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Nursing Home Staffing and Quality Under the Nursing Home Reform Act

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Purpose: We examine whether the Nursing Home Reform Act (NHRA) improved nursing home staffing and quality. ***Design and Methods:*** Data from 5,092 nursing homes were linked across the 1987 Medicare/Medicaid Automated Certification System and the 1993 Online Survey, Certification and Reporting system. A dummy-year model was used to examine the effects of the NHRA on pressure ulcers, physical restraints, and urinary catheters, and a first-difference approach to fixed-effects regression analyses was used to estimate the effects of time-varying staffing on the quality of care. ***Results:*** Overall, we found a significant increase in nursing home staffing levels from 1987 to 1993. Moreover, after controlling for other facility, resident, market, and state factors, there was a significant decrease in the proportion of residents with pressure ulcers, physical restraints, and urinary catheters following the implementation of the NHRA. Across all facilities, the increase in staffing was not directly related to the improvement in quality over the period of our study, but there was a positive relationship between registered nurse staffing and quality for facilities that were particularly deficient prior to the NHRA. ***Implications:*** Following the NHRA, quality improvements were found in nursing homes nationwide, and these results suggest that part of this improvement was due to the quality and staffing regulations within the NHRA.

Key Words: Regulation, OBRA 87, Long-term care

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The nursing home sector is one of the most heavily regulated industries within the U.S. economy. The government is the dominant purchaser of nursing home care by means of the Medicaid and Medicare programs, with state Medicaid programs covering approximately 50% of all nursing home expenditures and 70% of all bed days. The government is also a regulator and overseer of care in placing a number of restrictions on nursing homes that accept Medicaid and Medicare recipients. Any home that admits Medicare and Medicaid residents must be annually certified by means of a Centers for Medicare & Medicaid Services (CMS) survey. Several alternative remedies may be imposed on facilities that receive a high number of deficiencies. These punishments include civil money penalties of up to $10,000 a day, denial of payment for new admissions, state monitoring, temporary management, and immediate termination. In spite of the high degree of government involvement within the industry, quality has generally been perceived to be substandard over the past three decades (e.g., Institute of Medicine [IOM], 1986, 2001; U.S. General Accounting Office, 1998; U.S. Senate, 1974).

In 1987, Congress passed the Nursing Home Reform Act (NHRA) as part of the Omnibus Budget Reconciliation Act of 1987 with the goal of improving the quality of care in nursing homes through greater government regulation. Implemented in part in October of 1990, the NHRA mandated the most comprehensive legislative requirements to date in terms of the provision of nursing home care (IOM, 1996). The last regulations associated with the NHRA, related to certification and enforcement of standards, became effective on July 1, 1995 (IOM, 2001). The NHRA sought to improve nursing home quality by establishing a singular set of conditions for certification of all nursing homes. Although the NHRA was quite broad in nature, aspects of the regulations adopted in 1990 related directly to staffing and to particular quality issues.

The NHRA mandated a reduction in the use of unnecessary drugs, unnecessary physical restraints, any significant medication errors, pressure ulcers, and incontinence. The staffing regulations established

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under the NHRA required that Medicaid and Medicare certified nursing homes have licensed practical nurses (LPNs) on duty 24 hours a day; a registered nurse (RN) on duty at least 8 hours a day, 7 days a week; and an RN director of nursing in place (Omnibus Budget Reconciliation Act of 1987, 1987). The NHRA also mandated that nurse's aides (NAs) receive a minimum of 75 hr of training and pass a competency test. Furthermore, the NHRA required nursing homes to provide "sufficient" staff and services to help their residents attain or maintain the highest possible level of physical, mental, and psychosocial well-being (Health Care Financing Administration, 1991).

There is a large empirical literature examining the relationship between staffing and nursing home quality. Davis (1991) reviewed five early studies in this area and found inconclusive evidence regarding the effect of staffing on quality. However, more recent literature reviews conducted by the IOM (1996; 2001) argue that a number of studies have shown a positive association between nurse staffing levels and the processes and outcomes of nursing home care (e.g., Cherry, 1991; Cohen & Spector, 1996; Munroe, 1990; Spector & Takada, 1991; Zinn, 1993). In addition, Harrington, Zimmerman, Karon, Robinson, and Beutel (2000) found that higher staffing hours, particularly of RNs, were associated with fewer nursing home deficiencies. There are also clinical studies documenting that labor-intensive exercise and incontinence interventions can improve the quality of care (e.g., Fiatarone et al., 1994; Morris et al., 1999). On the basis of the IOM's (2001) review of the literature, the panel recommended that the CMS require a 24-hr RN presence within the nursing home. It further recommended that the CMS develop minimum staffing levels (number and skill mix) for direct care based on case-mix adjusted standards.

Perhaps the most comprehensive evidence to date regarding the relationship of staffing and quality is in a report by Abt Associates (2001) commissioned by the CMS under the Omnibus Budget and Reconciliation Act of 1990 to study the appropriateness of establishing minimum caregiver standards. The Abt report argues that RN, LPN, and NA staffing improves quality up to some threshold at which point there is no further significant quality improvement. For the long-stay nursing home population, these thresholds were 0.75 RN hr/resident day, 1.3 LPN hr/resident day, and 2.78 NA hr/resident day. If these thresholds were instituted as minimum staffing standards, 52% of all nursing homes would fail to meet all three standards and 97% would fail to meet one or more. On the basis of a detailed review of the available evidence, an expert panel has also argued in support of a higher minimum nurse staffing standard (Harrington, Kovner, et al., 2000).

