, depression, mental and physical deterioration, and mortality (Park and Stearns 2009; Zinn 1993).

For both resident outcomes and care practice quality measures, higher values imply lower quality. Additionally, some residents may have had the underlying condition or been ordered to have a care practice prior to admission. In order to account for preadmission case mix, the percentage of residents with each condition is adjusted for residents that had the condition prior to admission. The measures utilized therefore reflect the percentage of residents that acquired the condition at the facility. Even after adjusting for acquiring the condition at the facility, the variation in quality in these measures is significant (Table 1). For example, the average observation has 2.5 percent of residents with a facility-acquired bedsore though the range is 0–78 percent. Similar patterns are found for contractures, catheters, and physical restraints.

The final dependent variables we examine are measures of mortality. The OSHPD data report the annual number of discharges that are due to death. We calculate the proportion of discharges that are due to death by dividing discharges due to death by total discharges. For simplicity we refer to this measure as the discharge death rate. As an alternative measure, we also calculate the proportion of residents who die as a percentage of year-end census, which we refer to as the census death rate. The census death rate is not perfect because we do not have the

exact number of residents that were in the nursing home throughout the year, but it proxies for death rate.[11] We follow the literature by using logged death rate measures (Stevens et al. 2015).

Empirical Strategy

To identify the impact of turnover on mortality and quality of nursing home care, we specify the following linear panel regression model

$$(1) \qquad Q_{jct} = T_{jct}\theta + X_{jct}\beta + \tau_t + \tau_t^2 + \delta_j + \varepsilon_{jct}$$

where Q_{jct} is a measure of quality or mortality for nursing home *j* in county *c*, in year *t*, and T_{jct} is a measure of turnover. The parameter θ captures the effect of turnover on quality. The vector X_{jct} accounts for patient, facility, and market characteristics that may influence nursing home quality. To account for variation in quality over time a time trend is also included (τ_t) and is specified to be a quadratic. Finally, to account for unobserved time-invariant heterogeneity, δ_j is treated as a nursing home fixed effect.

An issue with estimating Equation (1) is that turnover is likely to be correlated with unobserved time-varying factors, and/or nursing home quality and turnover are simultaneously determined. Both of these lead to the endogeneity of turnover, and this requires Equation (1) to be estimated using IVs. IV methods require the existence of an exclusion restriction, commonly referred to as an instrument that explains the endogenous variable but is orthogonal to the dependent variable of interest. In this context, an exclusion restriction is a variable that explains turnover but does not explain quality or mortality independent of turnover. The exclusion restriction utilized is the annual county unemployment rate. County unemployment varies geographically across California and temporally with growth in the economy leading up to the

[11] Furthermore, we also define mortality as the proportion of residents who died per patient day and come to the same general conclusions.

Great Recession and the negative shock to the economy caused by the housing market crash. When IV is utilized, the following first-stage model is estimated in order to obtain predicted values of turnover for each nursing home

$$(2) \qquad T_{jct} = U_{ct}\alpha + X_{jct}\varphi + \tau_t + \tau_t^2 + \delta_j + \varepsilon_{jct}$$

where U_{ct} is the annual county unemployment rate and all other variables have the same interpretation as Equation (1).

Most prior studies on nursing home turnover and quality are cross-sectional in nature or use only fixed effects (FE). In order to compare the bias that may arise from only using ordinary least squares (OLS) or ignoring the endogeneity of turnover, we report multiple specifications of the above equations. First, we estimate Equation (1) using three different statistical methods: pooled OLS, panel FE, and panel FE with IV. Our preferred specification is the panel FE with IV. Second, for each of these three methods, we also report results using various levels of controls. In one set of specifications, we control for no additional covariates (X_{jct} or τ_t). In the second set of specifications, additional controls are included but time trends are omitted. The purpose of reporting these two model specifications is to show that including additional controls does not significantly impact the effect of turnover on quality.[12] The third specification includes all controls and includes a quadratic time trend. The time trends are highly correlated with the exclusion restriction and eliminate much of the yearly variation in the exclusion restriction, making Equation (1) sensitive to how time trends are defined. Specifically, the effect size for the turnover variable in Equation (1) is consistent, but the statistical significance is sometimes

[12] Some control variables may be endogenous and therefore by showing the results are not sensitive to including or excluding control variables, we show that any potential endogeneity of these other variables does not impact the results on turnover.

sensitive to the definition. Therefore, the main regression results include a common quadratic time trend, though alternative definitions are discussed further in the robustness section.[13]

The panel FE with IV regressions with all controls and time trends are considered the baseline regressions because they account for endogeneity and unobserved time-invariant heterogeneity. By comparing this baseline regression to the pooled OLS and the panel FE regressions, we are able to determine how much bias exists in estimating turnover models that ignore these issues. We expect OLS to be biased toward underestimating the effect of turnover on quality. While higher unemployment rates should reduce nursing home turnover and improve quality, unemployed workers may have more time to provide home care to their aging parents. This would reduce demand for nursing home care among the elderly that are healthier, leading a more dependent case-mix of resident in the nursing home. While we control for case mix, unobservable changes in the mix of patients entering a nursing home may lead to worse quality, holding all other factors constant. This implies that OLS would underreport the negative impact of turnover on quality.[14]

Exclusion Restriction Variable

The exclusion restriction utilized in this study is the county unemployment rate. The vast majority of nursing home workers are CNAs or other workers of similar skill levels, such has housekeeping and food service staff. The labor market for these types of workers is characterized by great fluidity and wages close to the minimum wage (Munroe 1990). This implies that most nursing home workers earn wages that are about the same as the wages of similar skill-level

[13] An alternative model specification that was utilized that does not require a time trend to be defined is to utilize a long-differenced model. This included taking the first difference of the data for years 2005 and 2011, and then estimating a cross-sectional regression. The coefficient estimates for the long-differenced model were consistent with those reported in the paper.

