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A Panel Data Analysis of the Relationships of Nursing Home Staffing Levels and Standards to Regulatory Deficiencies

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Objective. To examine the relationships between nursing staffing levels and nursing home deficiencies.

Methods. This panel data analysis employed random-effect models that adjusted for unobserved, nursing home–specific heterogeneity over time. Data were obtained from California's long-term care annual cost report data and the Automated Certification and Licensing Administrative Information and Management Systems data from 1999 to 2003, linked with other secondary data sources.

Results. Both total nursing staffing and registered nurse (RN) staffing levels were negatively related to total deficiencies, quality of care deficiencies, and serious deficiencies that may cause harm or jeopardy to nursing home residents. Nursing homes that met the state staffing standard received fewer total deficiencies and quality of care deficiencies than nursing homes that failed to meet the standard. Meeting the state staffing standard was not related to receiving serious deficiencies.

Conclusions. Total nursing staffing and RN staffing levels were predictors of nursing home quality. Further research is needed on the effectiveness of state minimum staffing standards.

Key Words: Deficiencies—Nursing home quality—Nursing staffing—State staffing standard.

NURSING staffing levels are generally believed to be a key element in improving quality of care (QoC) in nursing homes. Yet, the data regarding the relationship of nursing staffing levels to nursing home quality as reported in the literature are inconclusive. Castle (2008) found that of 59 nursing home staffing studies since 1991 examining more than 300 quality indicators, only 40% of the indicators were positively associated with staffing levels. These inconsistent findings might be associated with the complexity of the phenomenon of interest, use of different samples or quality measures, or limitations in existing data sets and analytic methods (Kane, 2004; Mor, 2005); but, in any event, they limit the use of existing studies and justify further investigation of the relationship.

Nursing home deficiencies are the only available means of determining whether or not nursing homes meet regulatory standards. Because of their unique value, despite variability in the state nursing home survey process (Lee, Gajewski, & Thompson, 2006), numerous studies have explored the relationship between nursing staffing levels and nursing home deficiencies (Harrington, Zimmerman, Karon, Robinson, & Beutel, 2000; Johnson-Pawlson & Infeld, 1996; Konetzka, Yi, Norton, & Kilpatrick, 2004; O'Neill, Harrington, Kitchener, & Saliba, 2003). However, most studies are cross-sectional, using 1-year or multiyear pooled data, and unobserved nursing home–specific traits cannot be adjusted for in such studies (Zhang & Grabowski, 2004). Ignoring unobserved heterogeneity may cause bias (Greene, 2003) in estimating the relationship between nursing staffing levels and deficiencies. Despite many states' recent implementation of or increase in nursing home staffing standards, few studies have examined whether the current state minimum nursing staffing standards may meaningfully decrease the probability of deficiencies that may cause serious harm or jeopardy to residents (Harrington, Swan, & Carrillo, 2007; Mueller et al., 2006).

To fill these gaps, we examined the extent to which nursing staffing levels and compliance with a state's minimum staffing standard are associated with total deficiencies, QoC deficiencies, and severe deficiencies. To strengthen existing evidence emerging for the most part from cross-sectional studies, the authors analyzed recent panel data (1999–2003) on nursing staffing from California nursing home cost reports. California has the largest number of nursing home beds and the most extensive historical data on nursing homes; in addition, in 1999, the state passed legislation that set the minimum nursing staffing standard for nursing homes at 3.2 total nursing hours per resident day (HPRD) (Harrington, O'Meara, & Kang, 2006).

Conceptual Framework and Hypotheses

This study, like the study of Weech-Maldonado, Meret-Hanke, Neff, and Mor (2004), was guided by both Donabedian's (1988) structure-process-outcome (SPO) model of quality and the resource-based view (RBV) of the firm (Barney, 1991; Wernerfelt, 1984), an organization theory that explains performance differences among firms as being related to the variance in the firms' resources and capabilities. Donabedian's model posits that QoC structure is associated with QoC process and outcomes, which has been supported by many nursing home staffing and quality studies (Aaronson, Zinn, & Rosko, 1995; Anderson, Hsieh, & Su, 1998; Dellefield, 2006; Dyck, 2007). This study examined how nursing staffing level, an organizational structural characteristic, is associated with regulatory survey deficiencies, an organizational outcome.

We used the RBV of the firm to conceptualize nursing staffing levels as an indicator of a nursing home's commitment to nursing human resources (HRs). The RBV of the firm posits that an organization is a collection of productive resources that encompasses all tangible, intangible, and personnel-based resources owned and controlled by the organization to produce goods and services to satisfy human wants (Barney, 1991). Among these, HRs are vital in forming the basis of an organization's sustainable competitive advantage (Barney; Jackson, DeNisi, & Hitt, 2003). The selection and deployment of HRs, therefore, is a core strategic operation of an organization (Becker & Gerhart, 1996; Oliver, 1997).