It is important that much of the empirical evidence to date examining nursing home staffing and quality has been based on somewhat limited econometric specifications. That is, the direct evidence regarding the relationship between staffing and quality has been identified solely by cross-sectional variation in staffing and quality. Thus, the finding that residents in homes with higher staffing, for example, receive better quality is observationally equivalent with two alternative interpretations. One interpretation is that this correlation reflects the responsiveness of nursing home quality to higher staffing. However, it is equally reasonable to suppose that this cross-facility relationship merely reflects the presence of unobserved home-specific attributes that influence both the level of staffing and the quality of care. For example, it may be that high-quality facilities with better care practices also choose to hire more staff. Although the estimation strategy will be discussed in detail in the paragraphs that follow, this study uses a first-difference approach to fixed-effects regression analyses, which exploits within-home variation in the regressors and outcomes, and, as a result, automatically controls for time-invariant factors that differ across homes.

In addition to the literature examining the direct association of staffing and quality, there is also previous work evaluating whether the NHRA has brought about a positive change in the nursing home industry. However, the evidence to date is mixed and incomplete. The U.S. Office of the Inspector General (1993) reported positive improvement in quality of care because of the government regulations. The average number of deficiencies per facility declined from 8.8 in 1991 to 7.9 in 1993, and to 6.1 by the end of 1995; the percentage of facilities with no deficiencies has increased from 10.8% in 1991 to 11.4% in 1993, and to 15.3% in 1995 (Harrington, Swan, Nyman, & Carillo, 1997; Harrington, Thollaug, & Summers, 1995). The most common changes in quality were thought to be the decreased use of restraints (Janelli, Kanski, & Neary, 1994; Marek, Rantz, Fagin, & Krejci, 1996a). Moseley (1996) studied the effect of the NHRA on catheterization among 3,149 pre-NHRA and 5,073 post-NHRA Virginia residents and found that a higher proportion of residents were catheterized before the NHRA than after the NHRA. Marek, Rantz, Fagin, & Krejci (1996b) observed an increase in nursing staff as a result of the NHRA. However, Janelli and colleagues (1994) found no increase in nursing staff following the enactment of the NHRA in October of 1990.

Although these studies have provided important information regarding the implications of the NHRA, the existing literature is limited in several ways. First, many of the studies to date have only used data in the post-NHRA period. Thus, there is no means of identifying quality in the period prior to the regulation. Second, few studies have examined outcomes outside of staffing. Third, no study to date has attempted to link the staffing requirements under the NHRA with quality measures to determine whether the increased staffing requirements have translated

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into higher quality. Although the NHRA staffing standards may be nonbinding or insufficiently low for certain facilities (IOM, 2001), the staffing requirement provides additional information on the potential relationship between staffing and quality. Thus, this study addresses all three of these limitations through the use of a novel data linkage. As part of the NHRA, the federal government changed the surveying system that was utilized to monitor nursing homes. Researchers have generally focused their analyses only on the more widely available post-NHRA data. In this current study, we have linked federal certification data from the pre- and post-NHRA periods for over 5,000 facilities in 22 states. Thus, to our knowledge, this study represents the first large-scale, multistate study of the NHRA and quality.

Using this unique data file, in this study we addressed the following two questions: first, what was the effect of the NHRA on staffing and quality of care? Second, were any observed changes in quality related to changes in staffing under the NHRA?

Methods

Data Sources

This study used secondary data sets from several sources. Home-level quality and facility information were drawn from two sources: the 1987 Medicare/Medicaid Automated Certification System (MMACS) and the 1993 Online Survey, Certification, and Reporting (OSCAR) system. The MMACS is the predecessor to the OSCAR system. The MMACS and the OSCAR both contain information from state surveys of all federally certified Medicaid (nursing care) and Medicare (skilled nursing care) facilities in the United States. Certified homes represent almost 96% of all facilities nationwide (Strahan, 1997). Collected and maintained by the CMS, these data are used to determine whether homes are in compliance with federal regulatory requirements. Every facility is required to have an initial survey to verify compliance. Thereafter, states are required to survey each facility no less often than every 15 months, and the average is approximately 12 months. Although there are some significant differences in the content of the MMACS and OSCAR files, the fields used within this study remained constant across the two instruments. As a note, we only had access to the 1987 MMACS file for 22 states. Thus, the analyses presented within this study contain nursing home data from the following states: Arkansas, Arizona, California, Delaware, Idaho, Louisiana, Maryland, Minnesota, New Jersey, New Mexico, Nevada, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, Virginia, Washington, Wisconsin, and West Virginia.

Two other data sources were utilized to supplement the MMACS and OSCAR nursing home data. First, the nursing home data were merged with aggregate county-level demographic, socioeconomic, and health status data from the Bureau of Health Professions' Area Resource File (ARF). Second, state-level Medicaid reimbursement rates were obtained from data collected by Harrington, Swan, and colleagues (Harrington et al., 1993; Swan, Harrington, Grant, Luehrs, & Preston, 1993).