[14] We examine the effect of turnover and unemployment rates on nursing home admissions and discharges, as well as resident case mix, and find that they did not affect these outcomes. We provide a thorough discussion of this in the next section.

workers in retail, hotels, or fast-food chains.[15] The intuition underlying the strength of the instrument is that weak labor markets would reduce nursing home turnover, as there are fewer non–health care employment opportunities for most nursing home workers.

In terms of orthogonality, the nursing home industry is only a small sector of any county's overall economy—any shock to a county's unemployment is uncorrelated with nursing home worker productivity that may influence quality. Furthermore, while we do not expect county unemployment rate to directly lead to unobservable changes in residents that are in or are admitted to nursing homes, there is a possibility that county unemployment is related to outcomes on the margin. As mentioned above, during poor macroeconomic conditions, unemployed workers may have more time to provide home care to their aging parents or relatives. The availability of home care could either hasten or delay entry for individuals who may marginally consider entering a nursing home, reducing demand for nursing home care among the elderly that are slightly healthier. This could affect quality of care and mortality by altering the characteristics of residents in a nursing home.

To rule out these possible channels we analyze the effect of county unemployment rate on total admissions, total discharges, and observable patient characteristics—that is, physical acuity level of patients, percent of residents with dementia, psychiatric illness, and developmental disability. We posit two models, the first is a simple correlation (OLS with no controls) and the second is the correlation after controlling for nursing home fixed effects and time trends. Our preferred specification is the second model since we use panel data in our analysis.

[15] Citing a 1996 Institute of Medicine report, Grabowski et al. (2011) note that the wage rates between CNAs are comparable to levels offered at retail and fast food establishments: there were "reports of CNAs leaving health care for retail jobs when a Kmart opened or to waitress or clean in locations where the tourist industry was growing" (p. 263).

The results of this exercise are reported in Appendix Table 1. In both models, we find that county unemployment rate has no direct effect on admissions, discharges, and percent of residents with dementia or developmental disability. Psychiatric illness is correlated with unemployment rates, but the effect disappears when nursing home fixed effects and time trends are included. We also find that county unemployment is negatively correlated with physical acuity, but once fixed effects and time trends are included the correlation is positive.[16] We conclude from our exercise that county unemployment rate has no direct effect on the volume or case mix of nursing home residents. This result is not surprising since most residents in nursing homes are the oldest of the elderly population, and the decision to enter a nursing home is usually determined by physical and/or psychological functioning, which is independent of county unemployment rate. While the business cycle may be correlated with the financial standing of some nursing home residents, making private-pay residents spend down to Medicaid faster, these time-varying factors are observable and controlled for in the regression analysis. Therefore, county unemployment rate has economic validity as an exclusion restriction.

Other Control Variables

Included in some model specifications and captured in the vector X_{jct} are resident, facility, and market control variables that may influence quality. These can broadly be broken into resident demographics, facility structure, operational characteristics, resident case mix, staffing levels, and market characteristics. Summary statistics for all of these variables are reported in Table 1.

[16] While physical acuity is correlated with unemployment, the results are sensitive to the controls included in the model and are not stable. Additionally, the positive correlation found when fixed effects and time trends are included suggest that higher unemployment is associated with worse patient case-mix. This should cause quality to be worse and would bias our results towards finding no effect.

Residential demographics capture the percentage of residents that report a nonwhite or unknown race and the percentage of residents that report Hispanic ethnicity. Facility structure is captured by ownership, facility size, membership in a multifacility organization, and the presence of special care units. Ownership of a facility can be by a for-profit, not-for-profit, or government organization. Each of these ownership types have different objectives and may result in different levels of investment in quality (Grabowski et al. 2013). Larger facilities may have economies of scale in quality while facilities that are part of large chains may institute standardized care processes and have greater resources that could be shared across facilities. Additional resources and specialized trained staff are often associated with special care units.

Operational characteristics dictate the amount of financial resources a facility has available to devote to improving quality. For example, Medicaid reimbursement rates are generally low and nursing homes that have greater reliance on Medicaid residents tend to have lower quality (Gertler 1992). To capture how payer-mix can influence quality, we include the percentage of resident days paid for by Medicare, Medicaid, and self-pay with a reference group of private pay. We also control for the percentage of residents who are in a managed care plan. These resources only materialize if a bed is occupied; therefore, occupancy rates are included as a control.

While operational characteristics indicate resources available, resident case mix dictates the amount of resources a facility needs. Most facilities provide postacute care and long-term care, which require different resources. To capture the relative importance of postacute care in each facility we include the percentage of discharges that occurred in less than one month. Additionally, more complex case-mix, as measured by higher physical acuity levels, and more

residents with dementia, psychiatric illnesses or developmental disability, impacts the level of quality a nursing home can achieve.[17]

Nurse staffing is the primary input in the production of nursing home services, and higher levels of staffing are thought to improve quality (Bowblis 2011; Lin 2014; Park and Stearns 2009). Nurse staffing consists of three types: RNs, LPNs, and CNAs. For each type of nurse, we construct measures of staffing level in terms of hours per resident day (HPRD). We also construct a measure of total nurse staff HPRD, which is the sum of HPRD for all three nurse types. Due to measurement error from self-reporting, following Bowblis (2011) we identify observations that have zero staffing or are three standard deviations above the mean. For these identified observations, reported staffing levels are changed to zero and we include in the regression an indicator variable for potentially erroneous staffing levels being reported.