HRs have been traditionally regarded as the single largest operational cost of nursing homes; a reduction in staff is frequently used to enhance organizational efficiency (Becker & Gerhart, 1996; Oliver, 1997). According to the RBV, however, improving organizational performance cannot be achieved solely by cost shifting or cost reduction; it also requires new value creation (Porter & Teisberg, 2004). Studies have reported positive associations between properly developed HR and/or HR systems and organizational performance (Aaronson et al., 1995; Lopez, 2003; Oliver, 1997). Thus, the RBV of the firm is consistent with Donabedian's SPO model of quality in its perspectives on the relationship between HRs and organizational outcomes (Weech-Maldonado et al., 2004).

We hypothesized that a nursing home's commitment to its nursing HRs would create and sustain the unique value of the organization. Commitment can be described and measured in various ways, such as staffing level, wage policies, educational support, and decision-making processes, all of which are aimed at achieving a high-performance work system (Becker & Gerhart, 1996; Oliver, 1997). Given that nursing workforce planning and deployment are major issues in the current nursing workforce shortage (Harrington, 2005a), we adopted nursing staffing as a context-sensitive indicator of organizational commitment to nursing HRs (Zinn, Aaronson, & Rosko, 1994) and examined its relationship to organizational performance as measured by deficiencies.

Total nursing staffing levels may reflect a nursing home's overall capacity to provide nursing care and may also affect the roles and performance of different types of nursing personnel in a nursing team. Nursing care requires collaborative teamwork; the quality and quantity of both licensed nurses and nonlicensed staff, the former leading the team and the latter delivering direct care, affect the QoC in a nursing home (Brannon, Barry, Kemper, Schreiner, & Vasey, 2007; Rantz & Connolly, 2004). Total nursing staffing level has been widely measured, and many studies have reported its positive relationship to process and outcome measures of quality (Bostick, Rantz, Flesner, & Riggs, 2006). The Institute of Medicine supported adoption of the standard of 4.1 total nursing HPRD, which was recommended by the Abt studies for the Centers for Medicare and Medicaid Services (CMS, 2000, 2001). Yet the total nursing staffing level of most nursing homes in the United States is much lower than recommended (Harrington, 2005b, 2005c). We hypothesized that a higher total nursing staffing level would be negatively related to the number of deficiencies that nursing homes received in state surveys (H1).

The role of registered nurses (RNs) in delivering quality nursing home care has been studied, but the findings are inconsistent. Most direct observation studies have reported that RN staffing is positively associated with QoC (Bates-Jensen, Schnelle, Alessi, Al-Samarrai, & Levy-Storms, 2004; Bostick, 2004; Schnelle, 2004; Schnelle et al., 2004; Simmons & Schnelle, 2004). Studies analyzing large secondary data sets, however, report more inconsistent findings (Castle, 2008). Based on our conceptual framework, we held that RNs have the leadership and assessment skills to provide resident-specific guided care, taking into consideration the unique context of each nursing home (Weech-Maldonado et al., 2004). As such, RN HRs may be critical to achieving high clinical performance and, ultimately, a nursing home's sustainable competitive advantage. We hypothesized that a higher RN staffing level would be negatively related to nursing home deficiencies (H2).

Approximately 40 states have established minimum nursing home staffing standards intended to improve staffing levels and QoC (Mueller et al., 2006). The required minimum nursing staffing levels, however, vary widely between states (Harrington, 2005b, 2005c). It has not been much examined whether state nursing home staffing standards require meaningful nursing staffing levels that can decrease deficiencies or improve resident outcomes. Mueller et al. (2006) reported no significant difference in the QoC between nursing homes in states where staffing standards were above 2.5 HPRD and nursing homes in states where staffing standards were below 2.5 total HPRD. California has a much higher nursing home staffing standard, 3.2 or more total nursing HPRD (Harrington & O'Meara, 2006), but whether this is a meaningful staffing level that can decrease harm to residents has not yet been evaluated. We hypothesized that meeting California's nursing

Table 1. Definition of Variables and Summary Statistics, 1999–2003 (n = 4,933)

