

The Influence of Nurse Staffing Levels on Quality of Care in Nursing Homes

Kathryn Hyer, MPP, PhD,^{1,*} Kali S. Thomas, MA,¹ Laurence G. Branch, PhD,²
Jeffrey S. Harman, PhD,³ Christopher E. Johnson, PhD,⁴ and
Robert Weech-Maldonado, MBA, PhD⁵

¹Florida Policy Exchange Center on Aging, School of Aging Studies, University of South Florida, Tampa.

²Department of Health Policy and Management, College of Public Health, University of South Florida, Tampa.

³Department of Health Services Research, Management and Policy, College of Public Health and Health Professions, University of Florida, Gainesville.

⁴Department of Health Policy and Management, School of Rural Public Health, Texas A&M Health Science Center, College Station.

⁵Department of Health Services Administration, School of Health Professions, University of Alabama at Birmingham.

*Address correspondence to Kathryn Hyer, MPP, PhD, Florida Policy Exchange Center on Aging, School of Aging Studies, University of South Florida, 4202 East Fowler Ave, MHC 1300, Tampa, FL 33620. E-mail: khyer@usf.edu

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Objective: This study examines the relationship between increasing certified nursing assistants (CNAs) and licensed nurse staffing ratios and deficiencies in Florida nursing homes over a 4-year period. **Methods:** Data from Florida staffing reports and the Online Survey Certification and Reporting database examine the relationship among staffing levels and deficiency citations for 663 Florida nursing homes between 2002 and 2005. Using a generalized estimating equation approach in SAS Proc Genmod, we estimate the relationship between CNA and licensed nursing staff, and facilities' total deficiency score and quality of care deficiency scores—calculated using the Centers for Medicare and Medicaid Services' Nursing Home Compare Five-Star Quality Rating System, which accounts for the complexity of the scope and severity of the citations. **Results:** Our results confirmed that higher CNA staffing levels were predictors of lower total deficiency scores and quality of care deficiency scores after controlling for facility characteristics. **Conclusion:** With a large sample size, repeated measure design, and advanced methods, we have found a relationship between CNA staffing and nursing home quality.

Key Words: Nursing home quality, State staffing standard, Deficiencies, Deficiency scores

Choosing a nursing home for a long-term placement is a daunting and emotionally charged task for families. Nursing homes that directly bill Medicare and Medicaid for residents' services (approximately 96% of all U.S. facilities) must be certified and inspected annually (Castle, Wagner, Ferguson, & Handler, 2011). Data from the inspections are summarized by the Centers for Medicare and Medicaid Services (CMS) through its Nursing Home Compare website, which provides information to consumers about factors related to the quality of care residents receive (CMS, 2011). CMS grades nursing homes based on, among other things, the average number of nursing hours each resident receives and facility violations of federal regulations. By providing details on nursing homes' average number of nurse staffing hours per resident a day and the deficiency score found during annual inspections of the home, CMS helps consumers consider the quality of care provided as part of their calculus in selecting a specific facility.

Deficiency citations are often used as a measure of nursing home quality (Castle & Myers, 2006; Castle et al., 2011; Harrington, Zimmerman, Karon, Robinson, & Beutel, 2000; Kim, Harrington, & Greene, 2009; Kim, Kovner, Harrington, Greene, & Mezey, 2009; Park & Stearns, 2009). When facilities fail to meet federal requirements, inspectors choose from approximately 180 possible deficiencies and cite the home for violating specific standards. Violations are assessed on two dimensions—scope (how many residents are affected) and severity (likelihood of harming residents). Scope is trichotomized into isolated, a pattern, or a widespread practice. Severity has four categories (no harm, no harm and potential for minimal harm, actual harm, and immediate jeopardy requiring immediate corrective action). The 12 possible combinations of scope and severity constitute the grade from “A” (isolated and no harm = 0 points) to “L” (immediate jeopardy and widespread pattern = 150 points). Deficiencies in categories “F” (potential for widespread harm) and “H” (pattern of actual harm) are considered substandard quality of care. Each deficiency is also placed within categories, such as quality of care, resident rights, or physical environment. If the deficiency is issued in a quality of care, quality of life, or resident rights category and the scope and severity denote substandard care, additional points are added. Thus, a deficiency for inadequate care planning (quality of care violation) would receive 40 points (“H”—pattern of harm) but that same pattern of harm would be only 35 points if it were improper food storage. With the introduction in March 2009 of this comprehensive deficiency score methodology, CMS captures both the scope and severity of all violations cited within the facility and reports deficiencies as a total point score; higher points and more serious violations reflect poorer quality (for further details on the scoring methodology, CMS, 2010).

