Nurse Staffing Levels and Medicaid Reimbursement Rates in Nursing Facilities

Charlene Harrington, James H. Swan, and Helen Carrillo

Objective. To examine the relationship between nursing staffing levels in U.S. nursing homes and state Medicaid reimbursement rates.

Data Sources. Facility staffing, characteristics, and case-mix data were from the federal On-Line Survey Certification and Reporting (OSCAR) system and other data were from public sources.

Study Design. Ordinary least squares and two-stage least squares regression analyses were used to separately examine the relationship between registered nurse (RN) and total nursing hours in all U.S. nursing homes in 2002, with two endogenous variables: Medicaid reimbursement rates and resident case mix.

Principal Findings. RN hours and total nursing hours were endogenous with Medicaid reimbursement rates and resident case mix. As expected, Medicaid nursing home reimbursement rates were positively related to both RN and total nursing hours. Resident case mix was a positive predictor of RN hours and a negative predictor of total nursing hours. Higher state minimum RN staffing standards was a positive predictor of RN and total nursing hours while for-profit facilities and the percent of Medicaid residents were negative predictors.

Conclusions. To increase staffing levels, average Medicaid reimbursement rates would need to be substantially increased while higher state minimum RN staffing standards is a stronger positive predictor of RN and total nursing hours.

Key Words. Nurse staffing, nursing facilities, Medicaid reimbursement, rates, resident case mix

Many studies have documented the importance of nursing staff in both the process and the outcomes of nursing home care (Aaronson, Zinn, and Rosko 1994; Bliesmer et al. 1998; Carter and Porell 2003; USCMS 2001; Grabowski 2001a, b; Harrington et al. 2000; Schnelle et al. 2004; Spector and Takada 1991; Zhang and Grabowski 2004). A recent study identified a threshold for registered nurses (RNs) and total nurse staffing levels (RNs, licensed vocational nurses [LVNs] and nursing assistants [NAs]) necessary to protect the

health and safety of residents (USCMS 2001). Over 90 percent of the nation's nursing homes had staffing levels below this level (USCMS 2001).

As the evidence accumulates about the importance of higher levels of staffing for improving the quality of nursing home care, the Institute of Medicine (IOM) (1996, 2001, 2003) called for increasing the federal regulatory requirements for nursing home staffing in three separate reports. In spite of these recommendations, total average nursing home staffing levels have remained relatively steady since 1994, although there was a 25 percent decline in RN staffing levels since passage of the Balanced Budget Act in 1997 (Harrington et al. 2003; Konetzka et al. 2004).

Nursing facilities (NFs) vary widely in the amount and type of nursing service they provide to residents (Zinn 1993a; IOM 1996, 2001; Harrington et al. 1998; 2000; 2003). The variation is based in part upon decisions that nursing facility managers/owners make about the amount and type of staff they want to provide. Some nursing facility owners and managers may make strategic decisions to provide higher levels of total staffing or more RN staff, even though this would increase facility costs, as a means of competing for residents or competing for the Medicare and private pay market (with higher reimbursement rates), and/or as a service to residents. Other NFs may target the Medicaid market (with lower reimbursement rates) in order to ensure a stable resident population. In this latter situation, facilities may elect to keep staffing levels low in order to keep expenditures under their Medicaid revenues (United States General Accounting Office [USGAO] 2000; USCMS and Scully 2003).

In 2002, Medicaid and other public payers paid for 51 percent of the nation's total $103 billion in nursing home expenditures, while Medicare paid for 12.5 percent, private insurance paid for 7 percent, and consumers paid the remaining costs (Levit et al. 2004). Because Medicaid pays for 67 percent of all nursing home residents in the United States (Harrington et al. 2003), the Medicaid reimbursement rates and methods are central to understanding nursing home staffing levels (IOM 2001). State cost containment efforts have resulted in substantially lower Medicaid reimbursement rates (an average of $115 per day across the nation in 2000) than Medicare rates ($269 for freestanding facilities in 2000) (USCMS and Scully 2003; USGAO 2000;

Address correspondence to Charlene Harrington, Ph.D., R.N., Department of Social & Behavioral Sciences, University of California, 3333 California Street, Suite 455, San Francisco, CA 94118. James H. Swan, Ph.D., is with the Department of Applied Gerontology, School of Community Service, Denton, TX. Helen Carrillo, M.S., is with the Department of Social & Behavioral Sciences, University of California, San Francisco, CA.

2002a, b). Low Medicaid reimbursement rates can result in low staffing and quality (Cohen and Dubay 1990; Zinn 1993b; Aaronson, Zinn, and Rosko 1994; Cohen and Spector 1996; Grabowski 2001a, b).

   This study examined the relationship of nurse staffing and state Medicaid reimbursement rates in U.S. NFs in 2002, using nurse staffing data from the federal On-line Survey Certification and Reporting (OSCAR) system, in a two-stage regression model. Although previous studies have shown the relationship between Medicaid reimbursement rates and staffing, they have not taken into account the complex relationship of staffing with other factors (Cohen and Dubay 1990; Zinn 1993b; Aaronson, Zinn, and Rosko 1994; Cohen and Spector 1996; Grabowski 2001a, b). Building on the work of Harrington and Swan (2003) for California, this study specifically examined the relationship of RN (and total) staffing hours per resident day with two endogenous measures: (1) state Medicaid reimbursement rates and (2) facility resident case mix. The study should be useful to policy makers as they consider changes that would improve nurse staffing levels and quality of care.