Data Cleaning

Originally, the 1987 MMACS file contained data for 7,221 homes, whereas the 1993 OSCAR file contained data for 8,332 nursing homes from the 22 study states. Previous studies have documented data-quality issues with the staffing fields in the OSCAR (Harrington, Woolhandler, Mullan, Carrillo, & Himmelstein, 2001; Harrington, Zimmerman, et al., 2000; Health Care Financing Administration, 2000). Because the staffing data for both data sets had skewed distributions with a number of outliers that appeared to be erroneous, we used a rule of mean $\pm$ 3 standard deviations to exclude potentially erroneous outliers. On the basis of this rule, we excluded 466 nursing homes from the MMACS file and 500 nursing homes from the OSCAR file. Nursing homes with 15 or fewer residents (especially those with only 1 resident) had extremely higher staffing hours than other homes (Harrington, Zimmerman, et al., 2000). In addition, some nursing homes had questionable resident count information in that the homes reported more total residents than total beds (Health Care Financing Administration, 2000). On the basis of these exclusion rules, we eliminated an additional 3 nursing homes from the MMACS file and 216 nursing homes from the OSCAR file. When there were multiple surveys of the same home within a calendar year, the most recent survey was utilized. Ultimately, 6,752 certified nursing homes from the MMACS file and 7,616 from the OSCAR file remained, and we were able to match 5,092 facilities across the two files for our final analytic file.

Staffing and Quality Measures

Given the mandated staffing changes under the NHRA, we transformed full-time equivalents (FTEs) for each nursing staff type (RNs, LPNs, and NAs) into hours per resident day by multiplying the FTEs reported for a 2-week period by 70 hr and dividing by the total number of residents and by the 14 days in the reporting period (the procedure used by the CMS). Hausman tests indicated that the staffing measures could be treated as exogenous in the quality models.

In this study, three separate quality measures were used to represent the quality of care in nursing homes. The outcome-oriented measure of quality was the number of residents with pressure ulcers (or decubitis

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ulcers), commonly associated with immobility in elderly persons. Pressure ulcers are areas of the skin and underlying tissues that erode as a result of pressure or friction or lack of blood supply. Pressure ulcers can often be prevented or resolved by frequently repositioning the immobile resident. The proportion of residents with catheters and the proportion of residents with physical restraints were also used as procedural measures of quality. Because labor constitutes 60–70% of nursing home costs, these procedures may be used as labor-saving practices on the part of nursing homes with potential negative consequences for resident health (Zinn, 1993). Immobility resulting from the use of physical restraints may increase the risk of pressure ulcers, depression, and mental and physical deterioration; it may increase the risk of mortality as well. Urethral catheterization places the resident at greater risk for urinary tract infection, which may result in hospitalization. Other long-term complications include bladder and renal stones, abscesses, and renal failure.

Model Covariates

We included a number of facility-, county-, and state-level factors as control variables within the model. Given prior findings showing a relationship between the organizational factors and quality of care, facility size (Ray, Federspiel, & Schaffner, 1980) and ownership (Graber & Sloane, 1995) were included as covariates within the analysis. In general, the raw rates of the outcomes may be a function of both quality and case mix if they are not risk adjusted (Mukamel, 1997). Thus, we included the home's average activities of daily living (ADLs) based on the need for assistance or complete dependence in the areas of bathing, eating, toileting, dressing, or walking as a covariate in the model. We also included the proportion of residents with Medicare as their primary payer source as a proxy for the amount of skilled care provided within the facility. Finally, we included both the proportion of individuals that were bedfast and the proportion of individuals who were chairbound as additional case-mix adjusters.

An important potential limitation of the ADL index is that lower quality within a facility may lead to greater ADL dependency. However, the nursing home case-mix literature has generally argued that need-based factors such as ADLs are sufficiently invariant to provider influence (e.g., Fries et al., 1994). The ADL most likely to be influenced by quality of care is toileting. That is, homes providing more extensive bladder and bowel retraining programs are likely to have fewer residents dependent in toileting. All of the results presented within this study are robust to the inclusion of a modified ADL measure that did not include toileting. There has also been recent experimental evidence suggesting that nursing home patients exposed to aggressive rehabilitative programs such as weight-bearing exercises have achieved significant improvements in the ADLs that have historically been thought of as exogenous such as walking and transferring (e.g., Schnelle et al., 2002). However, very few facilities have instituted these experimental programs. Thus, the ADL index is treated as an exogenous covariate within this study.

The county was used to approximate the market for nursing home care within this study. Most economic studies have used the county as a proxy for the nursing home market (e.g., Cohen & Spector, 1996; Nyman, 1985). As noted by Banaszak-Holl, Zinn, and Mor (1996), the county may be a reasonable approximation of the market for nursing home care, given patterns of funding and resident origin. At the county level, we controlled for the number of nursing homes, the number of elderly individuals per square mile (e.g., Grabowski, 2001a), and the average real per capita income (e.g., Grabowski, 2001a). Finally, given the importance of Medicaid as a payer of nursing home services (e.g., Cohen & Spector, 1996; Grabowski, 2001b), we included the real state-level Medicaid payment rate within the model.

Estimation Strategy

In order to examine the effect of the NHRA on the quality measures, we initially estimated models of the general form

$$Y_{it} = X_{it}\gamma + \alpha_t + \mu_{it}, \quad (1)$$

where Y_{it} is the level of quality for home i in year t and X_{it} is a vector of control variables. Parameter α_t is a time-specific intercept (a dummy variable equal to 1 if the year equals 1993) and μ_{it} is a mean-zero random error. This year dummy α_t was included to capture the effect of the NHRA on quality. By utilizing data roughly 3 years prior to the adoption of the NHRA and 3 years after the NHRA, we can examine whether homes modified their quality leveling following the implementation of the NHRA. One potential limitation of this dummy-year approach is that this fixed effect will also capture other factors that are common across all states over this time period, such as other Federal nursing home policies and the progress of health care technology. Nevertheless, this model provides the most comprehensive evidence to date regarding the effect of the NHRA on quality. We estimated the parameters of Equation 1 by using a least squares model. It is important that all the results presented within this study were found to be robust to a series of alternative model specifications available upon request from the authors. In particular, we experimented with a binomial model (with a logit link) for the quality equations.