Variable	Definition	*M* (*SD*)	Source
Deficiencies			
Total	Number of all federal and state deficiencies	15.56 (11.59)	ACLAIMS
QoC	Number of federal and state deficiencies in mistreatment, QoC, and resident assessment[a]	6.81 (5.52)	ACLAIMS
Serious deficiencies	Whether a nursing home received G or higher level of deficiencies (yes = 1)	0.19	ACLAIMS
Nurse staffing			
Total staffing hours	Sum of RN, LPN, and NA HPRD	3.23 (.66)	Cost report[b]
Meeting state staffing standard	Whether a nursing home provided 3.2 or more total nursing HPRD (yes = 1)	0.47	Cost report
RN hours	RN HPRD	0.35 (.26)	Cost report
LPN hours	LPN/licensed vocational nurse HPRD	0.61 (.27)	Cost report
NA hours	Nurse aide HPRD	2.27 (.41)	Cost report
Facility characteristics			
Small homes	Number of licensed beds < 60 (yes = 1)	0.24	Cost report
Medium homes	60 ≤ Number of licensed beds < 120 (yes = 1)	0.49	Cost report
Large homes	Number of licensed beds ≥ 120 (yes = 1)	0.27	Cost report
Profit status	Facility operated on a nonprofit basis (yes = 1)	0.12	Cost report
Medicare-paid days	% of resident days paid for mainly by Medicare	7.39 (6.77)	Cost report
Medi-Cal–paid days	% of resident days paid for mainly by Medicaid	64.41 (26.36)	Cost report
Self-pay days	% of resident days paid for mainly by self-pay	20.43 (21.65)	Cost report
Occupancy rate	(Total resident days/total number of licensed beds) × 100	87.62 (9.86)	Cost report
Chain affiliation	Two+ facilities with same owner (yes = 1)	0.63	OSCAR
Resident care needs	Facility's average case mix score[c]	1.07 (.31)	MDS
Market characteristics			
PCI ($)	Per capita income in a county	31,987.9 (8446.1)	BEA
Population aged 85+	Number of people aged over 85 in a county	49,008.2 (47504.5)	BEA
Competition	Sum of squared market shares of the facilities in each county (Herfindahl index)	.05 (.11)	Cost report
Bay region	Bay area (yes = 1, no = 0)	0.21	Cost report
Los Angeles region	Los Angeles area (yes = 1, no = 0)	0.33	Cost report

Notes: ACLAIMS = Automated Certification and Licensing Administrative Information and Management System; OSCAR = Online Survey Certification And Reporting; MDS = Minimum Data Set; BEA = Bureau of Economic Analysis data; SD = standard deviation.

[a] Deficiency categories were created based on research by Mullan and Harrington (2001).

[b] Cost Report: the California Long-Term Care Annual Cost Report Data (COSHPP, 2004).

[c] The case mix score is an aggregate RUGs score calculated from the MDS data set (Fries et al., 1994).

home staffing standard would be negatively related to deficiencies (H3).

Methods

Study Design and Sample

This study was a secondary panel data analysis, with the nursing home as the unit of analysis. All licensed, freestanding nursing homes in California that received state inspections between 1999 and 2003 were included in the study. Hospital-based nursing homes and uncertified nursing homes were excluded because their organizational characteristics, including staffing and resident care needs, are quite different from certified, freestanding homes (CMS, 2000, 2001). These selection criteria identified 1,165 nursing homes (with 5,328 total annual observations, 1999–2003) for inclusion, of which 66 (about 6%) were omitted from the final analytic data set. Twelve of these 66 nursing homes were excluded because their nursing staffing met one or more of the following conditions: total nursing HPRD was less than 0.5 or more than 12; the nursing home capacity was more than 60 beds and RN hours were zero; or the occupancy rate was more than 100%. These criteria are consistent with the criteria that CMS developed for its minimum nursing home staffing studies (CMS, 2000, 2001). The other 54 nursing homes were omitted because they did not have valid values for most variables, including the staffing, case mix, and chain-affiliation variables, in all five observed years. The final analytic sample consisted of a total of 4,933 yearly observations of 1,099 Medicare- and/or Medicaid-certified, freestanding, skilled nursing homes in California between 1999 and 2003.

Data Sources

Data were obtained from five existing electronic databases (see Table 1). The annual cost report data that all licensed nursing homes submit to the California Office of Statewide Health Planning and Development (COSHPD, 2004) were used to derive measures of staffing, facility, and market characteristics. These data are more complete and reliable than staffing data from the federal Online Survey Certification And Reporting (OSCAR) system, which only contains staffing data for the two week period prior to the state survey (Kash, Hawes, & Phillips, 2007).

Nursing home deficiencies were obtained from the Automated Certification and Licensing Administrative Information and Management System (ACLAIMS) database, maintained by the California Department of Health Services (the California Department of Public Health Licensing and Certification Program, 2001). All state survey agencies are empowered to issue federal and state deficiencies: the former reflect minimum standards or requirements (i.e., the mini-code); the latter are additional requirements (i.e., the maxi-code). Although state and federal inspections (surveys) are conducted at the same time, state nursing home surveyors have the discretion to issue deficiencies under federal or state regulations (Tsoukalas et al., 2006). The same deficiency cannot be simultaneously cited under both federal and state regulations. If state deficiencies are not cited or reported, the deficiency count is underreported (Tsoukalas et al., 2006). Thus, to increase the reliability of the deficiency data, the ACLAIMS data set, which includes both state and federal deficiencies, was used rather than the OSCAR database, which includes only federal deficiencies. A separate model for state deficiencies was not developed because most homes during the study period received a relatively small number of state deficiencies. The findings of the federal deficiency only models were consistent with those of the total deficiency models that are reported here.

Chain affiliation was obtained from the OSCAR database. Because few variables in the OSCAR database are appropriate for risk adjustment (Castle, 2008), we used the facility-level case mix index (CMI) score calculated from the Minimum Data Set (MDS) (Fries et al., 1994) as a risk adjustor for this study. When we conducted the study, we were able to obtain only the CMI scores for the observed years, not the entire MDS, which includes detailed resident assessment data. Two county-level variables, per capita income and size of older adult population, were obtained from the U.S. Bureau of Economic Analysis (BEA, 2003).