CONCEPTUAL MODEL AND HYPOTHESES

Resource dependency theory is used in this study to examine factors in the environment that influence organizational decisions (Thompson 1967; Pfeffer and Salancik 1978) of nursing homes. Nursing homes like other health care organizations depend upon resources in the environment and make accommodations with the environment to ensure their own survival (Banaszak-Holl et al. 1996; Scott 1998; Zinn, Weech, and Brannon 1998; Zinn et al. 1999). Facilities particularly depend on revenues from Medicaid and Medicare (Levit et al., 2004). Organizational characteristics are mediators of organizational decisions and impact on the ability of nursing homes to respond to contingencies (Banaszak-Holl et al. 1996; Zinn et al. 1999). The dependency on the economic environment is also related to political factors and regulatory requirements. In this study, nursing staffing levels (hours) are expected to be related to Medicaid nursing home rates and residents' need for care (case mix) as well as: sociodemographic and economic variables, political variables, and market factors.

POTENTIALLY ENDOGENOUS VARIABLES

Nurse Staffing Hours per Resident Day

The dependent variable in the study was nurse staffing in NFs, using NFs as the unit of analysis. Two types of nurse staffing were considered in

separate models: (1) RN hours per resident day and (2) total nurse staffing hours per resident day (which includes RNs, LVN/LPNs, and NAs hours per resident day). RNs have the highest training requirements and are more expensive to employ than LVN/LPNs and NAs (AHCA, Decker et al. 2003). Higher RN and total staffing levels should increase state Medicaid reimbursement rates and encourage facilities to accept residents with higher case-mix levels. At the same time, facilities with higher Medicaid reimbursement rates and higher case-mix levels should have higher RN hours and total nursing hours.

State Medicaid Reimbursement Rates

Aaronson et al. (1994), Cohen and Spector (1996), Zinn (1993a, b), and Grabowski (2001a, b) found significant positive relationships between staffing and reimbursement. As Medicaid reimbursement rates are set by state policy makers, in part, on the basis of facility costs including staffing, higher staffing should result in higher Medicaid nursing homes reimbursement rates. Moreover, some states that have increased nursing home staffing requirements have increased Medicaid reimbursement rates to cover these costs (Tilly et al. 2003). Facilities that receive higher rates should be able to increase staffing levels making rates and staffing potentially endogenous.

Resident Case Mix

A number of nursing facility studies have shown a strong positive relationship between resident characteristics (case mix) and nurse staffing time (Cohen and Dubay 1990; Fries et al. 1994). Because residents with higher case-mix needs (where high values represent high acuity) require more nursing staff time to meet their needs, facilities should make decisions to increase their staffing hours when residents require additional time and/or expertise. Resident characteristics are expected to be endogenous with nurse staffing levels because facilities with higher staffing may choose to or may be more likely to admit residents with higher case mix (Harrington and Swan 2003).

Table 1 shows the specific hypothesized relationships among the potentially endogenous variables. The table also shows the factors used to identify RN hours and the total nursing hours in two separate equations using a two-stage model based upon existing literature. The shaded areas show where variables are omitted from the model in order to identify the endogenous variables.

Table 1: Hypotheses for Structural Model: Medicaid Rates, Case Mix, and Nursing Staffing

	State Medicaid Reimbursement Rates	Resident Case Mix	RN Hours	Total Nursing Hours*
Endogenous variables				
State Medicaid reimbursement rate		+	+	+
Resident case mix	+		+	+
Total RN hours per resident day	+	+		
Total nursing hours per resident day	+	+		
Facility resources				
RN pay rate per hour	+	+	−	−
Proportion Medicaid residents	−	−	−	−
Medicaid case-mix reimbursement method		+	+	+
Prospective reimbursement method	−	−		
State RN minimum staffing standard	+		+	+
Medicare SNF reimbursement rate	+	+	+	+
Facility characteristics				
For-profit facility	−	−	−	−
Multifacility system member	−		−	−
Hospital-based		+	+	+
Number of facility beds	−		−	−
Facility dual/distinct part certification	+	+	+	+
Facility SNF certification	−	+	+	+
Demographic/economic variables (state)				
Proportion aged 65 and older	+	+	+	+
Percentage females in the labor force		+	+	+
Personal income per capita	+		+	+
Percent metropolitan population	+	−	+	+
Political variables				
Democratic governor	+			
Political party split	−	−	−	−
Market factors				
Nursing facility Herfindahl index (facility concentration)		−	−	−
Percent excess NF beds in the county	−	−	−	−
Nursing home beds per 1,000 aged 65+	−	−	−	−
Hospital beds per 1,000 population	−	−	−	−

Shaded areas show omitted variables from the model; + = positive predictor; − = negative predictor. RN, registered nurse; SNF, skilled nursing care; NF, nursing facility.