A second set of analyses examine whether changes in staffing have been related to changes in quality under the NHRA. Interfacility differences in quality are likely to be influenced by differences in difficult to observe characteristics such as the organizational

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culture of the facility, the qualifications of the administrative staff, and the average tenure of nursing home staff. Many previous studies of staffing and quality have ignored this heterogeneity, resulting in biased estimates if the unobserved factors are correlated with cross-facility variations in staffing. For example, if those facilities with a poor organizational structure (and thus, worse quality) also had the lowest staffing, we would systematically overestimate the effect of staffing on quality. Other researchers have attempted to control for the heterogeneity by including an unusually large set of explanatory variables. Although this approach has the advantage of providing a more fully specified model, the measured differences are unlikely to account for all the disparities between facilities. The alternative and, we argue, preferred approach used in this study is to estimate first-difference fixed-effects models. This approach exploits within-facility variation in the regressors and outcomes, and, as a result, it automatically controls for all time-invariant factors that differ across homes. Within the nursing home literature, this methodology has been previously used by Davis, Freeman, and Kirby (1998) to examine changes in facility performance stemming from the adoption of case-mix adjusted Medicaid payment in Kentucky.

Thus, we estimate a set of first-difference fixed-effects models of the general form

$$Q_{it} - Q_{i,t-6} = (S_{it} - S_{i,t-6})\beta + (X_{it} - X_{i,t-6})\delta + (\varepsilon_{it} - \varepsilon_{i,t-6}), \quad (2)$$

where Q_{it} is the level of quality, S_{it} is the level of staffing, X_{it} is a vector of covariates, and ε_{it} is a mean-zero random error for home i in year t. This first-difference approach allows us to remove the effects of latent unobserved variables by subtracting lagged variable values from each observation to determine whether those facilities that increased their staffing levels over the 1987–1993 period were those facilities that experienced an increase across the three quality measures (Hsiao, 1986). Thus, the basic identification strategy implicit in Equation 2 purges the unobserved and potentially confounded cross-sectional heterogeneity by relying on the within-facility variation in staffing and by using homes that did not change their staffing as a control for unrelated time-series variation.

In addition to examining a first-difference model for our entire sample, we also present results for those facilities in the lowest and highest quartiles of each of the staffing measures in 1987. For the lowest quartile model, we alternatively restrict the model to those facilities with less than 0.090 RN hr/resident day in 1987, those facilities with less than 0.323 LPN hr/resident day, and those facilities with less than 1.338 NA hr/resident day. For the highest quartile model, we alternatively restrict the model to those facilities with more than 0.366 RN hr/resident day in 1987, those facilities with more than 0.550 LPN hr/resident day, and those facilities with more than 1.927 NA hr/resident day. These model specifications are used to explore possible nonlinear relationships between staffing and quality. A nonlinear relationship may persist for several reasons. First, it may be that only those facilities that were particularly deficient prior to the adoption of the NHRA would increase staffing (i.e., the regulation is only binding for these facilities); second, it may be that greater staffing improves quality only up to some threshold at which point greater staffing will not affect quality; or third, it may be that staffing may not improve quality until staffing reaches some minimal threshold. The first two explanations would point toward a stronger effect in the bottom quartile of the distribution, and the final explanation would support a stronger response within the top quartile.

Results

Descriptive Statistics

Table 1 provides means, standard deviations, and the results of *t*-test statistics comparing the 1987 MMACS data to the 1993 OSCAR data. Over this time period, there was a statistically significant increase in all of three of the staffing measures, and two of the three nursing home quality measures. RN hours per resident day increased 18% from 0.26 in 1987 to 0.30 in 1993. LPN hours per resident day increased 30% from 0.46 in 1987 to 0.60 in 1993. Finally, NA hours per resident day increased 24% from 1.61 in 1987 to 1.99 in 1993. Once again, the NHRA only mandated minimum staffing standard for RNs and LPNs, which implies that the increase in NAs was driven by other features of the NHRA or a more disabled census of residents in 1993 relative to 1987.

Under the NHRA, nursing homes also showed some improvement in two of the three quality measures during the period between 1987 and 1993. The proportion of residents with urinary catheters decreased from 10% to 8%, whereas the proportion of residents with physical restraints declined from 39% to 23%, an almost 41% decrease. Both of these differences were statistically significant ($p < .001$). However, the proportion of nursing home residents with pressure ulcers increased 8% ($p < .001$). This increase may be related to the more chronically ill nursing home population in 1993 relative to 1987. The average number of ADLs for which residents required assistance or were completely dependent increased significantly from 3.90 to 3.98 during this time period. Similarly, there was a statistically significant increase in the proportion of individuals who were bedfast (18.6%) and chairbound (6.2%). Given the incentives underlying the Medicare prospective payment system for hospitals, there was also a 124% increase in the proportion of Medicare residents within facilities over this period.