Variables and Measures

Dependent variables.—The dependent variable of the study was nursing home deficiencies. Deficiencies are issued by California regional health department surveyors when a nursing home does not meet federal and/or state quality standards in the nursing home inspection process. Harrington and colleagues categorized all federal and state deficiencies into nine groups (Mullan, Joseph, & Harrington, 2001; O'Meara, Collier, & Harrington, 2005). We counted within the nine groups the number of total deficiencies, QoC deficiencies, and severe deficiencies that may cause harm or jeopardy. *Total deficiencies* is the sum of all federal and state deficiencies in the nine groups. *QoC deficiencies* is the sum of federal and state deficiencies in three of the nine groups: QoC, mistreatment, and resident assessment. These groups are more closely related to nursing care than the other groups (i.e., administration, environment, life safety, nutrition, pharmacy, and resident rights). *Severe deficiencies* indicate whether a nursing home received one or more federal deficiencies indicating poor QoC that poses immediate harm or jeopardy (i.e., deficiencies classified by surveyors at a G or higher level) to patients (Harrington et al., 2000; O'Meara et al., 2005).

Key explanatory variables.—Three sets of nursing staffing levels were of primary interest: total nursing HPRD, meeting the state minimum nursing home staffing standard (hereafter *meeting state staffing standard*), and nursing HPRD by type of personnel: RNs, licensed practical nurses (LPN)/licensed vocational nurses, and nursing assistants (NAs). Total nursing HPRD, a continuous variable, was the sum of RN, LPN, and NA HPRD. The *meeting state staffing standard* variable was a dichotomous measure of whether or not a nursing home provided 3.2 or more total nursing HPRD (Harrington & O'Meara, 2006). The RN, LPN, and NA HPRD were calculated by dividing each category's hours by total resident days. If a nursing home had 59 or fewer licensed beds, the hours of the director of nursing were also included in RN hours, as in California's staffing standards (O'Meara et al., 2005). All nursing staffing data were obtained from the COSHPD (2004) data set, in which *nursing hours* included part-time and temporary hours, as well as full-time nursing employee hours, counting only productive hours and excluding time for vacation, sick time, disability, and other paid time off.

Control variables.—A literature review led to adjusting the analytic model for several other facility-level and market-level characteristics. Number of beds was measured by categorical groups (Harrington et al., 2000), with mid-sized homes (60–119 beds), the largest group, as the reference group. Profit status, which may make a difference in organizational philosophy and mission (O'Neill et al., 2003), was represented by a dichotomous variable indicating nonprofit nursing homes. Three payer mix variables defined in the COSHPD cost report were included: the percentage of Medicare, Medicaid ("Medi-Cal" in California), and self-pay resident days. Occupancy rate, defined as the percentage of licensed beds occupied during the reporting period, was calculated by dividing resident census days by bed days (COSHPD, 2004). We used the average CMI score reflecting overall resident care needs in a nursing home as the risk adjustment variable. The average CMI score is an aggregate resource use groups (RUGs) score from the MDS (Anderson et al., 1998; Fries et al., 1994). Chain affiliation was represented by a dummy variable in the analysis (Konetzka, Spector, & Shaffer, 2004). For the missing values in chain status, if the chain status was missing in a given year but present and consistent in the years just before and after the missing year, the missing variable

was coded as the same chain status for the missing year. The differences in Medi-Cal reimbursement rates among the Bay, Los Angeles, and other areas in California (O'Neil et al., 2003) were controlled for by using dummy variables for the areas (Table 1).

Estimation Procedure

Several nursing home deficiency studies have adopted a linear regression model using ordinary least-squares estimators (Dellefield, 2006; Harrington et al., 2000; Johnson-Pawlson & Infeld, 1996). However, this approach ignores the nature of nonnegative, integer-valued, count-dependent variables, and may produce biased estimates (Greene, 2003). This study, in contrast, adopted the Poisson random-effects (REs) model with maximum likelihood estimators (Wooldridge, 2002).

The RE model includes the following: a constant term, a vector of nursing home characteristics (nursing staffing levels and all facility and market covariates), a vector of time fixed effects (year dummy variables), and a random parameter allowing a separate intercept for each respective nursing home. The random effects control for the heterogeneity that comes from unobserved, time-invariant, individual nursing home–specific traits (Wooldridge, 2002). The time-invariant covariates that appear in the model embody a part of the heterogeneity that is correlated with the included variables; the random effects pick up what remains. We assumed the random parameter (ψi) had a gamma distribution (θ, θ) so that $E[\exp(\psi i)]$ had a mean of 1 and a variance of $1/\theta = \alpha$ (Econometric Software, 2002). To estimate the relationship of nursing staffing levels to serious deficiencies, a dichotomous dependent variable, we used the Probit RE model with maximum likelihood estimators (Wooldridge, 2002).