EXOGENOUS VARIABLES

Nurse Pay Rates

RN pay rates are important market factors that impact nurse staffing levels in nursing homes. Where markets have higher RN pay rates, facilities are

expected to hire fewer RNs (and fewer hours) and perhaps substitute lower paid staff, such as LVNs and NAs for RNs, than in areas were RN pay rates are low (Zinn 1993b).

Facility Resources

NFs prefer the higher pay for Medicare and private pay residents over Medicaid residents (USGAO 2002b). Facilities in states with higher Medicare payment rates may have higher nurse staffing levels as well as higher Medicaid reimbursement rates and resident case mix. Higher percentages of Medicaid residents may result in facilities lowering their RN and total nurse staffing levels in order to keep costs under the state Medicaid reimbursement rates (Nyman 1988; Harrington et al. 1998; Zinn 1994). Staffing levels are not expected to have a direct effect on the percent of Medicaid residents in facilities (i.e., is not considered endogenous).

Medicaid case-mix reimbursement methods are increasingly used by states to give facilities higher reimbursement rates for higher case mix (Grabowski 2002; Swan et al. 2000). Facilities in states with case-mix reimbursement methods should increase their total nurse staffing hours because these states would pay higher rates tied to or adjusted for residents with higher care needs. At the same time, states that use prospective payment methods are expected to have lower Medicaid payment rates but this should not have a direct effect on nurse staffing levels.

Some states have established minimum staffing standards that go beyond the federal standards (Harrington 2005). It is expected that states that establish regulations with higher minimum standards for RN hours than the federal standards will have higher RN and total nurse staffing levels.

Facility Characteristics

Six facility characteristics were expected to be predictive of management decisions about nurse staffing levels. Lower overall staffing levels are expected in for-profit NFs (Cohen and Dubay 1990; Aaronson et al. 1994; Cohen and Spector 1996; Harrington et al. 1998). Chain-owned NFs have reported lower costs (Cohen and Dubay 1990), but these were not found to be due to reduced staffing levels (Cohen and Dubay 1990). Hospital-based NFs have traditionally had substantially higher nurse staffing levels because their residents have more Medicare residents, higher acuity levels, and require short-term intensive care (Cohen and Spector 1996; Harrington et al. 1998). Large facilities have been reported to be associated with higher quality (Nyman 1988) but other studies

found a negative relationship between size and staffing (Cohen and Spector 1996). Larger NFs are not required by federal law to have proportionate staffing and they may achieve some economies of scale in caring for residents.

Finally, facilities have the option of being certified for: (1) skilled nursing care (SNF) for Medicare-only; (2) NFs for Medicaid residents only; or (3) combination facilities (dually certified for Medicare and Medicaid or distinct-part facilities with a Medicare certified unit), if they meet the federal quality standards. NFs tend to make decisions to specialize in different markets based upon their payment sources (Zinn et al. 1999; Aaronson et al. 1994). Facilities certified for Medicare-only or dually certified or with a distinct-part unit should have more short-term residents with higher care needs and are expected to have higher staffing than Medicaid-only facilities.

Sociodemographic and Economic Variables

Higher percentages of the aged 65 and older population in a state were expected to have a positive effect on Medicaid reimbursement rates, resident case mix, and RN staffing hours (Kemper and Murtaugh 1991). The number of women in the labor force may increase resident case mix and increase the amount of RN hours. Facilities in states with higher state personal income should have higher Medicaid reimbursement rates and nurse staffing hours because more discretionary resources are available. The percent of a state's population living in metropolitan areas is expected to increase the state Medicaid rate and RN hours but decrease the resident case mix.

State Political Variables

States that have Democratic governors (often considered to be more liberal than Republicans) may be more generous in their financial support for Medicaid reimbursement rates (Lanning, Morrisey, and Ohsfeldt 1991) but this is not expected to be directly related to nurse staffing levels. In states where the party control of the House and the Senate are split, there may be less consensus and ability to provide consistent resources for state Medicaid programs and nurse staffing hours (Lanning et al. 1991).

Market Variables

NFs in areas with less nursing home bed competition (i.e., a higher concentration of beds using the Herfindal measure) are expected to have less RN hours and residents with lower case mix. Facilities in counties with a higher percentage of excess nursing home beds should have lower reimbursement

rates, resident case mix, and RN staffing hours. States with more nursing facility beds per population available should have more competition for nursing hours and therefore they would have fewer RN hours as well as lower reimbursement rates and lower case mix. Finally, hospital beds per population should be negatively associated with Medicaid nursing home reimbursement rates, resident case mix, and RN hours.

METHODS

Data Sources

All federally certified facilities for Medicare (skilled nursing care) and Medicaid (NFs) in 2002 were included in this study, except those located in the trust territories and Puerto Rico. The federal On-Line Survey Certification and Reporting system (OSCAR) was used for: (1) nurse staffing, (2) resident characteristics, and (3) facility characteristics (USCMS 2003). The OSCAR data require cleaning to correct some problems by eliminating duplicate provider records (191 facilities) and setting the maximum number of beds for a hospital-based facility to equal the maximum number of certified skilled nursing beds in the facility.