The final set of controls includes market-level characteristics that may influence turnover or nursing home quality. Following the nursing home literature, the county is used as a proxy for the geographic market (Cawley, Grabowski, and Hirth 2006).[18] Market-level variables used in this study include market concentration as measured by a Herfindahl-Hirschman Index using number of beds to measure market share, the log of population over the age of 65, and the log of per capita income.

[17] The average physical acuity level of the facility is measured by the acuindex (Cowles 2002), which captures the level of need based on activities of daily living and special treatments received by residents. Higher values imply greater acuity levels.

[18] For antitrust and merger analysis purposes, nursing home geographic markets may be better defined using alternative metrics, such as patient flows. In this study, market-level characteristics are utilized as control variables, and using alternative definitions does not significantly influence the impact of turnover on quality.

RESULTS

First-Stage Results

An exclusion restriction that is weakly correlated with the endogenous variable can do more harm than good by increasing the bias relative to treating the endogenous variable as exogenous (Bound, Jaeger, and Baker 1995). Visual evidence from the Figure 1 shows that all three turnover measures are highly correlated with the employment rate (100 − unemployment rate), with correlations of at least 0.93.[19] While this suggests a strong correlation between unemployment and turnover, statistical tests can determine if an exclusion restriction is too weakly correlated to be considered valid. Staiger and Stock (1997) suggest estimating the first-stage regression (Equation [2]) and performing an F-test on the exclusion restrictions to determine if they are jointly equal to zero. Their rough guideline is that an F-statistic below 10 would imply that the correlation is too weak for the exclusion to be considered valid. A second method is to estimate a Cragg-Donaldson statistic on the exclusion restrictions in the first stage and compare the test to the critical values obtained by Stock and Yogo (2005). An exclusion restriction is weak if the null hypothesis cannot be rejected.

Table 2 reports the first stage results (Equation 2) using various levels of control variables: column (1) only included facility fixed effects, column (2) adds other control variables, and column (3) is the full regression specification that includes other control variables, fixed effects, and time trends. All three specifications find that higher unemployment rates reduce nursing home turnover, with effect sizes ranging from a 1.0 to 2.4 percentage point reduction in turnover for each one percentage point increase in the county unemployment rate. The effects are all statistically significant at the 1 percent level and all specifications pass the

[19] For easy visualization, Figure 1 plots the employment rate the opposite of the unemployment rate (i.e., 100 – unemployment).

Staiger-Stock criteria for a weak exclusion restriction by having an F-statistic over 10. Additionally, all specifications pass the Stock-Yogo criteria by having a Cragg-Donaldson statistic above the critical value of 8.96 assuming a 15 percent maximal IV size, and two of three pass based on a 10 percent maximal IV size (critical value = 16.38).

The Effect of Nursing Turnover

Table 3 reports the regression results for Equation (1) for total deficiencies and number of deficiencies by the three domains of quality of care, quality of life, and other deficiencies. The model specifications include the use of pooled OLS, panel FE, and panel FE with IV. The first three columns report models that do not include any additional control variables or time trends, whereas columns (4)–(6) include additional controls but not time trends. The final three columns, (7)–(9), are the full model specifications. For all coefficient estimates reported, the interpretation is how the quality measure changes in response to a one percentage point change in the nurse turnover rate.

The effect of turnover tends to follow a similar pattern across all model specifications and for all four measures of deficiencies. Generally, the inclusion of FE reduce the effect size of turnover relative to using pooled OLS, though both coefficient estimates are smaller than the panel FE with IV estimation. This suggests that the simultaneity of turnover and quality is an important component in modeling turnover, and that even including a FE underestimates the negative impact of turnover. In addition to showing the bias from using only OLS or FE, the table also shows the importance of controlling for other covariates. The inclusion of additional control variables and time trends tends to increase the size of coefficient estimates.

In Panel A of Table 3, the results of the nine model specifications are reported using the number of deficiencies as the dependent variable. Across all specifications the coefficient

estimate for turnover is positive and statistically significant at the 1 percent level. For the panel FE with IV regression specification (columns 3, 6, and 9), a 10 percentage point increase in turnover results in a facility receiving 0.6–2.2 more deficiencies, reflecting a 5.1–19.3 percent increase in the number of deficiencies relative to the sample average. For the three domains (Panels B–D), all specifications have effects in the same direction as the results for total number of deficiencies, indicating that all aspects of nursing home quality improve with lower turnover. While all domains of deficiencies improve, relative to the sample average, the magnitudes for the quality of life and other deficiencies are significantly larger than for quality of care. For example, a 10 percentage point increase in turnover results in 0.93 more quality of care, 0.79 quality of life, and 0.41 more other deficiencies (column 9), but adjusting for the sample average, the effects translate into increases of 13.5 percent, 23.1 percent, and 48.8 percent, respectively.[20]

Table 4 reports the results for resident outcomes (Panels A–B) and care practice quality measures (Panels C–D), as well mortality outcomes (Panel E–F). Similar to Table 3, the effect of turnover tends to follow a similar pattern across all model specifications. One exception is that when time trends are included, the effect sizes are similar but become statistically insignificant. This is likely due to the time trend being highly correlated with the exclusion restriction and IV being less efficient than pooled OLS or panel FE regression.