Many of our variables were time invariant. Thus, we were unable to fit a fixed-effects Poisson model or carry out a Hausman test (Econometric Software, 2002; Greene, 2007). The negative binomial (NB) model, meanwhile, is a commonly used alternative to the Poisson. Its use is generally motivated by a desire to account for overdispersion in the data. Because the random-effects Poisson specification already accounts for overdispersion, we eschewed the NB formulation as this would have led to overspecifying the model (Greene, 2007). A second natural extension of our model might have been a dynamic panel data specification. Standard approaches to this model for continuous dependent data did not apply to these nonlinear models for discrete data. Conceivably, an alternative approach based on the generalized method of moments and the method of instrumental variables could have been used, but these methods are not well developed (Blundell, Griffith, & Windmeijer, 2002).

More importantly, however, we were not convinced that a truly dynamic model was applicable for this study. The random-effects model we adopted already takes into account potential autocorrelation (that is, correlation across observations) across years of data. Correlation of the deficiencies (outcomes) across time arises from two sources. The simpler source is the persistence of the observed variables in the model, the independent variables. The observed outcomes are conditioned on these variables, so autocorrelation of the outcome variable arises because of correlation in the inputs. The second source of correlation across observation is persistence of effects not in the model. These persistent unobserved effects influence the outcome in every time period. The random parameter in the RE model, which is constant across time, picks up these persistent effects. In other words, the random effects pick up the correlation across time of the latent effects (Greene, 2003, 2007). However, it does not seem to convincingly follow that the number of deficiencies in a given year is a policy decision conditioned on the previous year's count.

In summary, using the Poisson random-effects model and the Probit random-effects model, we estimated the relationship between the three sets of nursing staffing variables and the three sets of deficiencies (Table 1), while adjusting for all observed covariates and time fixed effects, as well as for unobserved, time-invariant nursing home–specific heterogeneity. All data management was conducted with SAS 9.1; data analyses were with NLOGIT 4.0.

Results

Table 1 provides descriptive statistics for the variables in the analysis. On average, the nursing homes in the sample received 15.6 total deficiencies annually, of which approximately 43.7% (6.8) were QoC deficiencies. Almost 19% of homes received one or more deficiencies that may cause harm or jeopardy. On average, the nursing homes provided a mean total of 3.23 nursing HPRD (median = 3.17), but there was large variation: only about 47% of nursing homes met the state staffing standard between 1999 and 2003. Mean RN hours was 0.35 HPRD (median = 0.31) in the observation years.

Total Nursing Staffing

Table 2 illustrates the estimated results of the relationship of total nursing hours to deficiencies. Hypothesis 1—that a higher total nursing staffing level would be negatively related to deficiencies—was supported by the data. Adjusting for organizational and market covariates, a higher total nursing staffing level was consistently related to lower total deficiencies ($p < .001$), QoC deficiencies ($p = .001$), and serious deficiencies ($p = .046$). The marginal effects of total nursing staffing level (the effects of a one-unit change in total nursing staffing level) on all three deficiencies were negative and significant, and the extent of the marginal effects was a decrease

Table 2. Estimation Results of the Relationship Between Total Nursing Hours and Deficiencies (N = 4,933)

	Total Deficiencies, Coefficient (*SE*)	QoC Deficiencies, Coefficient (*SE*)	Serious Deficiencies, Coefficient (*SE*)
Constant	3.056*** (0.069)	2.184*** (0.109)	0.539 (0.345)
Total nursing hours	−0.027*** (0.006)	−0.041*** (0.012)	−0.096* (0.048)
Bed <60[a]	−0.205*** (0.012)	−0.266*** (0.033)	−0.138* (0.066)
Bed 120+[a]	0.156*** (0.020)	0.199*** (0.027)	0.060 (0.059)
Nonprofit (yes = 1)	−0.105*** (0.016)	−0.167*** (0.033)	0.092 (0.090)
% Medicare days	−0.002* (0.001)	−0.0004 (0.001)	0.006 (0.005)
% Medi-Cal days	0.0002 (0.0004)	0.001* (0.0005)	0.005** (0.002)
% Self-pay days	−0.003*** (0.0004)	−0.002* (0.0007)	0.002 (0.002)
Occupancy rate	−0.003*** (0.0002)	−0.004*** (0.0005)	−0.012*** (0.002)
Chain (yes = 1)	0.119*** (0.010)	0.141*** (0.018)	0.059 (0.051)
Resident care needs	0.057*** (0.017)	0.122*** (0.033)	0.025 (0.102)
Per capita income[b]	0.001 (0.001)	−0.003 (0.002)	−.009 (0.004)
Population 85+[b]	−0.007*** (0.001)	−0.001 (0.001)	0.007* (0.003)
Competition (HI)[c]	−0.307** (0.116)	−0.091 (0.148)	0.670* (0.276)
Region Bay (yes = 1)	0.122** (0.038)	0.238*** (0.047)	0.190 (0.099)
Region Los Angeles (yes = 1)	0.462*** (0.066)	−0.076 (0.101)	−1.066*** (0.284)
Year 2000[d]	0.084*** (0.006)	0.021 (0.012)	−0.286*** (0.067)
Year 2001[d]	0.159*** (0.007)	0.080*** (0.013)	−0.543*** (0.072)
Year 2002[d]	0.143*** (0.007)	0.033* (0.014)	−0.693*** (0.076)
Year 2003[d]	0.110*** (0.009)	−0.013 (0.016)	−0.559*** (0.077)
Alpha/rho	0.165*** (0.008)	0.171*** (0.009)	0.086** (0.025)
Log-likelihood	−21,677.94	−15,034.53	−2,258.28