The average nursing hours per resident day (including all fulltime, parttime, and contract staff) were used to standardize the data. To make this conversion, the total nurse staff fulltime equivalents (FTEs) reported for a 2-week period were multiplied by 70 hours for the period and divided by the total number of residents and then divided by 14 days in the reporting period (the standard procedure used by CMS) for each type of nursing staff. RN directors of nursing and other RN administrators were included in the total RNs (about 0.08 hour per resident per day in a 100 bed facility).

In order to minimize erroneous data, standard procedures were used to remove outliers from the data set (Grabowski 2001a, b; Harrington et al. 1998; USCMS 2001). Facilities with 15 beds or less were excluded (398 facilities), facilities reporting more than 24 hours of staffing care per resident day, facilities with no hours or residents reported (54 facilities), and facilities in the upper 2 percent and lower 1 percent within each staffing category because they were outliers and appeared to be erroneous. We conducted a sensitivity analysis on alternative cuts for the removal of outliers (e.g., 1 standard deviation and the upper 1 percent) and found the regressions were comparable for different processes used (see also Harrington et al. 2000). As a result of the cleaning process, a total of 14,256 NFs were used in the RN analysis and 13,632 facilities were used for the total nurse staffing hours analysis, where more outliers were removed from total facilities.

Variable Definitions and Sources of Data

Table 2 shows the source for all the variables in the model as well as the means and standard deviations. For the Medicaid reimbursement rate, we used the

Table 2: Means and Standard Deviations for Study Variables ($N=$ 14,256 Facilities)

	Data Source	Mean	Std. Dev.
Potentially endogenous variables			
State average Medicaid reimbursement rate, 2002	Swan (2003)	117.16	23.08
Resident case mix (ADL score) by facility, 2002	Harrington et al. (2003)	5.82	0.68
RN hours per resident day by facility, 2002	Harrington et al. (2003)	0.66	0.68
Total nursing hours per resident day by facility, 2002	Harrington et al. (2003)	3.62	1.17
Exogenous variables			
Facility resources			
RN pay rate per hour, 2002	BOL (2003b)	$22.80	$2.69
Percent Medicaid residents, 2002	Harrington et al. (2003)	63.09	23.98
Medicaid case-mix reimbursement (percent yes), 2002	Swan (2003)	69.19	
Medicaid prospective reimbursement method (percent yes), 2002	Swan (2003)	33.43	
State RN minimum staffing standard (hours per resident day), 2001	Harrington et al. (2005)	0.42	0.18
Medicare SNF reimbursement rate, 2001 adjusted to 2003 dollars	CMS (2003)	$273.01	$29.48
Facility characteristics			
For-profit facility (percent yes), 2002	Harrington et al. (2003)	66.10	
Multifacility system member (percent yes), 2002	Harrington et al. (2003)	52.47	
Hospital-based (percent yes), 2002	Harrington et al. (2003)	9.78	
Number of facility beds, 2002	Harrington et al. (2003)	105.91	66.42
SNF/NF dual and distinct (percent yes), 2002	Harrington et al. (2003)	84.41	
SNF (percent yes), 2002	Harrington et al. (2003)	5.48	
Demographic/economic variables (state level)			
Percent of population aged 65 and older, 2002	US BOC (2002)	12.62	1.80
Percent females in the labor force, 2002	US BOLS (2003a)	56.97	4.06
Personal income per capita, 2002	US DOC (2002)	$30,557	$4,097
Percent metropolitan population, 2001	US BOC (2002)	75.89	17.50
State political variables			
Democratic governor (percent yes), 2002	NCSL (2002a)	54.35	49.81
Political party split (percent yes), 2002	NCSL (2002b)	31.20	46.33
Market factors			
Nursing facility Herfindahl index in county, 2002	Harrington et al. (2003)	0.20	0.23
Percent excess NF beds in county, 2002	Harrington et al. (2003)	14.88	8.12
Nursing home beds per 1,000 aged +65, 2002	Harrington et al. (2004)	49.03	13.36
Hospital beds per 1,000 population, 2001	USDHHS (2003)	3.27	2.59

RN, registered nurse; SNF, skilled nursing care; NF, nursing facility; ADL, activities of daily living.

average payment rate for all NFs in the state (Swan 2003). For the RN pay rate, we used the state average rate (U.S. Bureau of Labor Statistics 2003b). The state minimum RN staffing standards (in hours per resident day) were available from a study by Harrington (2005). For the Medicare SNF reimbursement rates, we used the average state rate reported by CMS (USCMS and Scully 2003).

For the case-mix measure, OSCAR data were used to describe resident dependency on activities of daily living (ADL) in each facility. The average score for each of the three ADLs were used in this study: (1) eating, (2) toileting, and (3) transferring to and from the bed, chair, wheelchair, or a standing position. The OSCAR report has a three-point scale for each of these three categories, where a 1 indicates the lowest need for assistance and the 3 indicates the greatest need for assistance (highest case mix). The average summary score for each ADL was computed for each facility (range 1–3) and these were added together for a total score of 3–9 for the three ADL scores. ADL scores may be less likely to be manipulated by the facility to obtain higher reimbursement than resource utilization group (RUGs) scores (not available for the study) and have been used in other studies (Grabowski 2001a, b; Harrington and Swan 2003). We developed an alternative case-mix measure that summarized the total percentage of residents in a facility that needed intravenous therapy, injections, respiratory therapy, and ventilator therapy. No substantial differences were found when this summary case-mix score was used compared with the ADL dependency score.