Prior studies have examined the relationship of staffing to deficiencies (Castle et al., 2011; Harrington et al., 2000; Kim, Harrington, et al., 2009; Kim, Kovner, et al., 2009; Park & Stearns, 2009). Harrington and colleagues (2000) measured the number and type of nursing home deficiencies cited during survey inspections and reported that fewer registered nurse (RN) and certified nursing assistant (CNA) staffing hours were associated with higher numbers of citations, especially citations for poor quality of care. A later study by Kim, Kovner, et al. (2009) reported that both

total nurse staffing and 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. Another study by Kim, Harrington, and colleagues (2009) indicates that RN to total nurse staffing ratio was negatively related to serious deficiencies in nursing homes, and as the RN to licensed vocational nurse ratios increased, total deficiencies and serious deficiencies decreased. In a study examining the impact of state staffing standards on quality of care, Park and Stearns (2009) also confirmed that total deficiencies declined significantly as states increased staffing standards. Although these studies do show a relationship between staffing levels and deficiency scores, they were based on staffing data from the Online Survey, Certification, and Reporting (OSCAR) database, which has been criticized for its inconsistent reporting of staffing levels (Kash, Hawes, & Phillips, 2007). Research examining the reliability of OSCAR data indicates that audited cost reports contain a more accurate reflection of day-to-day nurse staffing levels. Furthermore, previous studies have used a “count” of deficiencies, ignoring the scope and severity of these various violations.

The current study advances the understanding of the relationship between nursing staff ratios and nursing home quality because we are able to analyze a range of nurse staffing levels as Florida implemented new nurse staffing requirements between 2002 and 2005 and because we use two new indicators of deficiencies—CMS’ new comprehensive total deficiency score and also the quality of care deficiency score. Furthermore, previous studies use only the OSCAR database for staffing levels, but this analysis supplements OSCAR with verified staffing reports submitted to the State.

We hypothesize that higher nurse staffing levels—both CNA hours per resident day (HPRD) and licensed nurse (RN and licensed practical nurses [LPN] combined) HPRD—will be significant predictors of lower deficiency scores after controlling for facility characteristics. We examine Florida because in 2001, Florida’s State Legislature mandated a one-time increase from 0.6 HPRD RN/LPN staffing to a minimum of 1.0 HPRD in 2002 and a tiered increase in CNA hours from 1.7 HPRD in 2001 to 2.3 HPRD in 2002, and to 2.6 HPRD in 2003 (S. 1202, 2001). Because Florida also rebased the Medicaid formula to ensure full Medicaid funding of these new staffing levels

(Hyer, Temple, & Johnson, 2009) and committed \$300 million in state and federal funds to implement and enforce the staffing standards, facilities complied with the mandates. Taking advantage of the variability in staffing that existed in 2002 and 2003 (when new monies were allocated to pay for those direct care staff increases) and extending the analysis through 2004 and 2005, the study was able to examine the relationship among staffing levels and deficiency citations in the fourth largest state, a state with the highest proportion of elders and a state with more than 75,000 nursing home residents (Harrington, Carrillo, & Blank, 2008). Furthermore, previous research has indicated that there is variability in citations across states, and therefore, this study will focus on one state, Florida (Harrington et al., 2000).

Methods

Data

All freestanding licensed nursing homes in Florida were included in the analyses. The final sample included 2,493 observations from 663 freestanding nursing homes over the 4-year period of 2002–2005. The unit of analysis is the nursing home. Data from both the OSCAR and the Florida Nursing Home Staffing Reports were merged for these analyses.

The OSCAR database provides information on licensing, survey deficiencies, and structural information about the nursing homes. CMS contracts with every state to inspect and enforce federal standards for nursing homes. State surveyors are trained to review patient outcomes and determine whether the facility is meeting state and federal standards. While in the facility, inspectors also collect data on many aspects of nursing home operations. Data include ownership; number of licensed beds; the number of residents; resident acuity and needs; reimbursement by Medicare; Medicaid; private payment; and details on numbers of full-time, part-time, or contract staff within specific jobs (e.g., nurse aides, RNs, housekeeping and dietary staff).

The Florida Nursing Home Staffing Reports refer to the information that each facility in Florida must self-report semiannually to the Florida Agency for Health Care Administration and includes the quarterly staff HPRD for licensed nurses (RN and LPN are combined) and CNAs. The quarterly data are used to calculate an average annual staffing HPRD for CNAs and licensed nurses in these analyses.