Notes: HI = Herfindahl index; QoC = quality of care; SE = standard error.

[a]Nursing homes with 60–119 beds are the reference.

[b]For scaling purposes, these variables were divided by 1,000 and added into the analytic model.

[c]Higher HI score refers to lower competition.

[d]Year 1999 is the reference.

*p < .05; **p < .01; ***p < .001.

of 0.419 in the mean number of total deficiencies, 0.276 in the mean number of QoC deficiencies, and 0.024 in the likelihood of receiving serious deficiencies.

RN Staffing

Hypothesis 2—that a higher RN staffing level would be negatively related to deficiencies—was supported. RN staffing was negatively related to total (p < .001) and QoC (p = .005) deficiencies and also marginally related to serious deficiencies (p = .051) (Table 3). In contrast, LPN staffing was positively related to total (p < .001) and QoC (p < .001) deficiencies but not related to serious deficiencies (p = .254). When we examined licensed nurse staffing by combining RN and LPN staffing, we found it was positively related to total deficiencies (p < .001) and not related to either QoC (p = .156) or serious deficiencies (p = .769, data not shown). NA staffing levels were negatively related to all three deficiencies, whether RN and LPN staffing were entered into the equations separately or combined (p < .05).

State Staffing Standard

Hypothesis 3—that meeting California's nursing home staffing standard would be negatively related to deficiencies—was partially supported. Meeting the standard was associated with a lower number of total deficiencies (p = .001) and QoC deficiencies (p = .042) but not with the probability of receiving serious deficiencies (p = .085) (Table 4). Upon further analysis, we found no difference in the probability of receiving serious deficiencies between nursing homes that consistently met the current California nursing staffing standard (n = 201, mean = 0.54, SD = 1.43) and those that consistently failed to meet the standard (n = 210, mean = 0.52, SD = 1.42). Meeting the CMS-recommended staffing standard, 4.1 or more total nursing HPRD, however, was negatively associated with receiving serious deficiencies (p = .023).

Discussion

This panel data study on the relationship between nursing staffing and deficiencies employed data over a 5-year period from California after the state passed legislation in 1999 on the new nursing home staffing standard. We conceptualized nursing staffing levels, structural quality indicators, as a nursing home's commitment to its nursing HRs. The study supports our hypotheses that a higher nursing staffing level would be associated with fewer deficiencies. The study strengthens the existing evidence, most of which comes from cross-sectional studies, for the relevance of nursing staffing levels to nursing home outcomes. Nursing staffing levels remain important factors in nursing homes' regulatory compliance, even when adjusting for unobserved, individual nursing home–specific heterogeneity.

Table 3. Estimation Results of the Relationship Between Meeting the State Nursing Home Staffing Standard and Deficiencies (N = 4,933)

	Total Deficiencies, Coefficient (*SE*)	QoC Deficiencies, Coefficient (*SE*)	Serious Deficiencies, Coefficient (*SE*)
Constant	2.971*** (0.063)	2.056*** (0.098)	0.244 (0.309)
Meeting state staffing standard (yes = 1)	−0.016*** (0.005)	−0.020* (0.010)	−0.009 (0.057)
Bed <60[a]	−0.210*** (0.024)	−0.273*** (0.033)	−0.158* (0.066)
Bed 120+[a]	0.156*** (0.020)	0.199*** (0.027)	0.055 (0.059)
Nonprofit (yes = 1)	−0.112*** (0.016)	−0.181*** (0.033)	0.049 (0.090)
% Medicare days	−0.002** (0.001)	−0.001 (0.001)	0.004 (0.004)
% Medi-Cal days	0.0002 (0.0004)	0.001* (0.001)	0.005* (0.002)
% Self-pay days	−0.003*** (0.0004)	−0.002* (0.001)	0.001 (0.002)
Occupancy rate	−0.003*** (0.0002)	−0.003*** (0.001)	−0.011*** (0.002)
Chain (yes = 1)	0.119*** (0.010)	0.142*** (0.018)	0.067 (0.051)
Resident care needs	0.055*** (0.017)	0.115*** (0.033)	−0.015 (0.102)
Per capita income[b]	0.0009 (0.001)	−0.003 (0.002)	−0.009* (0.004)
Population 85+[b]	−0.007*** (0.001)	−0.001 (0.001)	0.007* (0.003)
Competition (HI)[c]	−0.309** (0.116)	−0.093 (0.149)	0.666* (0.279)
Region Bay (yes = 1)	0.121** (0.038)	0.237*** (0.047)	0.189 (0.100)
Region Los Angeles (yes = 1)	0.470*** (0.066)	−0.067 (0.101)	−1.059*** (0.284)
Year 2000[d]	0.083*** (0.006)	0.019 (0.012)	−0.296*** (0.068)
Year 2001[d]	0.157*** (0.007)	0.075*** (0.013)	−0.565*** (0.073)
Year 2002[d]	0.140*** (0.007)	0.027* (0.013)	−0.723*** (0.078)
Year 2003[d]	0.108*** (0.009)	−0.019 (0.016)	−0.593*** (0.081)
Alpha/rho	0.166*** (0.008)	0.172*** (0.009)	0.086*** (0.025)
Log-likelihood	−21,678.95	−15,036.37	−2,260.54