The Herfindal score was calculated for each county using the total nursing home beds for each county for 2002 from the OSCAR data. The total beds in each NF were divided by the total beds in each county and then the proportions for each facility were squared and summed to create an index for each county. The index ranges from 0 to 1 with the higher values representing more concentration (less competition). Using OSCAR data, the percent of excess beds in each county was calculated by first subtracting the number of residents from the total number of beds to identify the vacant beds for each facility. Then, total vacant beds in each county were divided by the total number of beds in the county in order to identify the percent of vacant (excess) beds.

ANALYTICAL MODEL

The descriptive data for staffing levels were examined by facility characteristics and other independent variables. Two models were analyzed separately: (1) RN hours and (2) total nursing hours. Table 1 shows the specific hypothesized relationships between resident characteristics and nurse staffing levels and shows the instrumental variables used to identify each separate equation in

each of the two models, where the shaded areas show the omitted variables. Two instrumental variables were selected to predict RN hours and total nursing hours: (1) prospective reimbursement methods; and (2) democratic governor. These were selected because previous studies did not show that they would have a direct effect on RN hours or total nursing hours whereas they were expected to predict the potentially endogenous variables as discussed above.

Pearson correlations among the predictor variables were modest, suggesting that multicollinearity was not likely to be problematic. Tolerance statistics were also used in the regression analysis; they did not detect a high degree of multicollinearity among the variables. We examined the relationship between state Medicaid levels and facility staffing levels using a χ^2 analysis.

There was also a concern that there may be correlated errors among endogenous variables if an ordinary least squares (OLS) model was used. In this situation, if the correlation between the endogenous variables with the "error terms" for the staff hours is positive, then the OLS estimator may be biased upward or if it is negative, it could be biased downward. Because of this concern, we conducted both the OLS regression and a two-stage least squares (2SLS)[1] regression analysis to assess the relationships among the potentially endogenous variables. We calculated the Durbin–Wu–Hausman test for endogeneity and report the results in the findings section (Davidson and Mac-Kinnon 1993). There was a concern regarding whether RN pay rates were endogenous but the Hausman test confirmed that RN pay was not endogenous in the RN and total nursing hour models.

The study used the *Stata*, version 8 for the OLS and the 2SLS regression analysis. See the footnote for the equations used. First-stage (reduced-form) and second-stage equations were estimated for the endogenous variables. In the first stage, each endogenous variable was regressed (using OLS regression analysis) on all exogenous factors (shown in Table 3), and the predicted values for each endogenous factor were retained for the second stage. The first stage regression models showed that the R^2 values are sufficiently high.

Table 3 shows the first stage regression for RN hours with and without the instrumental variables. Exclusions tests were performed to verify that the instruments predicted the endogenous variables and not the staffing variables. A comparison of the R^2 was performed and joint F tests were calculated (Wooldridge 2003). These tests showed that the instrumental variables were not predictors of RN hours or total nursing hours and that the instrumental variables appeared to meet the requirements to estimate the second stage.

An overidentification test for the instrumental variables was conducted by regressing the 2SLS equation residuals on the exogenous variables and then

Table 3: Stage 1—OLS Reduced-Form Equations: Medicaid Rates, Resident Case Mix, RN Hours, and Total Nursing Hours (Coefficients with Standard Error in Parentheses)

Exogenous Factors	State Average Medicaid Reimbursement Rate	Resident Case Mix	RN Hours	Total Nursing Hours	RN Hours without Instrumental Variables***	Total Hours without Instrumental Variables***
Facility resources						
RN pay rate per hour	5.890**	0.055**	0.001	0.039**	−0.003	0.053**
	(0.101)	(0.006)	(0.004)	(0.008)	(0.004)	(0.008)
Proportion Medicaid residents	0.014*	−0.0002	−0.003**	−0.005**	−0.003**	−0.005**
	(0.005)	(0.0003)	(0.0002)	(0.0004)	(0.0002)	(0.0004)
Medicaid case-mix reimbursement	3.932**	0.008	0.016	−0.150**	0.008	−0.134**
	(0.261)	(0.015)	(0.011)	(0.021)	(0.010)	(0.020)
Medicaid prospective reimbursement method	−15.936**	−0.060**	−0.044**	−0.110**		
	(0.251)	(0.014)	(0.010)	(0.020)		
State RN minimum staffing standard	28.978**	0.111**	0.247**	0.562**	0.232**	0.703**
	(0.726)	(0.041)	(0.029)	(0.057)	(0.028)	(0.054)
Medicare SNF Reimbursement rate	−0.105**	−0.007**	0.001*	−0.002**	0.001**	−0.005**
	(0.009)	(0.001)	(0.0004)	(0.001)	(0.0003)	(0.001)
Facility characteristics						
For-profit facility	−1.588**	−0.067**	−0.147**	−0.358**	−0.148**	−0.359**
	(0.219)	(0.012)	(0.009)	(0.017)	(0.009)	(0.017)
Multifacility system Member	−1.714**	−0.005	−0.008	−0.132**	−0.007	−0.134**
	(0.198)	(0.011)	(0.008)	(0.016)	(0.008)	(0.016)
Hospital-based	0.186	0.010	0.024	0.054*	0.024	0.058*
	(0.316)	(0.018)	(0.013)	(0.025)	(0.013)	(0.025)
Number of facility beds	0.010**	0.0001	−0.001**	−0.001**	−0.001**	−0.001**
	(0.002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Dual/distinct part Certification	1.917**	0.266**	0.099**	0.201**	0.100**	0.219**
	(0.332)	(0.019)	(0.014)	(0.026)	(0.013)	(0.027)