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Table 1. Descriptive Statistics: Means With Standard Deviations

Variables	1987	1993	T	Change (%)
Quality measures				
Prop. of residents with pressure ulcers	0.065 (0.073)	0.070 (0.051)	3.42***	7.7
Prop. of residents with physical restraints	0.386 (0.203)	0.229 (0.167)	−42.55***	−40.7
Prop. of residents with catheters	0.098 (0.096)	0.079 (0.064)	−12.20***	−19.4
Staffing measures				
RN (hours/resident day)	0.258 (0.221)	0.304 (0.252)	9.83***	17.8
LPN (hours/resident day)	0.458 (0.233)	0.596 (0.259)	28.19***	30.1
NA (hours/resident day)	1.614 (0.690)	1.993 (0.581)	30.00***	23.5
Facility factors				
Total no. of beds in the NH	114.05 (77.208)	118.92 (79.023)	3.15***	4.3
For profit	0.682 (0.466)	0.686 (0.464)	0.38	0.6
Not for profit	0.257 (0.437)	0.252 (0.434)	−0.59	−1.9
Government owned	0.061 (0.240)	0.063 (0.242)	0.33	3.3
Prop. of Medicare residents	0.021 (0.085)	0.047 (0.088)	15.16***	124
Resident factors				
Avg. no. of ADLs	3.895 (0.826)	3.981 (0.545)	6.18***	2.2
Prop. of bedfast residents	0.043 (0.079)	0.051 (0.072)	5.40***	18.6
Prop. of chairbound residents	0.487 (0.291)	0.517 (0.191)	6.11***	6.2
Market factors				
No. of NHs in the market	44.50 (85.85)	44.65 (97.26)	0.08	0.3
No. of elderly persons (65+)/mile^2 in the market	186.35 (617.07)	189.90 (616.70)	0.29	1.9
Per capita income in the market (in 2000 dollars)	22,227 (5,512)	23,303 (5,860)	9.55***	4.8
State factor				
Medicaid payment rate (in year 2000 dollars)	85.89 (24.05)	91.62 (25.05)	11.78***	6.7

Notes: Standard deviations are shown in parentheses. $N = 5{,}092$. Prop. = proportion; RN = registered nurse; LPN = licensed practical nurse; NA = nurse's aide; NH = nursing home; ADL = activities of daily living.
*$p < .05$; **$p < .01$; ***$p < .001$.

In terms of other key variables in the model, there was a statistically significant increase in the mean size of the facilities from 114 beds to 119 beds. Both the average number of nursing homes and the number of elderly persons per square mile in each county increased, but these changes were not statistically significant. After inflation was adjusted for, the average per capita income in the market increased significantly by $1,076 (in year 2000 dollars) from 1987 to 1993, a 4.8% increase. Finally, the average state Medicaid reimbursement rate increased significantly by 6.7% in real terms over the period of study.

Dummy-Year Model

In the first set of regressions, we tested the association between a dummy variable representing the NHRA and nursing home quality, controlling for facility, resident, market, and state factors (see Table 2). The NHRA had a negative and statistically significant effect ($p < .05$) on all three quality measures. That is, the NHRA was associated with a 0.2 percentage point decline in the pressure ulcer rate, a 16.8 percentage point decrease in the rate of physical restraints, and a 2.5 percentage point decrease in the catheter use rate. In sum, the dummy-year model shows that the NHRA was associated with higher quality as measured by fewer pressure ulcers, physical restraints, and lower catheter use. These results also highlight the importance of adjusting for risk factors associated with the particular quality measures. For example, in the unadjusted descriptive statistics, the pressure ulcer rate increased by 0.5 percentage points over the period from 1987 to 1993. However, after facility, resident, market, and state factors were controlled for, the pressure ulcer rate was found to decrease by 0.2 percentage points.

First-Difference Model

We next used a first-difference approach to examine whether changes in staffing over the 1987–1993 period were associated with changes in quality over this period (see Table 3). The results from this model are somewhat counterintuitive in that an increase in 1 RN hr/resident day led to a statistically significant increase in pressure ulcers (1.9 percentage points), physical restraints (3.4 percentage points), and catheters (1.8 percentage points). Similarly, an increase in 1 LPN hr/resident day was significantly associated with a 0.9 percentage increase in the pressure ulcer rate and a 1.6 percentage point increase in the catheter rate. An increase in 1 NA hr/resident day was associated with a statistically significant decrease in pressure ulcers (0.3 percentage points)

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Table 2. Dummy-Year Regression Results

Variables	Pressure Ulcers	Physical Restraints	Catheters
Nursing Home Reform Act	−0.002* (0.001)	−0.168*** (0.003)	−0.025*** (0.002)
No. of beds (100s)	0.002** (0.001)	0.011*** (0.002)	0.008*** (0.001)
ADL score	0.007*** (0.001)	0.082*** (0.003)	0.015*** (0.001)
Prop. of bedfast residents	0.109*** (0.008)	−0.003 (0.022)	0.207*** (0.010)
Prop. of chairbound residents	0.061*** (0.003)	0.155*** (0.007)	0.057*** (0.003)
Prop. of Medicare residents	0.113*** (0.007)	−0.046* (0.020)	0.145*** (0.009)
Not for profit	−0.006*** (0.001)	−0.004 (0.004)	−0.010*** (0.002)
Government owned	−0.002 (0.002)	0.026*** (0.007)	−0.010** (0.003)
No. of nursing homes (100s)	0.007*** (0.001)	0.001 (0.002)	0.010*** (0.001)
Elderly persons/mile^2 (1,000s)	−0.0004 (0.001)	−0.014*** (0.003)	−0.002 (0.001)
Real per capita income ($1,000s)	0.0004*** (0.0001)	0.001*** (0.0003)	−0.0005** (0.0001)
Real Medicaid payment rate ($10s)	−0.0001 (0.0003)	−0.002* (0.001)	−0.005*** (0.0004)
Intercept	−0.010* (0.004)	−0.032** (0.012)	0.047*** (0.005)
R^2	0.15	0.31	0.19
N	10,179	10,179	10,179

Notes: Standard errors are shown in parentheses. ADL = activities of daily living; Prop. = proportion.
*$p < .05$; **$p < .01$; ***$p < .001$.

and physical restraints (1.1 percentage points). Thus, in the overall model, there are negative effects of RN and LPN staffing and a positive effect of NA staffing on nursing home quality.