Notes: HI = Herfindahl index; QoC = quality of care; SE = standard error.

[a] Nursing homes with 60–119 beds are the reference.

[b] For scaling purposes, these variables were divided by 1,000 and added into the analytic model.

[c] Higher HI score refers to lower competition.

[d] Year 1999 is the reference.

*p < .05; **p < .01; ***p < .001.

That total nursing staffing level was inversely related to all three deficiency measures strengthens the existing evidence of the importance of overall capacity of nursing care (Bates-Jensen et al., 2004; CMS, 2000, 2001; Harrington et al., 2000; Schnelle et al., 2004). The California nursing home staffing standard, 3.2 total nursing HPRD, may decrease the number of total deficiencies or QoC deficiencies, but it does not decrease the likelihood of receiving serious deficiencies. The findings inform us that although the current California nursing home staffing standard is higher than many other states, it may not be a meaningful staffing standard, unlike the CMS-recommended standard that can decrease serious harm or jeopardy to residents. Further studies on the California nursing home staffing standard are needed.

Nursing homes with higher RN staffing levels received significantly fewer total and QoC deficiencies. Higher licensed (RN and LPN) nurse staffing had either no relationship with or a positive relationship with the deficiencies. When RN and LPN staffing were examined separately, however, only RN staffing was negatively related to deficiencies. These findings imply that combining RN and LPN hours confounds their individual effects and that the real positive driving force for improving QoC is RN staffing (Anderson et al., 1998; Castle & Engberg, 2007; Weech-Maldonado et al., 2004). The effects of LPN staffing on quality are inconclusive: some studies report a positive relationship (Zhang & Grabowski, 2004); others find a negative relationship (Castle & Engberg, 2007); still others find no relationship (Anderson et al., 1998; Arling, Kane, Mueller, Bershadsky, & Degenholtz, 2007; Harrington et al., 2000). Few studies explain why LPN staffing is not or negatively associated with quality, even when RN and NA staffing are adjusted for.

Considering that the current federal and state regulations often regard RN and LPN as one category, that is, licensed nurses (CMS, 2000, 2001; Mueller et al., 2006), nursing homes might be using LPNs not to complement RN staffing but rather to substitute for RNs. As such, nursing homes might fill most licensed nurse positions with LPNs to save on labor costs and hire only the minimum number of RNs required by regulations. If such substitution persists, higher LPN staffing may contribute to decreasing quality rather than increasing quality. Given that RNs have more leadership and assessment skills than LPNs (Anderson et al., 1998; Weech-Maldonado et al., 2004), further study is needed to examine whether and to what extent such substitution exists and what effects, if any, it has on quality and cost of care.

As with RN staffing levels, NA staffing levels were also negatively related to all three types of deficiencies. Approximately 70% of direct care is provided by NAs, including assisting with activities of daily living (ADLs) such as bathing, eating, dressing, and other nonskilled care needs (CMS, 2000,

Table 4. Estimation Results of the Relationship Between RN Staffing Level and Deficiencies (N = 4,933)