Panels A and B report the results for the resident outcomes measures of facility-acquired bedsores and contracture respectively. For bedsores, all specifications indicate that higher turnover decreases quality. For all the panel FE with IV regressions, a 10 percentage point increase in turnover results in a 0.15–0.65 percentage point increase in the proportion of

[20] These results are consistent with lower turnover spilling over to all aspects of quality in a nursing home. For example, lower turnover allows nurses to create bonds with residents, potentially improving their quality of life more than quality of care. It is also worth noting that most of the deficiencies classified as "other" are related to administrative tasks. With lower turnover the experience of the average nurse increases, improving his or her knowledge of what administrative tasks need to be performed.

residents with bedsores. This effect size is quite large, reflecting a 6.1–26.5 percent increase relative to the sample average. This result is statistically significant at the 10 percent level. In contrast, none of the results are statistically significant for contractures, and two model specifications have negative coefficient estimates.

Panels C and D report the results for the care practice quality measures. For facility-acquired catheters and physical restraints, all but one of the model specifications show a positive relationship between turnover and care practice and the majority of coefficient estimates are statistically significant. This indicates that higher turnover leads to use of care practices associated with poor quality. It should be noted that for both care practice measures, the panel FE with IV models with full controls are statistically significant without time trends, but are not statistically significant when time trends are included. Again, this is likely due to the high correlation of the time trend with the exclusion restriction and inefficiency associated with IV.

The final two panels (E and F) report the mortality results. For both mortality measures and across all specifications, the effect of turnover is positive, which is consistent with higher turnover resulting in greater mortality among nursing home residents. For all panel FE with IV models the effect of turnover is statistically significant for the discharge death rate (proportion of discharges due to death), though in our preferred specification the result is only statistically significant at the 10 percent level (column 9). In terms of effect size, a 10 percentage point increase in turnover results in a 9.4 to 17.4 percent increase in the discharge death rate. In the case of the census death rate (number of deaths divided by year-end census), we find that all results are statistically significant except in the last two columns, which include our preferred specification (column 9). For effect sizes, the census death rate increases 2.0 to 8.3 percent for every 10 percentage point increase in turnover in the panel FE with IV models.

To put these results in the context of Stevens et al. (2015), who find that a 1 percentage point increase in unemployment reduces the state-level mortality rate among nursing home residents by 4.7 percent; a similar 1 percentage point increase in unemployment in our data decreases turnover by 1.3–2.4 percentage points depending on the specification (as per Table 2). If we extrapolate these changes in turnover to calculate the effect of turnover on mortality using results from the panel FE with IV models (Table 4), we calculate a 0.9–3.8 percent reduction in the discharge death rate and a 0.2–1.9 percent reduction in the census death rate.

Robustness Tests

To ensure that the results are robust to the empirical strategy employed, a series of robustness tests are performed. The results of some of these robustness tests are reported in Tables 5 and 6. In both tables, the baseline column (1) reports the coefficient estimates for the impact of turnover as estimated by the panel FE with IV that includes full control variables and a common quadratic time trend (i.e., column [9] of Table 3 or 4).

As noted in the results section, the statistical significance of some measures of quality is sensitive to the definition of the time trend. Additionally, quality may be dynamic in nature, and any persistence in quality may impact the results. To test the sensitivity to the definition of the time trend, models were estimated that used a common linear trend (Table 5, column 2), a county-specific linear trend, and a county-specific quadratic trend (column 3). To examine whether the dynamic nature of nursing home quality created persistence in our outcomes that may be correlated with turnover, we estimated models that a lagged measure of quality or mortality (column 4). These alternative definitions of the time trends and included lagged measures of quality or mortality found effect sizes for turnover consistent with those reported in column (1).

In our main specification, we used all nursing homes regardless of the number of times they are observed in the data, but our results may be sensitive to missing data. First, OSCAR surveys are performed every 9–15 months, and some nursing homes may be missing data for a year because there were no OSCAR data available. Second, firms may not have data for all years because the firm entered or exited the market during the study period. If nursing homes that enter or exit the market are systematically different from those that are observed in all years, this could potentially bias the results. Column (5) of Table 5 reports results based on a balanced panel—that is, using only nursing homes that have data for all years. We find that the general conclusions we can draw are similar to the baseline model, though some of the results become insignificant. This is likely due to the sample size being over 44 percent smaller than the baseline specification.

A third concern is that California started increasing reimbursement rates in 2005. To account for these changes, column (6) of Table 5 includes the facility-specific reimbursement rate as a control variable.[21] The coefficient estimate for turnover after accounting for reimbursement rates is larger (0.284 vs. 0.221) for total number of deficiencies but not statistically different from our main result. The other quality and mortality measures have similar results to the baseline models.

Nurse staffing levels may be simultaneously determined with turnover, making the effect of turnover sensitive to how nurse staffing levels are measured. Additionally, staffing levels are highly correlated with the unemployment rate, and similar to the robustness checks related to time trends, the inclusion of staffing levels that are highly correlated with the exclusion restriction could impact the results. Finally, some nursing homes report staffing levels that are

[21] Medicaid reimbursement rates are obtained from The Long-Term Care System Development Unit of the Department of Health Care Services. The rates are available at http://www.dhcs.ca.gov/services/medi-cal/Pages/AB1629/LTCAB1629.aspx. Reimbursement rates are not available for all facilities.

clearly coding errors, and we flagged these nursing homes in our regressions with an indicator for coding error. To test the sensitivity of our results to how staffing levels are specified we estimate a series of alternative specifications. In Table 6, column (2), total nurse staffing HPRD is utilized instead of staffing levels for each nurse type. In column (3), nurse staffing levels are excluded as a control variable whereas in column (4) we estimated models that excluded observations with staffing levels that are coding errors. All of these specifications report results similar to the baseline model.