There exists the possibility of a nonlinear association between staffing and quality. That is, initial units of staffing may have a strong influence on quality, but there may be diminishing returns to additional staffing units after some threshold. An alternative explanation is that initial units of staffing may not be productive until some minimum staffing threshold is achieved. We test for this first nonlinear relationship by isolating the model to those nursing homes among the lowest quartile of the RN, LPN, or NA measures (see Table 4). Within this model, an increase in 1 RN hr/resident day was associated with a statistically significant 12.8 percentage point decline in the physical restraint rate. Similarly, an additional 1 LPN hr/resident day was associated with a 1.6 percentage point decline in pressure ulcers, which is statistically significant at the 10% level. However, an additional 1 LPN hr/resident day was associated with a 2.4 percentage point increase in the catheter rate. Finally, an additional 1 NA hr/resident day was associated with a statistically significant 5.7 percentage point decline in the physical restraint rate. Although the results are not statistically significant, greater numbers of RNs, LPNs, and NAs were associated with fewer pressure ulcers and greater numbers of RNs and NAs were associated with fewer catheters for homes in the bottom quartile of these staffing measures. It is important that these quartile models may lack meaningful precision relative to the overall results within the full sample. Thus, there is some support for a nonlinear relationship between nursing home staffing and quality.

We also test the second nonlinear relationship by examining whether staffing is important for quality within those facilities that start at a high baseline (see Table 5). In this model, we isolate the analysis to those facilities in the top quartile of the three staffing measures in 1987. On the basis of this model, there is only limited support for the idea that staffing must achieve some minimal threshold before a positive relationship between staffing and quality can be achieved. The only result that supports this hypothesis is the relationship between NA staffing and physical restraints. For those nursing homes in the top quartile of the NA measure in 1987, we found that an additional 1 NA hr/resident day had a statistically significant 2.4 percentage point decrease in the use of restraints.

Discussion

The existing literature has yielded little in the way of consistent findings regarding the effect of the NHRA on staffing and quality of care. By using a novel linkage of data files before and after the implementation of the NHRA for nursing homes from 22 states, this study provides the most comprehensive evidence to date regarding these issues. We found that the NHRA was associated with an increase in quality, as measured by presence of pressure ulcers, physical restraints, and catheters. The overall variation in staffing across the pre- and post-NHRA periods was not directly related to the variation in quality over time across all facilities, but there was an effect for those homes in the bottom quartile of the staffing measures in 1987.

From a policy perspective, the observed increase in quality under the NHRA is an important finding. Although an estimation of the costs of the NHRA was not within the scope of this study, an obvious area for future research is to link the public expenditures associated with the NHRA with the findings of this current study. Calculating how much additional cost is associated with the NHRA is not straightforward. The NHRA mandated greater government monitoring and oversight of nursing

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Table 3. First-Difference Regression Results

Variables	Pressure Ulcers	Physical Restraints	Catheters
RN (hr/resident day)	0.019*** (0.005)	0.034* (0.016)	0.018** (0.006)
LPN (hr/resident day)	0.009* (0.004)	0.015 (0.013)	0.016** (0.005)
NA (hr/resident day)	−0.003* (0.001)	−0.011* (0.004)	−0.002 (0.002)
No. of beds (100s)	−0.002 (0.004)	−0.003 (0.012)	−0.002 (0.004)
Average ADL score	0.004** (0.001)	0.073*** (0.004)	0.010*** (0.002)
Prop. of bedfast residents	0.095*** (0.012)	0.053 (0.034)	0.106*** (0.013)
Prop. of chairbound residents	0.055*** (0.004)	0.109*** (0.011)	0.042*** (0.004)
Prop. of Medicare residents	0.038*** (0.011)	−0.061 (0.032)	0.024* (0.012)
No. of nursing homes (100s)	0.006 (0.006)	−0.010 (0.016)	−0.027*** (0.006)
Elderly persons/mile^2 (1,000s)	0.027 (0.067)	−0.764*** (0.201)	−0.042 (0.075)
Real per capita income ($1,000s)	−0.0001 (0.001)	−0.002 (0.002)	0.001 (0.001)
Real Medicaid payment rate ($10s)	−0.001 (0.001)	−0.013*** (0.003)	−0.002 (0.001)
Intercept	−0.00004 (0.002)	−0.152*** (0.005)	−0.025*** (0.002)
R^2	0.06	0.10	0.05
N	5,081	5,081	5,081

Notes: Standard errors are shown in parentheses. RN = registered nurse; LPN = licensed practical nurse; NA = nurse's aide; ADL = activities of daily living.
*$p < .05$; **$p < .01$; ***$p < .001$.

facilities by means of the survey and certification process. It was recently estimated that the total survey and certification process costs the government nearly $400 million dollars annually, which equates to approximately $22,000 per nursing home or $208 per nursing home bed (Walshe, 2001). In relative terms, these totals constitute less than one half of 1% of the total expenditures on nursing home care in the United States (Walshe & Harrington, 2002). However, these dollar totals do not include any indirect costs to the facility associated with the certification process such as interacting with the regulatory agency, preparing for and hosting survey visits, gathering and providing data, and responding to complaint investigations. Experience from other sectors of the economy suggests that the indirect costs of the certification process to the nursing home are likely greater than the direct costs to the government (Walshe, 2001). Moreover, there has been some concern about the enforcement of certain provisions within the NHRA (U.S. General Accounting Office, 1999), which raises the question of whether greater enforcement of the NHRA would raise costs even further (and, of course, also potentially increase quality further).