	Total Deficiencies, Coefficient (*SE*)	QoC Deficiencies, Coefficient (*SE*)	Serious Deficiencies, Coefficient (*SE*)
Constant	3.023*** (0.070)	2.148*** (0.108)	.462 (0.339)
RN hours	−0.066*** (0.015)	−0.087** (0.031)	−0.245 (0.126)
LPN hours	0.119*** (0.012)	0.110*** (0.024)	0.121 (0.106)
NA hours	−0.059*** (0.008)	−0.075*** (0.016)	−0.139* (0.071)
Bed < 60[a]	−0.204*** (0.024)	−0.264*** (0.033)	−0.127 (0.066)
Bed 120+[a]	0.159*** (0.020)	0.202*** (0.027)	0.068 (0.059)
Nonprofit (yes = 1)	−0.101*** (0.016)	−0.162*** (0.033)	0.109 (0.090)
% Medicare days	0.002* (0.001)	−0.0002 (0.001)	0.007 (0.005)
% Medi-Cal days	0.0001 (0.0004)	0.001* (0.001)	0.005* (0.002)
% Self-pay days	−0.003*** (0.0004)	−0.002* (0.001)	0.002 (0.002)
Occupancy rate	−0.003*** (0.0002)	−0.003*** (0.001)	−0.011*** (0.002)
Chain (yes = 1)	0.121*** (0.011)	0.143*** (0.019)	0.066 (0.052)
Resident care needs	0.046** (0.017)	0.108** (0.034)	0.012 (0.103)
Per capita income[b]	0.002 (0.001)	−0.002 (0.002)	−0.006 (0.004)
Population 85+[b]	−0.007*** (0.0006)	−0.001 (0.001)	0.006 (0.003)
Competition (HI)[c]	−.281* (0.116)	−.067 (0.149)	.687* (0.277)
Region Bay (yes = 1)	0.128** (0.039)	0.239*** (0.048)	0.188 (0.101)
Region Los Angeles (yes = 1)	0.507*** (0.066)	−0.015 (0.101)	−0.938** (0.289)
Year 2000[d]	0.083*** (0.007)	0.020 (0.013)	−0.291*** (0.067)
Year 2001[d]	0.156*** (0.007)	0.077*** (0.013)	−0.552*** (0.073)
Year 2002[d]	0.140*** (0.008)	0.030* (0.014)	−0.702*** (0.078)
Year 2003[d]	0.106*** (0.010)	−0.017 (0.017)	−0.571*** (0.080)
Alpha/Rho	0.165*** (0.007)	0.171*** (0.009)	0.085** (0.025)
Log-likelihood	−21,661.62	−15,025.52	−2,254.82

Notes: HI = Herfindahl index; QoC = quality of care; SE = standard error.

[a]Nursing homes with 60–119 beds are the reference.

[b]For scaling purposes, these variables were divided by 1,000 and added into the analytic model.

[c]Higher HI score refers to lower competition.

[d]Year 1999 is the reference.

*p < .05; **p < .01; ***p < .001.

2001). The findings from this study suggest that nursing home quality may be improved by a team of RNs and NAs, the former playing a significant role in assessing, directing, and monitoring in order to prevent significant and precipitous deterioration of residents' health and functionality, and the latter delivering care to the residents under RN supervision (Anderson et al., 1998; Brannon et al., 2007; Rantz et al., 2004). Further studies are needed on the effects of RN-to-NA mix, NA caseload, the maximum number of NAs that can be monitored by an RN, and the role of the LPN as co-team leader.

Limitations of the study include sole examination of deficiencies noted from nursing home survey inspections. Properly risk-adjusted patient outcomes may be more sensitive quality measures. Deficiency use may vary by geographical location, but this study focused only on data from California. The study took steps to improve the reliability of the deficiency and nursing staffing data by counting state as well as federal deficiencies and obtaining staffing data from the cost report instead of the OSCAR. However, as with any secondary data analysis, reliability remains an issue. Nurse turnover and agency-nurse use, potentially important to QoC, were not included; and potential interaction effects between nursing staffing and other staffing characteristics, such as turnover, stability, and agency-nurse use were also not observed (Arling et al., 2007; Castle & Engberg, 2007). Our findings do not confirm a causal relationship between nursing staffing levels and deficiencies. The potential dynamic nature of the relationship between nursing staffing and deficiencies was not fully explored. The study findings, based on California nursing home data, may not be able to be generalized to the rest of the nation.

In conclusion, the findings of this study suggest that total nursing staffing level is a predictor of deficiencies and that the current federal and state nursing home staffing standards, which are lower than the standard recommended in an Abt study for the CMS (4.1 total nursing HPRD) (2001), may not prevent serious harm to residents. An important question for future research would be whether there is a point between 3.2 and 4.1 total nursing HPRD that could lead to a significant reduction in serious deficiencies. The study findings also suggest that not only the total nursing staffing standard but also the current RN staffing standard should be examined for effectiveness. The current federal staffing standard requires an RN for only eight consecutive hours a day; however, many homes have a waiver for this requirement (Harrington, 2005b; Mueller et al., 2006). Only 12 states require an RN on duty 24 hr a day, with or without a bed number requirement. Given the latitude permitted to nursing homes with regard to RN staffing, the regulatory standards may be providing nursing homes with a disincentive to hire RNs and permitting them to substitute RNs with

LPNs. The findings of this study suggest that the practice of substituting LPNs for RNs may be efficient in cutting labor costs but is not effective in maintaining or improving QoC. Despite concerns about the 25% decrease in average RN staffing levels in nursing homes since 1997 (Harrington, 2005a), the pressure to reduce Medicaid expenditure in nursing homes and doubts about the effectiveness of higher staffing standards on QoC may be inhibiting discussion of strengthening RN staffing from moving forward (CMS, 2001; Konetzka and Yi, 2004; Zhang & Grabowski, 2004). Given the complex nature of staffing and quality, further research on the relationship of RN staffing level to nursing home resident outcomes is needed.

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