Finally, the main results reported in the paper use turnover for all nurses. The results may be sensitive to the measure of turnover utilized. Columns (6) and (7) of Table 6 use the other measures of turnover: CNA turnover and all employees turnover. These alternative specifications are in line with the baseline models.

CONCLUSION

Nurse turnover has been cited as an important source of nursing home quality problems. Several studies have asserted that nurse turnover in nursing homes are associated with low-quality care (Bostick et al. 2006; Castle and Engberg 2005; Collier and Harrington 2008), although most studies find no statistically significant relationship and fail to account for the fact that nursing turnover is endogenous. In this paper, we use IV estimation to address the endogeneity of nurse turnover on mortality and quality of care. Specifically, we leverage the deterioration in labor market conditions during the Great Recession when nursing turnover at nursing homes in California declined by 17 percentage points. This decline was highly correlated with the decrease in employment rate during the same period.

Not accounting for endogeneity severely underestimates the impact of nurse turnover on quality of care in nursing homes. Our main finding is that a 10 percentage point increase in nursing turnover leads to an additional 2.2 deficiency citations to a nursing home per annual survey. This represents a 19.3 percent increase in deficiency citations. Not accounting for endogeneity suggests that nurse turnover leads to a 1 percent increase in citations. We also find that higher turnover leads to worse quality of care in terms of bedsores and suggestive evidence that other measures of quality are also worse, although the statistical significance of the effect for other measures of quality is sensitive to the inclusion of time trends.

We find that mortality tends to improve as turnover is reduced. A 10 percentage point increase in turnover results in a 9.4–17.4 percent increase in the discharge death rate and increases the census death rate by 2.0 to 8.3 percent. While these results are statistically weak in our preferred specifications—in particular, the census death rate results—the findings are generally consistent with the procyclical nature of mortality suggested by Stevens et al. (2015), who find that mortality among nursing home residents increased by 4.7 percent for each 1 percentage point increase in unemployment. We find results that are consistent, though smaller than their finding. One reason for the divergence is that they use state-level age-adjusted mortality rates, which are defined as the number of deaths in a nursing home, whereas we examine the mortality in specific nursing homes. Second, in our data we are not able to accurately calculate the denominator, as we do not know the number of residents that were in a nursing homes during the course of the year. While this is a limitation of our study, our results suggest that turnover is a potentially important mechanism that may explain the procyclical nature of mortality. Further research is needed in order to more accurately measure mortality in nursing homes, such as using the minimum data set.

There have been efforts to reduce turnover, such as commitments by the American Health Care Association and Ohio's use of pay-for-performance based on keeping turnover below a certain threshold. While these initiatives were promoted using studies based on association and not causal effect, our finding that ignoring the endogeneity of turnover can severely underestimate the impact of high turnover on reducing quality suggests that maybe even greater emphasis on this nursing home quality issue is warranted. Efforts that improve pay relative to outside options, improve working conditions and employee satisfaction, and reward nursing homes that are able to retain good employees should be examined as possible public policy responses.

The fact that turnover is lower during the Great Recession and that nursing home quality improves with lower turnover points to nursing home quality being countercyclical. While maintaining nursing home quality has always been a concern, the Great Recession has lowered turnover in nursing homes, improving overall quality. As labor markets return to normal and competition for workers increase, outside options will become more available, thus increasing turnover in nursing homes.

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Figure 1 Turnover and Employment Trends