	(1)	(2)	(3)	(4)	(5)	(6)
SNF certification	0.158*	−0.080*	1.937**	2.911**	1.939**	2.927**
	(0.627)	(0.035)	(0.025)	(0.050)	(0.025)	(0.050)
County demographic economic variables						
Proportion aged 65 and older	2.941**	−0.038**	0.002	0.024**	0.006*	0.020**
	(0.070)	(0.004)	(0.003)	(0.006)	(0.003)	(0.005)
Percentage females in labor force	−0.682**	−0.014**	−0.001	−0.007**	−0.0002	−0.003
	(0.035)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)
Personal income per capita	1.661**	−0.009**	0.015**	−0.002	0.017**	−0.001
	(0.053)	(0.003)	(0.002)	(0.004)	(0.002)	(0.004)
Percent metropolitan	−0.338**	0.003**	−0.003**	−0.005**	−0.004**	−0.003**
	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Population	0.003**					
	(0.001)					
Political variables						
Democratic governor	−6.647**	0.085**	0.025**	−0.129**		
	(0.235)	(0.013)	(0.010)	(0.018)		
Political party split	−4.455**	−0.200**	0.022*	0.050*	0.021*	−0.018
	(0.270)	(0.015)	(0.011)	(0.021)	(0.010)	(0.020)
Market factors						
NF Herfindahl (facility concentration)	0.279	−0.134**	−0.045*	−0.059	−0.042*	−0.051
	(0.469)	(0.026)	(0.019)	(0.037)	(0.019)	(0.037)
Percent excess NF beds in the county	−0.062**	−0.003**	0.001	0.007**	0.001	0.006**
	(0.014)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Nursing home beds per 1,000 age 65+	−0.094**	−0.011**	−0.002**	−0.014**	−0.003**	−0.014**
	(0.011)	(0.001)	(0.0004)	(0.001)	(0.0004)	(0.001)
Hospital beds per 1,000 population	−0.037	0.0001	0.002	0.007*	0.001	0.008**
	(0.038)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
Intercept	−12.609**	8.249**	0.340**	4.699**	0.363**	4.804**
	(2.561)	(0.144)	(0.104)	(0.202)	(0.104)	(0.202)

Continued

Table 3. *Continued*

Exogenous Factors	State Average Medicaid Reimbursement Rate	Resident Case Mix	RN Hours	Total Nursing Hours	RN Hours without Instrumental Variables***	Total Hours without Instrumental Variables***
R^2	0.771**	0.162***	0.560**	0.477**	0.559**	0.474***
Mean =	117.16	5.82	0.66	3.62	0.66	3.62
N = 14,256; df =	22	22	22	22	20	20

Shaded areas show omitted variables from the model.

*Significant at the .05 level.

**Significant at the .01 level.

***Instrumental variables are excluded from the OLS regression.

RN, registered nurse; SNF, skilled nursing care; NF, nursing facility.

multiplying the R^2 by the sample size (nR^2). The resulting nR^2 showed that the IV's were uncorrelated with the residuals and the values were small (nR^2 for the RN Hours Model was 0.570 and 0.545 for the total hours; p-value = .53 for both). Therefore, the variables passed the overidentification test (Wooldridge 2003). The first-stage equations for total nursing hours were estimated but are not reported here (a table of such results will be furnished upon request).

In the second stage, each endogenous factor was regressed, based on the specified structural model, on: (1) the predicted values of the other endogenous factors from the first stage and (2) the exogenous factors. In order to take into account the potential clustering of state variables in the regressions, we used the *Stata* jackknife cluster procedures to test state level effects. No significant difference was found between the 2SLS estimates and the jackknife cluster estimates using *t*-tests. We also conducted the regression analysis to calculate robust standard errors.

RESULTS

Staffing Levels

The average hours of RN (including nurse administrators) care were 0.66 hours (40 minutes) per resident day and total nurse staffing hours per resident day averaged 3.62 hours per resident day in 2002. The average Medicaid reimbursement rate was $117 per day but rates ranged from $80 to $200 per day. A significant relationship between higher RN and total nursing hours and higher state Medicaid reimbursement rates was found using a χ^2 test (no table shown).