Variables

Because nursing homes can be surveyed anytime during a 9- to 15-month window from the prior survey, the latest survey conducted during the calendar year was used if more than one survey is present. If the survey is missing for the year, the last survey from the year prior was used. From that survey, the calculated dependent variables were the total deficiency score and, within total deficiency score, a subset score termed the quality of care deficiency score that captures violations specifically focused on quality of care (Harrington et al., 2000). Lower scores indicate better adherence to the standards of care. These scores were calculated by using CMS' Nursing Home Compare Five-Star Quality Rating System (CMS, 2010). In an effort to make quality more comprehensive to consumers, CMS assigns points to each individual health citation according to its scope and severity; more points are assigned to more serious violations. Therefore, the more deficiencies, and the more serious or widespread those deficiencies, the higher the deficiency score. The total deficiency score includes approximately 180 different items used to assess the major aspects and standards for nursing facility care (with each citation assigned a value ranging 0–150—depending on the scope and severity). The quality of care deficiencies included a subset of 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 (Harrington et al., 2000).

The independent variables—licensed nurse combined HPRD and CNA HPRD—were defined as the facility's average of the four quarterly reports from Florida's Nursing Home Staffing Reports over a 1-year period. The control variables included eight facility characteristics that were potentially associated with deficiencies and were selected from the OSCAR dataset a priori. First, to account for the level of resident care needs, we used resident acuity index created by the Cowles Research Group (Cowles, 2002) and derived from the OSCAR files. It combines a range of activities of daily living dependencies and special treatment needs for all residents in a facility on a scale of 0 (*low need*) to 38 (*high need*). Second, because larger facilities require more direct care staff and may be better able to restructure staff to meet needs, we controlled for

size using a measure of the number of total beds (private, Medicare, Medicaid, and dual-certified beds). Third, facilities that are members of a chain potentially may have more resources available. Therefore, we included chain membership (1 = *yes*, 0 = *no*) to control for this potential confound. Fourth, in Florida, approximately 70% of the nursing homes are for-profit (FP) facilities. The remaining 30% are either government-owned, church-owned, or otherwise designated as private not-for-profit (NFP) facilities (Harrington et al., 2008). Harrington and colleagues (2000) found that NFP facilities have higher direct care staffing levels compared with FP nursing homes. For this reason, we controlled FP status using a dichotomous variable where 1 = *for profit* and 0 = *others*. Fifth and sixth, the proportion of Medicaid residents and the proportion of Medicare residents are included because payer mix may influence the resources, quality, and financial performance of a facility (Weech-Maldonado, Neff, & Mor, 2003). Seventh, we controlled for a facility's occupancy rate as occupancy is one of the most commonly used measures of performance and serves as a proxy for the ability to capture market share in a competitive marketplace (Zinn, Mor, Feng, & Intra-tor, 2009). Eighth, we controlled for the facilities' Florida survey region as variation in the number of deficiencies is sometimes attributed to the different surveyors in the different survey regions (Harrington et al., 2000). Finally, to control for the correlation among yearly measurements in the same facility, the variable year was included in the models.

Analyses

Repeated measures multivariate analyses of the outcome, total deficiency score, were performed with a generalized estimating equation approach, a gamma distribution, and a log link function in SAS Proc Genmod (SAS Institute, 2004). Because the distribution of total deficiency scores were skewed and kurtotic, gamma regression with a log link was chosen to best estimate the distribution as it is not sensitive to heteroskedasticity.

Quality of care deficiency score was modeled with a generalized estimating equation approach, a negative binomial distribution to account for the facilities with no deficiencies, and a log link function in SAS Proc Genmod. The generalized estimating equation method and the variable "Year"

Table 1. 2002 Descriptive Characteristics of Study Variables (N = 635)

Variable	M	SD
Dependent variables		
Total deficiency score	49.0	46.9
Quality of care deficiency score	9.3	14.8
Independent variables		
CNA HPRD	2.5	0.3
Licensed nurse HPRD	1.2	0.2
Control variables		
Acuity index	10.6	1.2
Total beds	123.4	47.6
Member of a chain	63.0%	48.2%
For profit	78.0%	41.2%
Medicaid ratio	59.9%	21.8%
Medicare ratio	15.9%	10.8%
Occupancy	86.1%	13.9%
Survey region	Range (1–11)	

Note: HPRD = hours per resident day.

adjusts for the correlation among years of measurement in the same nursing facility.