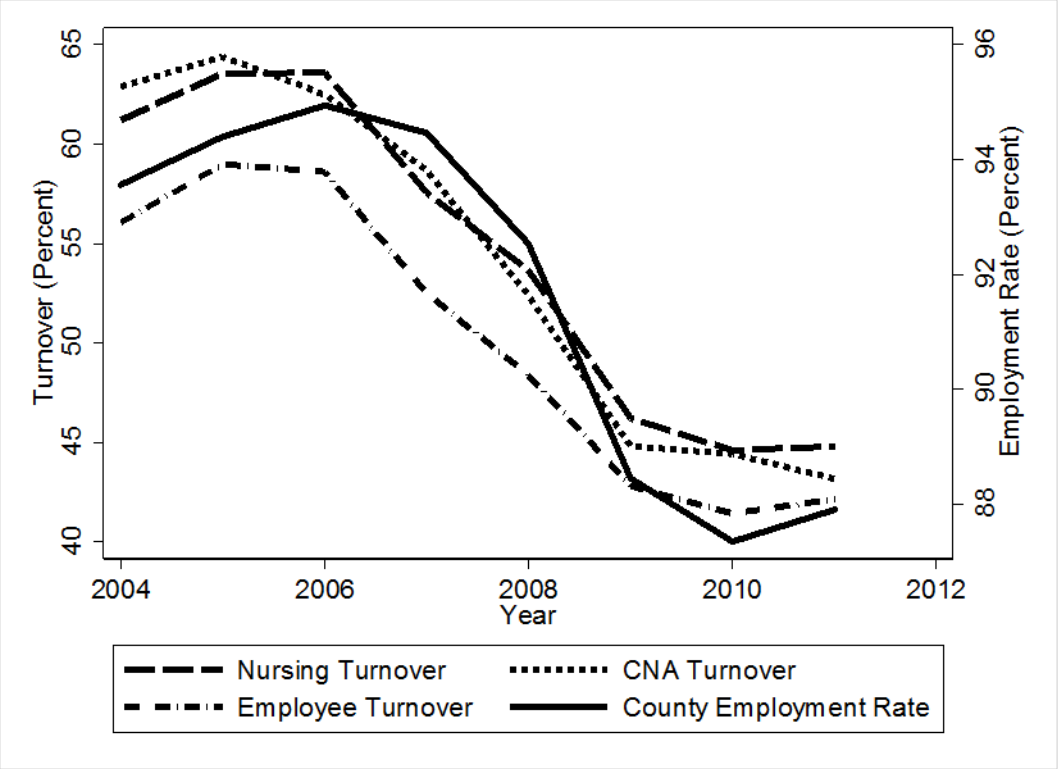

Table 1 Summary Statistics of Selected Variables

	Mean	Std Dev	Min	Max
Annual turnover-all nurse staff	53.01	32.07	0	412.50
Annual turnover-CNAs	52.67	34.75	0	354.17
Annual turnover-all employees	49.01	27.43	0	233.33
Quality - total number of deficiencies	11.46	6.84	0	51.00
Quality - Quality of care deficiencies	6.86	4.20	0	32.00
Quality - Quality of life deficiencies	3.42	2.68	0	21.00
Quality- Other deficiencies	0.84	0.99	0	9.00
Quality - % bedsores - facility acquired	2.46	3.40	0	78.02
Quality - % catheters - facility acquired	1.11	3.05	0	87.80
Quality - % physical restraints - facility acquired	6.30	8.60	0	94.62
Quality - % contractures - facility acquired	7.58	12.74	0	89.74
Mortality- Log death rate (discharges)	2.43	0.80	−1.78	4.61
Mortality- Log death rate (census)	3.32	0.83	−0.71	6.48
Annual county unemployment rate	8.56	3.71	3.40	29.90
Race: % minority	37.27	25.74	0	100
Ethnicity: % Hispanic	16.15	14.81	0	96.81
Non profit ownership	0.04	0.21	0	1
Government ownership	0.00	0.06	0	1
Facility part of chain	0.54	0.50	0	1
Payer mix: % Medicare	12.83	10.69	0	92.14
Payer mix: % Medicaid	68.13	21.38	0	100
Payer mix: % Self pay	9.65	12.39	0	87.77
Payer mix: % Managed care	5.15	8.26	0	99.54
Bed size	103.62	48.61	19	391
Occupancy rate	88.27	9.33	12.38	162.67
Discharges less than 1 month (%)	47.03	19.53	0	100
Case mix: Physical acuity level	10.94	2.02	3	21.86
Case mix: % Dementia	40.86	20.48	0	100
Case mix: % Psychiatric illness	23.73	21.64	0	100
Case mix: % Developmental disability	2.34	5.37	0	83.08
Case mix: Alzheimer special care unit	0.07	0.26	0	1.00
Staffing: RN hours per resident day	0.34	0.27	0	3.65
Staffing: LPN hours per resident day	0.76	0.43	0	3.94
Staffing: CNA hours per resident day	2.32	0.82	0	6.20
County-level HHI	613.90	1,248.69	39.48	10,000
Log per capita income	10.59	0.24	9.97	11.44
Log population 65+	12.32	1.36	7.80	13.91
Number of observations	5,992	5,992	5,992	5,992

SOURCE: Data are from 2005–2011 long-term care financial and utilization files collected by Office of Statewide Health Planning and Development, the Online Survey, Certification and Reporting System (OSCAR) data set maintained by the Centers for Medicare and Medicaid Services (CMS), and Bureau of Labor Statistics.

NOTE: There are 980 unique facilities.

Table 2 Select First Stage IV Results

	Model 1	**Model** 2	**Model** 3
Annual county unemployment rate	–2.444	–1.898	–1.029
	(0.134)	(0.170)	(0.288)
Facility fixed effects	Yes	Yes	Yes
Facility and county characteristics	No	Yes	Yes
Time trends	No	No	Yes
F statistics on exclusion restriction	333.2	127.55	12.74
Cragg-Donaldson Wald F statistic	624.3	124.0	15.23
Number of unique facilities	980	980	980
Number of observations	5,992	5,992	5,992

SOURCE: Data are from 2005–2011 long-term care financial and utilization files collected by Office of Statewide Health Planning and Development, the Online Survey, Certification and Reporting System (OSCAR) data set maintained by the Centers for Medicare and Medicaid Services (CMS), and Bureau of Labor Statistics.

NOTE: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parenthesis are clustered at the facility level.