RN Hours

The 2SLS model found that the expected variables were endogenous using the Hausman test for endogeneity. (See Table 4 for the OLS and the 2SLS regression results for RN hours.) Therefore, 2SLS was the most appropriate model for RN hours. RN hours were positively related to the state Medicaid reimbursement rate as expected. A $10 increase in state Medicaid reimbursement rates would increase RN hours by an estimated 0.01 hours per resident day or 1 hour for every 100 residents. Resident case mix was positively related to RN hours as expected.

As expected, RN pay reduced the number of RN hours of care. The proportion of Medicaid residents in a facility was a negative predictor of RN hours as expected. A ten percent decrease in Medicaid residents increased total RN staff by 0.03 hours per resident day or 3 hours for every 100 residents per day. Facilities in states that had case-mix reimbursement did not have

Table 4: Stage Two Analysis and Ordinary Least Square Analysis: RN Hours and Total Nursing Hours (Coefficients with Robust Standard Errors in Parentheses)

	RN Nursing Hours OLS Regression	RN Nursing Hours 2SLS*	Total Nursing Hours OLS Regression	Total Nursing Hours 2SLS*
Potentially endogenous variables				
State Medicaid reimbursement rate	0.002** (0.0003)	0.001* (0.001)	0.006** (0.001)	0.010** (0.001)
Resident case mix (ADL dependency)	0.020* (0.008)	0.392** (0.107)	0.175** (0.015)	−0.821** (0.233)
Exogenous variables				
Facility resources				
RN pay rate per hour	−0.014** (0.004)	−0.029** (0.007)	0.006 (0.008)	0.028 (0.016)
Proportion Medicaid residents	−0.003** (0.0002)	−0.003** (0.0002)	−0.005** (0.0004)	−0.006** (0.001)
Medicaid case-mix reimbursement	0.002 (0.011)	0.008 (0.012)	−0.163** (0.021)	−0.177** (0.026)
Medicaid prospective reimbursement method				
State RN staffing standard	0.169** (0.032)	0.166** (0.040)	0.479** (0.062)	0.388** (0.083)
Medicare SNF reimbursement rate	0.002** (0.0003)	0.004** (0.001)	−0.002** (0.001)	−0.007** (0.002)
Facility characteristics				
For-profit facility	−0.143** (0.009)	−0.118** (0.012)	−0.343** (0.018)	−0.376** (0.024)
Multifacility system member	−0.005 (0.008)	−0.004 (0.009)	−0.124** (0.016)	−0.119** (0.019)
Hospital-based	0.023 (0.016)	0.019 (0.017)	0.056 (0.030)	0.059 (0.036)

Number of facility beds	−0.001**	−0.001**	−0.001**	−0.001**
	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Dual/distinct part certification	0.089**	−0.008	0.158***	0.381***
	(0.010)	(0.031)	(0.022)	(0.065)
SNF certification	1.935**	1.966**	2.926**	2.817**
	(0.059)	(0.063)	(0.101)	(0.112)
County demographic/economic variables demographic/economic variables				
Proportion aged 65 and older	0.001	0.013*	0.006	−0.035**
	(0.003)	(0.005)	(0.006)	(0.011)
Percentage females in labor force	0.001	0.006**	0.002	−0.014**
	(0.002)	(0.002)	(0.003)	(0.005)
Personal income per capita	0.014**	0.016**	−0.012**	0.024**
	(0.002)	(0.003)	(0.004)	(0.006)
Percent metropolitan population	−0.003**	−0.004**	−0.002*	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Political variables				
Democratic governor				
Political party split	0.042**	0.106**	0.071**	−0.053
	(0.011)	(0.023)	(0.021)	(0.047)
Market factors				
NF Herfindahl index (facility concentration)	−0.042**	0.007	−0.038	−0.144**
	(0.015)	(0.023)	(0.032)	(0.048)
Percent excess NF beds in the county	0.001	0.002**	0.008**	0.005**
	(0.001)	(0.001)	(0.001)	(0.002)
Nursing home beds per 1,000 aged 65+	−0.002**	0.002	−0.011**	−0.022**
	(0.0004)	(0.001)	(0.001)	(0.003)
Hospital beds per 1,000 population	0.001	0.002	0.008**	0.007*
	(0.001)	(0.002)	(0.003)	(0.003)

Table 4. *Continued*

	RN Nursing Hours OLS Regression	RN Nursing Hours 2SLS[*]	Total Nursing Hours OLS Regression	Total Nursing Hours 2SLS[*]
Intercept	0.195 (0.125)	−2.88** (0.892)	3.355** (0.235)	11.700** (1.984)
R^2	0.560**	0.443**	0.486**	0.229**
Mean =	0.66	0.66	3.62	3.62
N = 14,256; df =	22	22	22	22

*Significant at the .05 level.
**Significant at the .01 level.
[†]Because reimbursement rates and ADL were endogenous, the 2SLS model was the most appropriate.
The shaded areas show instrumental variables that predict endogenous variables but that do not predict RN hours and total nursing hours.
RN, registered nurse; SNF, skilled nursing care; NF, nursing facility; OLS, ordinary least squares; 2SLS, two-stage least square; ADL, activities of daily living.

higher RN hours but facilities in states with higher minimum standards for RN hours did have higher actual RN hours per resident day (an increase of 16.6 RN hours for every 100 residents which is a substantial difference).