The four final regression models adjust for all eight time-varying facility characteristics (acuity index, total beds, chain membership, FP status, Medicaid ratio, Medicare ratio, occupancy rate, and survey region) and the year (to control for correlations among repeated measures) while examining the main effect of either CNA HPRD or licensed nurse HPRD on the outcomes of total deficiency (Model 1) and quality of care deficiency scores (Model 2). Incidence rate ratios were calculated for increasing levels of each of the independent variables relative to the lowest level of each in the negative binomial models.

Results

Baseline descriptive characteristics of Florida nursing homes in 2002 are reported in Table 1. When staffing requirements (SB 1202) were implemented in 2002, Florida nursing homes had on average 123 beds. Of the nursing homes, 63% were affiliated with a chain, 78% were FP, and the facilities cared for residents, with an average acuity index of 10.6. In 2002, facilities were staffing on average at 2.5 CNA HPRD and 1.2 licensed nurse HPRD; both average rates were above the minimum standards mandated by the state. Table 2 reflects the changes in the two independent variables—CNA HPRD and licensed nurse HPRD over the 4-year study period—as well as the change in the two dependent variables. The CNA hours increase in 2003 to an average of 2.71 HPRD

Table 2. Change Over Time in Main Independent and Dependent Variables

Variable	2002 (N = 635)		2003 (N = 641)		2004 (N = 643)		2005 (N = 649)	
	M	SD	M	SD	M	SD	M	SD
Dependent variables								
Total deficiency score	47.93	46.96	47.55	47.85	42.96	43.16	44.55	34.85
Quality of care deficiency score	9.27	14.85	8.68	17.55	7.18	12.16	6.84	8.51
Independent variables								
CNA HPRD	2.49	0.29	2.71	0.29	2.73	0.35	2.73	0.31
Licensed nurse HPRD	1.15	0.24	1.14	0.26	1.16	0.28	1.18	0.32

Note: HPRD = hours per resident day.

when the 2.6 HPRD minimum staffing standard is established. The CNA hours remain stable over the next 3 years presumably because state minimum staffing standards are constant.

CNA and Licensed Nurse HPRD

Table 3 presents results of two regression models of the influence of the CNA HPRD and licensed nurse HPRD for the two deficiency measures. Model 1 indicated a nearly significant relationship ($p = .06$) between CNA HPRD and total deficiency score. Every additional hour of CNAs per resident day was associated with a 10% decrease in the total deficiency score. Model 2 revealed that the CNA HPRD in Florida nursing homes was significantly associated with the incidence rate of quality of care deficiencies ($p < .05$). Facilities staffing 1 hour fewer CNAs per resident day have a 33% increase in quality of care deficiencies when controlling for other facility characteristics.

Discussion

This study assesses the relationship between CNA staffing levels and two new measures of nursing home quality that capture both nursing facilities'

violation of nursing home standards and the significance of those violations. Our data are reported over the 4-year period that Florida increased nurse staffing standards and reported total staffing standards among the highest in the country. The findings from this study provide partial support for the hypothesis that higher CNA HPRD are associated with lower scores on both total deficiencies and deficiencies related specifically to quality of resident care. These findings hold even while controlling for organizational characteristics and patient acuity.

In the most practical terms, the findings from our analyses indicate that with every 6 minute increase (tenth of an hour) in CNA HPRD, there is a 3% reduction in the quality of care deficiency score. To provide an understanding of its clinical significance, at baseline, the average quality of care deficiency score was 9.3. Therefore, facilities that staffed one tenth of an hour lower in their CNA HPRD than the average facility increased their average quality of care deficiency score to 9.6. Because a higher deficiency score indicates more serious quality of care problems, this means that facilities with lower CNA staffing provide poorer quality of care controlling for that same facility in

Table 3. Regression Results of the GEE Models for Total Deficiency Score and Quality of Care Deficiency Score With the CNA and Licensed Nurse Hours per Resident Day From 2002 to 2005 (N = 663)

Variables	Model 1			Model 2			
	Total deficiency score			Quality of care deficiency score			
	Est	SE	p Value	Est	SE	IRR	p Value
CNA HPRD	-0.10	0.05	.06	-0.29	0.13	0.75	.02
Licensed nurse HPRD	-0.11	0.07	.10	-0.20	0.16	0.81	.20

Notes: All models control for year, acuity index, beds, chain membership, for-profit, Medicaid ratio, Medicare ratio, occupancy rate, and survey region. CNA = certified nursing assistant; Est = estimate; HPRD = hours per resident day; IRR = incidence rate ratio; SE = standard error.

earlier years. This could mean that the facility had one more citation, a more widespread citation, or a more severe citation than the average facility. Using the CMS deficiency scores allows us to demonstrate the relationship between all staffing standards and deficiencies that others (e.g., Kim, Harrington, et al., 2009) using counts of deficiencies have not demonstrated.