Table 3 Main Results-Effect of Nursing Turnover on Deficiencies

		(1) Pooled OLS	(2) FE	(3) IV FE	(4) Pooled OLS	(5) FE	(6) IV FE	(7) Pooled OLS	(8) FE	(9) IV FE
Panel A: Total Deficiencies										
Annual turnover-all nurse staff		0.017***	0.014***	0.058***	0.024***	0.012***	0.082***	0.022***	0.012***	0.221***
		(0.004)	(0.004)	(0.011)	(0.004)	(0.004)	(0.021)	(0.004)	(0.004)	(0.082)
Mean Total Deficiencies	11.46									
Panel B: Quality of Care										
Annual turnover-all nurse staff		0.011***	0.010***	0.044***	0.015***	0.007***	0.036***	0.013***	0.007***	0.093**
		(0.002)	(0.002)	(0.007)	(0.002)	(0.002)	(0.013)	(0.002)	(0.002)	(0.044)
Mean Quality of Care	6.86									
Panel C: Quality of Life										
Annual turnover-all nurse staff		0.003**	0.003*	0.010**	0.006***	0.003*	0.029***	0.005***	0.003*	0.079**
		(0.001)	(0.001)	(0.004)	(0.001)	(0.002)	(0.009)	(0.001)	(0.002)	(0.032)
Mean Quality of Life	3.42									
Panel D: Other										
Annual turnover-all nurse staff		0.002***	0.002***	0.007***	0.003***	0.002***	0.015***	0.003***	0.002***	0.041***
		(0.001)	(0.001)	(0.002)	(0.000)	(0.001)	(0.003)	(0.001)	(0.001)	(0.015)
Mean Other	0.84									
Facility fixed effects		No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Facility and county characteristics		No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Time trends		No	No	No	No	No	No	Yes	Yes	Yes
Number of observations		5,992	5,992	5,992	5,992	5,992	5,992	5,992	5,992	5,992

NOTE: *** p<0.01, ** p<0.05, * p<0.1. Regression estimates are reported in the table with standard errors adjusted for clustering by facility in parentheses. Facility and county characteristics include ownership status, facility size, chain membership, payer-mix, occupancy rates, proportion of minority and Hispanic patients, discharges less than one month, log of county-level per capita income, log of population over 65, HH\I, and case-mix variables reported in Table 1. The instrumental variables is county unemployment rate. There are 5,992 observations for 980 unique facilities.

Table 4 Main Results-Effect of Nursing Turnover on Quality of Care and Mortality

		(1) Pooled OLS	(2) FE	(3) IV FE	(4) Pooled OLS	(5) FE	(6) IV FE	(7) Pooled OLS	(8) FE	(9) IV FE
Panel A: Facility-Acquired Bedsores										
Annual turnover-all nurse staff		0.009***	0.006***	0.015**	0.008***	0.005**	0.022	0.008***	0.005**	0.065*
		(0.002)	(0.002)	(0.007)	(0.002)	(0.002)	(0.014)	(0.002)	(0.002)	(0.035)
Mean Facility-Acquired Bedsores	2.46									
Panel B: Facility-Acquired Contractures										
Annual turnover-all nurse staff		0.011	0.003	0.005	0.004	0.000	−0.084*	0.006	0.002	−0.189
		(0.007)	(0.007)	(0.022)	(0.007)	(0.007)	(0.047)	(0.007)	(0.007)	(0.144)
Mean Facility-Acquired Contractures	7.58									
Panel C: Facility-Acquired Catheter										
Annual turnover-all nurse staff		0.004***	0.002	0.012**	0.003**	0.002	0.030***	0.003*	0.001	0.050
		(0.001)	(0.002)	(0.006)	(0.001)	(0.002)	(0.010)	(0.001)	(0.002)	(0.033)
Mean Facility-Acquired Catheter	1.11									
Panel D: Facility-Acquired Restraints										
Annual turnover-all nurse staff		0.029***	0.027***	0.226***	0.019***	0.002	0.083***	0.010**	−0.000	0.130
		(0.005)	(0.005)	(0.020)	(0.005)	(0.005)	(0.027)	(0.005)	(0.005)	(0.087)
Mean Facility-Acquired Restraints	6.3									
Panel E: Log Death Rate(Discharge)										
Annual turnover-all nurse staff		0.002***	0.002***	0.016***	0.001	0.000	0.009***	0.000	0.000	0.009*
		(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.005)
Mean Log Death Rate(discharge)	2.43									
Panel F: Log Death Rate(Census)										
Annual turnover-all nurse staff		0.002***	0.001***	0.008***	0.001***	0.001**	0.006***	0.001***	0.000	0.002
		(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.005)
Mean Log Death Rate(census)	3.32									
Number of observations		5,992	5,992	5,992	5,992	5,992	5,992	5,992	5,992	5,992

NOTE: *** p<0.01, ** p<0.05, * p<0.1. Regression estimates are reported in the table with standard errors adjusted for clustering by facility in parentheses. Facility and county characteristics include ownership status, facility size, chain membership, payer-mix, occupancy rates, proportion of minority and Hispanic patients, discharges less than one month, log of county-level per capita income, log of population over 65, HHI, and case-mix variables reported in Table 1. The instrumental variables is county unemployment rate. There are 5,992 observations for 980 unique facilities.