Another important link is the one between staffing and quality. As noted in our literature review, most recent empirical and clinical studies have argued that staffing and quality are positively associated with one another. We were not able to find a positive association between staffing and quality except in certain cases for which facilities were in the bottom quartile for the staffing measures in 1987. This lack of a finding may be due to several factors. First, it may be the case that the ADL index and the other control variables did not fully capture a facility's case mix, which led to some omitted variable bias within the study. Second, the NHRA staffing provisions were only binding for those facilities that exhibited low RN and LPN staffing in 1987. Thus, it may not be surprising that we mainly found a positive effect of staffing on quality in these instances. Interestingly, however, the increase in staffing following the NHRA still did not meet the standards prescribed by the recent CMS–Abt study (Abt Associates, 2001). In 1993, the mean staffing hours per resident day were 0.30 RNs, 0.60 LPNs, and 1.99 NAs. The CMS–Abt study called for 0.75 RNs, 1.3 LPNs, and 2.78 NAs. Finally, it should be noted that staffing may be a *necessary*, but not *sufficient*, input toward achieving greater quality. Many desirable outcomes may require not only additional staff but better care practices in general.

All of these issues underlie the recent call for a more stringent minimum staffing standard for nursing home care. A minimum staffing standard has the potential to be an important step toward remedying quality in those facilities with substandard staffing. Several recent reports have recognized that Medicaid payment levels would have to be reevaluated in the context of a staffing standard. For example, the IOM (2001) report recommended that "Congress and state Medicaid agencies adjust their Medicaid reimbursement formulas for nursing homes to take into account any increases in the requirements of nursing time to meet the casemix-adjusted needs of residents" (p. 19). Two recent economic developments make this call for increased spending particularly challenging. First, given current state budget shortfalls caused by the recent economic recession, there is concern that states will choose to substantially decrease Medicaid payment levels for nursing homes as a means to lower state expenditures. A June, 2002 survey of state Medicaid directors found that 16 states plan actual cuts in their Medicaid spending for nursing homes in 2003, whereas 41 states plan to reduce the rate of growth in Medicaid spending (Kaiser Family Foundation,

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Table 4. First-Difference Regression Results: Facilities in the Lowest Staffing Quartile of 1987

Variables	Pressure Ulcers	Physical Restraints	Catheters
Lowest quartile of RNs			
RN (hr/resident day)	−0.020 (0.016)	−0.128** (0.043)	−0.017 (0.017)
LPN (hr/resident day)	−0.010 (0.009)	−0.031 (0.025)	0.007 (0.010)
NA (hr/resident day)	0.002 (0.003)	−0.003 (0.009)	−0.005 (0.004)
R^2	0.08	0.07	0.04
N	1281	1281	1281
Lowest quartile of LPNs			
RN (hr/resident day)	0.024** (0.008)	0.038 (0.027)	0.007 (0.010)
LPN (hr/resident day)	−0.016 (0.008)	0.016 (0.028)	0.024* (0.010)
NA (hr/resident day)	−0.002 (0.002)	−0.009 (0.009)	−0.003 (0.003)
R^2	0.09	0.08	0.04
N	1266	1266	1266
Lowest quartile of NAs			
RN (hr/resident day)	0.017 (0.011)	0.033 (0.028)	0.009 (0.011)
LPN (hr/resident day)	0.011 (0.008)	0.017 (0.021)	0.025** (0.008)
NA (hr/resident day)	−0.001 (0.003)	−0.057*** (0.008)	−0.006 (0.003)
R^2	0.09	0.21	0.07
N	1270	1270	1270

Notes: Standard errors are shown in parentheses. All models include variables measuring the total number of beds in the facility, an activities of daily living score, the proportion of bedfast residents, the proportion of chairbound residents, the proportion of Medicare residents, the number of nursing homes in the market, the number of elderly persons per square mile, real per capita income in the market, and the real state Medicaid payment rate. Full regression results are available upon request. RN = registered nurse; LPN = licensed practical nurse; NA = nurse's aide.

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

2002). Second, a serious shortage exists in the nursing work force, which would severely compromise efforts to recruit and retain additional nurses within the nursing home sector. The obvious economic answer is to simply pay higher wages to recruit additional staff, but clearly this would be difficult in the context of the first issue. Thus, any additional nursing staff will have to come out of an already diminished Medicaid budget and from a fairly tight labor market.

As the study of staffing and quality moves forward, a critical next step will be the link between the costs and quality benefits of a minimum staffing standard. Harrington, Kovner, and colleagues (2000) noted that the overall cost increases necessary to meet a minimum staffing standard proposed by the authors would range between $1.4 billion and $6 billion dollars (in 1996 dollars). Of this total, Medicaid would be responsible for approximately two thirds of the costs ($938 million to $4 billion). The authors also note that some savings may occur as a result of higher staffing, including fewer hospitalizations, fewer on-the-job injuries that result in higher worker compensation costs, lower spending on supplies and drugs that often substitute for staff time, lower staff turnover resulting in lower training and hiring costs, and, finally, fewer poor resident outcomes that can result in costly treatment protocols. For example, the costs associated with treating a pressure ulcer can be far greater than the additional staff time necessary to prevent the pressure ulcer from occurring in the first place. Given the different staffing levels currently present in high Medicare homes, the CMS–Abt report estimates only a small cost increase for the Medicare program (Abt Associates, 2001).