It is important to note that Florida substantially increased CNA levels during these years as Table 2 documents. Florida had among the highest average total staffing levels in the country (Hyer et al., 2009), and these levels are close to the CMS-recommended standard of 4.1 total HPRD. Our findings support Mueller and colleagues' (2006) conclusions that states must establish staffing standards or "floors" substantial enough to increase average total staffing in order to avoid a "dampening effect" (p. 79). As others have noted, if state standards are established at the state staffing average, it merely raises the lowest-staffed facilities and, consequently, may have little effect on the average quality of care (Hyer et al., 2009; Park & Stearns, 2009).

Our finding that licensed nursing is not statistically related to deficiency scores when controlling for CNA HPRD is not surprising given the minimal variation in this variable across years, it might be expected. There may be an independent association of LPN or RN staffing with deficiency scores, but unfortunately, because the state report combines RN and LPN hours together, we are unable to differentiate LPN from RN HPRD in these Florida data. Using cost report data, Hyer and colleagues (2009) reported that RN HPRD were decreasing during this timeframe and that the decrease in RN HPRD is a troubling trend given the increased acuity of nursing home residents. Other researchers (Kim, Kovner et al., 2009; Kim, Harrington, et al., 2009; Konetzka, Stearns, & Park, 2008; Weech-Maldonado, Neff, & Mor, 2003) have found that RN hours have an independent effect on quality of care. Future research should examine the specific levels of licensed nurse staffing and their relationship to deficiency scores.

This research is innovative in several respects. First, this research uses state-verified facility-specific staffing data, aggregated quarterly and required by the State of Florida as part of its staffing enforcement efforts (Hyer et al., 2009). Second, this is among the first studies to use the new deficiency score as calculated by the CMS' Nursing Home Compare Five-Star Quality Rating System, thereby providing a more robust and comprehensive

dependent variable measure than previously available. Most previous studies have simply provided a count for the number of deficiencies, which ignores the complexity of the scope and severity score. Third, deficiency citations have significant implications for the quality of care and quality of life of nursing home residents, thereby providing enhanced face validity and practical significance. Fourth, because we used a time period in which there were significant increases in staffing levels, we have an independent variable, CNA HPRD, with great variation that allows us to adequately assess the varying staffing levels on quality as measured by deficiency scores

A review of the staffing literature suggests that although many have identified an association between staffing and quality, findings are not consistent. Much of this variation has been noted as due to sample size limitations, cross-sectional designs, and other methodological issues (Castle, 2008). However, with Florida's policy change resulting in increases in CNA average HPRD, our large sample size, repeated measures design, and sophisticated statistical methods, we found a significant relationship between paraprofessional staffing levels and quality as defined by deficiency citation scores. However, it is important to point out our study's limitations. Florida has a history of vigorous regulatory enforcement and well-trained surveyors (Hyer et al., 2009), but it is still one state and the results of this study may not be generalizable. Florida's staffing report is presumed superior to OSCAR data because it is verified by the State; however, we have no studies of its validity. Finally, the inability to differentiate RN from LPN hours in licensed nursing may inadvertently imply CNA staffing alone is sufficient to improve quality. Our outcome measure of deficiency scores, while superior to counts of deficiencies, is still subject to detection bias; there is variation in the rating of scope and severity. While variation between surveyors may limit the usefulness of deficiency citations (Castle, Engberg, & Men, 2007), we accounted for this by limiting our data to one state and controlling for survey region within that state.

The findings from this study have implications for states and providers. Nursing Home Compare uses both staffing levels and deficiency scores to rate nursing homes. Because this is a tool consumers use to select a nursing home, providers would benefit from hiring more CNA staff because our study has demonstrated a relationship between higher CNA staffing levels and lower deficiency

scores. By improving in one area (CNA staffing), providers subsequently will improve in another area (lower deficiency scores) and thereby improve their quality score and marketability to attract residents. Furthermore, while still in its early stages, the pay for performance movement includes nine states currently implementing pay for performance demonstrations in nursing homes (Werner, Konetzka, & Liang, 2010). Again, deficiencies are part of the performance criteria in eight of these states; providers will benefit financially, by improving quality through higher CNA staffing.

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