Table 5 Specification Checks

	(1) Baseline	(2) Linear trend	(3) Quad County trend	(4) Lagged Dependent var	(5) Balanced Panel	(6) Medicaid Rates
Panel A: Total Deficiencies						
Annual turnover-all nurse staff	0.221***	0.203**	0.232**	0.176**	0.169**	0.284***
	(0.082)	(0.079)	(0.100)	(0.076)	(0.086)	(0.098)
Panel B: Facility Acquired Bedsores						
Annual turnover-all nurse staff	0.065*	0.064*	0.067	0.071*	0.066	0.058
	(0.035)	(0.034)	(0.046)	(0.037)	(0.045)	(0.036)
Panel C: Facility Acquired Contractures						
Annual turnover-all nurse staff	−0.189	−0.193	−0.067	−0.169	−0.012	−0.175
	(0.144)	(0.141)	(0.142)	(0.137)	(0.158)	(0.140)
Panel D: Facility Acquired Catheter						
Annual turnover-all nurse staff	0.050	0.049	0.024	0.065*	0.093*	0.040
	(0.033)	(0.032)	(0.040)	(0.037)	(0.054)	(0.033)
Panel E: Facility Acquired Restraints						
Annual turnover-all nurse staff	0.130	0.134	0.242*	0.136	−0.020	0.161*
	(0.087)	(0.085)	(0.123)	(0.094)	(0.104)	(0.093)
Panel F: Log Death Rate (Discharges)						
Annual turnover-all nurse staff	0.009*	0.009*	0.010*	0.014**	0.005	0.012**
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)
Panel F: Log Death Rate (Census)						
Annual turnover-all nurse staff	0.002	0.003	0.007	0.007	0.000	0.004
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.004)
Observations	5,992	5,992	5,992	5,953	3,390	5,646

NOTE: *** p<0.01, ** p<0.05, * p<0.1. Regression estimates are reported in the table with standard errors adjusted for clustering by facility in parentheses. Facility and county characteristics include ownership status, facility size, chain membership, payer-mix, occupancy rates, proportion of minority and Hispanic patients, discharges less than one month, log of county-level per capita income, log of population over 65, HHI, and case-mix variables reported in Table 1. The instrumental variables is county unemployment rate.

Table 6 Robustness Checks

	(1) Baseline	(2) Total nurse staffing	(3) No nurse staffing	(4) Non-missing staffing	(5) Nurse asst. turnover	(6) Total employee turnover
Panel A: Total Deficiencies						
Annual turnover-all nurse staff	0.221***	0.228***	0.227***	0.224***		
	(0.082)	(0.085)	(0.086)	(0.086)		
Annual turnover-CNAs					0.167***	
					(0.056)	
						0.300**
						(0.122)
Panel B: Facility Acquired Bedsores						
Annual turnover-all nurse staff	0.065*	0.067*	0.069*	0.065*		
	(0.035)	(0.036)	(0.036)	(0.037)		
Annual turnover-CNAs					0.047*	
					(0.025)	
Annual turnover-all employees						0.088*
						(0.050)
Panel C: Facility Acquired Contractures						
Annual turnover-all nurse staff	−0.189	−0.179	−0.190	−0.224		
	(0.144)	(0.145)	(0.147)	(0.156)		
Annual turnover-CNAs					−0.138	
					(0.104)	
Annual turnover-all employees						−0.255
						(0.199)
Panel D: Facility Acquired Catheter						
Annual turnover-all nurse staff	0.050	0.051	0.050	0.042		
	(0.033)	(0.033)	(0.034)	(0.035)		
Annual turnover-CNAs					0.037	
					(0.023)	
Annual turnover-all employees						0.067
						(0.045)
Panel E: Facility Acquired Restraints						
Annual turnover-all nurse staff	0.130	0.135	0.134	0.146		
	(0.087)	(0.088)	(0.089)	(0.091)		
Annual turnover-CNAs					0.096	
					(0.062)	
Annual turnover-all employees						0.178
						(0.120)
Panel F: Log Death Rate(discharges)						
Annual turnover-all nurse staff	0.009*	0.009*	0.009*	0.009*		
	(0.005)	(0.005)	(0.005)	(0.005)		
Annual turnover-CNAs					0.007*	
					(0.004)	
Annual turnover-all employees						0.013*
Panel F: Log Death Rate(census)						(0.008)
Annual turnover-all nurse staff	0.002	0.002	0.002	0.004		
	(0.005)	(0.005)	(0.005)	(0.005)		
Annual turnover-CNAs					0.001	
					(0.004)	
Annual turnover-all employees						0.003
						(0.007)
Observations	5,992	5,992	5,992	5,173	5,967	5,991

NOTE: *** p<0.01, ** p<0.05, * p<0.1. Regression estimates are reported in the table with standard errors adjusted for clustering by facility in parentheses. Facility and county characteristics include ownership status, facility size, chain membership, payer-mix, occupancy rates, proportion of minority and Hispanic patients, discharges less than one month, log of county-level per capita income, log of population over 65, HHI, and case-mix variables reported in Table 1. The instrumental variables is county unemployment rate.

Appendix Table 1: Effect of Unemployment Rate on Patient Characteristics

	(1) OLS	(2) FE
Total admissions	–0.000	–0.000
	(0.000)	(0.000)
Log of total admissions	–0.001	0.069
	(0.077)	(0.076)
Total discharges	–0.000	–0.000
	(0.000)	(0.000)
Log of total discharges	–0.003	0.048
	(0.077)	(0.077)
Case mix: Physical acuity level	–0.072*	0.040*
	(0.038)	(0.024)
Case mix: % Dementia	–0.001	0.002
	(0.003)	(0.002)
Case mix: % Psychiatric illness	0.012***	0.001
	(0.004)	(0.002)
Case mix: % Developmental disability	0.009	0.013
	(0.009)	(0.009)
Facility fixed effect	No	Yes
Linear time trend	No	Yes
Observations	5,992	5,992

NOTE: *** p< 0.01, ** p < 0.05, * p < 0.1. Regression estimates are reported in the table with standard errors adjusted for clustering by facility in parentheses. Each column is a separate regression.