An interesting follow-up study would attempt to directly estimate the costs to the U.S. nursing home industry of complying with the NHRA. Clearly, this type of analysis is complicated in that some of the observed staffing increase between 1987 and 1993 was not due to the NHRA, but rather such factors as an increased case mix, liability risks, and consumer demand for higher quality. Moreover, the current federal requirements are nonbinding for a number of facilities that operate at levels far above the mandated level. As this line of research moves forward, a better link between the costs and benefits of higher staffing will facilitate policymakers in making an informed decision regarding whether further regulations in the nursing home industry are warranted.

Limitations

Our study was limited in several ways. First, although the three quality indicators are quite distinct in nature, these measures cannot fully encompass the multidimensional construct of nursing home quality. Moreover, these three measures focus on the technical aspects of care, but they do not capture the quality of life within the facility, an important dimension of nursing home quality. It may indeed be the case that the NHRA improved other unmeasured dimensions of quality and that the observed increase in staffing may be related to such dimensions. Second, the OSCAR system is collected

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Table 5. First-Difference Regression Results: Facilities in the Highest Staffing Quartile of 1987

Variables	Pressure Ulcers	Physical Restraints	Catheters
Highest quartile of RNs			
RN (hr/resident day)	0.019* (0.008)	−0.002 (0.025)	0.017 (0.009)
LPN (hr/resident day)	0.003 (0.008)	0.029 (0.024)	0.023* (0.009)
NA (hr/resident day)	−0.0002 (0.002)	−0.028*** (0.007)	−0.002 (0.003)
R^2	0.09	0.14	0.07
N	1272	1272	1272
Highest quartile of LPNs			
RN (hr/resident day)	0.020* (0.009)	0.049 (0.028)	0.019 (0.011)
LPN (hr/resident day)	0.018* (0.007)	0.007 (0.022)	0.014 (0.008)
NA (hr/resident day)	−0.006** (0.002)	−0.022** (0.007)	−0.001 (0.003)
R^2	0.12	0.11	0.13
N	1270	1270	1270
Highest quartile of NAs			
RN (hr/resident day)	0.023* (0.009)	0.017 (0.031)	0.018 (0.012)
LPN (hr/resident day)	−0.001 (0.008)	0.006 (0.026)	−0.003 (0.010)
NA (hr/resident day)	−0.002 (0.003)	−0.024* (0.010)	0.005 (0.004)
R^2	0.12	0.09	0.05
N	1270	1270	1270

Notes: Standard errors are shown in parentheses. All models include variables measuring the total number of beds in the facility, an activities of daily living score, the proportion of bedfast residents, the proportion of chairbound residents, the proportion of Medicare residents, the number of nursing homes in the market, the number of elderly persons per square mile, real per capita income in the market, and the real state Medicaid payment rate. Full regression results are available upon request. RN = registered nurse; LPN = licensed practical nurse; NA = nurse's aide.

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

for the purposes of provider certification, which may raise concerns about the accuracy and interstate reliability of the measures for the purposes of research. The data are generally not audited. Third, we have used data roughly 3 years before and 3 years after the adoption of the NHRA. It is possible that there may have been other trends unassociated with the NHRA over this 6-year time period that we do not account for in these analyses.

Fourth, the staffing data within the MMACS and OSCAR files have been known to be problematic. As we already described, we have spent considerable effort cleaning the data and removing outliers, but we recognize there still may be erroneous staffing totals for particular facilities. The staffing data are collected during a 2-week period and they are not audited by surveyors. Thus, it may be the case that facilities misreport their staffing or increase their staffing during this period in anticipation of a survey. However, Harrington, Zimmerman, and colleagues (2000) compared the OSCAR staffing data with staffing totals collected from California Medicaid cost reports, and the two sources provided almost identical estimates. Fifth, there may be a variant of observer bias present in the data collected in the post-NHRA period. One of the primary goals of the NHRA was better surveying and oversight of facilities. Thus, homes and surveyors may be more likely to accurately report staffing and quality under the OSCAR system relative to the MMACS. This bias could help to explain part of the increase in pressure ulcers following the adoption of the NHRA. Sixth, the data utilized within this study were collected at the facility level, which prohibits resident-level risk adjustment. Thus, as we already stated, we must acknowledge the potential for omitted variable bias caused by inadequate risk adjustment across facilities.

Finally, even though we measured the effects of the NHRA in 1993, some provisions of the regulation had yet to be fully implemented at that time. For example, the NHRA increased the sanctions available to enforce compliance with Medicare and Medicaid program standards, but the enforcement regulations covering sanctions did not become effective until July of 1995 (U.S. General Accounting Office, 1999). Given the incremental implementation of the NHRA, the 1996 IOM report argued that it is unreasonable "to expect overnight changes that would drastically reduce deficiencies or improve the nursing homes across the nation" (pp. 140–141). Moreover, in the early years of the NHRA, states were allowed to waive the requirements for 24-hr licensed nursing service as well as the 8 hr/day RN presence if certain criteria were met. The IOM (1996) reported that a large number of facilities obtained waivers. For example, governments in 13 states granted waivers—predominantly for the 8-hr RN requirement—to 518 of the 5,302 facilities certified for Medicaid only in 1993.

Conclusions

This study found some support for higher staffing and quality under the NHRA adopted in 1990. However, we were unable to link higher staffing

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under the NHRA to better quality except in certain cases where homes had substandard staffing in the pre-NHRA period. In light of the continued quality of care problems within the nursing home industry, these results are quite important for policymakers considering further actions such as increased regulatory oversight and a minimum staffing standard. Future research will be necessary to examine this issue and link the increased costs of such policies with the perceived quality gains and other potential benefits.

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