For-profit facilities had fewer RN hours (0.12 hours less per resident day or 12 hours less care for 100 residents) than nonprofit and government facilities. Smaller facilities and SNF-certified beds (compared with Medicaid-only facilities) had higher levels of RN nurse staffing.

Facilities in states with higher percentages of aged, more females in the labor force, with higher average incomes, and a party split in the state legislature had higher RN staffing hours. States with more metropolitan areas had fewer RN hours, controlling for other factors. Market factors were not as important as expected. Only areas where there was an excess of nursing home beds per county had more RN hours of care.

Total Nursing Hours

Table 4 also shows the OLS and 2SLS model for total nursing hours. As expected state Medicaid reimbursement rates and resident case mix were both found to be endogenous using the Hausman test for endogeneity so that the 2SLS model was the most appropriate model. The analysis found that an increase in state Medicaid reimbursement rates of $10 per resident day would increase total nurse staffing by 0.10 hours per resident or 10 hours per 100 residents. Contrary to expectations, resident case mix was negatively associated with total nursing hours.

RN pay rates were not related to total nursing hours. Other findings for total nursing hours were similar to the RN model, except that Medicaid case-mix reimbursement was a negative predictor of total hours. Total nurse staffing hours were also substantially higher in states that had higher minimum RN staffing standards. Overall, the 2SLS models explained 44.3 percent of the variance for RNs hours and explained 22.9 percent for the total nursing staff hours (Table 4). Both models showed that the relationship between staffing and Medicaid reimbursement rates was positive but not as strong as the relationship with state minimum staffing standards.

DISCUSSION

As expected, a small, positive relationship between state Medicaid reimbursement rates was found for both RN and total nurse staffing hours per resident day. This is consistent with other studies that have found that higher

Medicaid reimbursement rates encourage facilities to provide more nursing care (Cohen and Dubay 1990; Zinn 1993b; Aaronson et al. 1994; Cohen and Spector 1996; Grabowski 2001a, b). The major difference between this study and previous studies is that we developed a conservative model to account for potential endogeneity and we included a comprehensive set of potential predictive factors including nursing home staffing standards, Medicare reimbursement rates, and many other factors.

The actual average RN staffing (0.66) in the U.S. NFs found in this study was 0.09 hours lower than 0.75 RN hours per resident day and the actual average total nurse staffing (3.62) was 0.5 hours per resident day lower than the 4.1 hours found to be necessary to prevent harm or jeopardy to residents with long stays in the study prepared for CMS (USCMS 2001). Using a simple linear extrapolation, a crude estimate was made that in order to increase RN staffing by 0.09 hours per resident day to the recommended level, Medicaid would need to increase its rates by $90 per resident per day, holding other factors constant. In order to increase total nurse staffing levels by 0.5 hours per resident day as recommended, Medicaid reimbursement rates would need to be increased by $50 per resident per day.

The case mix of residents was a positive predictor of RN hours and was a negative predictor of total staffing hours, suggesting that NFs take resident case mix into account for RNs but not for total nurse staffing levels, which could result in inadequate total hours for residents with high care needs. Higher RN pay rates per hour were related to lower RN hours as found in another study (Zinn 1993b), but not to total nurse staffing hours.

As expected, higher percentages of Medicaid residents had a negative effect on RN and total staffing levels, controlling for Medicaid reimbursement rates and other factors. Facilities that are more resource dependent upon Medicaid reimbursement appear to be reluctant to hire more staff of all types. The findings are consistent with previous findings by Nyman (1988), Harrington et al. (1998), and Grabowski (2001a, b) where facilities with higher proportions of Medicaid residents had fewer nurses and consequently these facilities appeared to have lower quality of care (Mor et al. 2004). This effect is troubling from a policy perspective, because Medicaid residents should receive the same staffing levels that other residents receive.

NFs that are heavily dependent on Medicaid payments can be expected to keep staffing at the existing levels unless Medicaid rates are raised or other policies are changed such as instituting minimum staffing requirements, recommended by the IOM (2003). If the goal is to increase nurse staffing levels using a market-incentive approach, state Medicaid reimbursement rates need

to be substantially increased. States are unlikely to raise their Medicaid rates by the amount needed to encourage or require facilities to implement the recommended nurse staffing levels without some federal financial incentives beyond the current federal–state Medicaid matching formula. Another potential policy approach is to use nurse staffing levels as a pay-for-performance indicator in the current federal demonstration projects that are considering pay-for-performance indicators. In order to make this possible, an increase in nurse staffing costs would probably need to be offset by a reduction in hospitalization and other costs in order to maintain some cost neutrality.

A more successful, but politically charged, approach appears to be instituting higher state minimum RN staffing standards, because states with higher minimum RN staffing standards were shown to have substantially higher RN and total nurse staffing levels in this study. In any case, these findings show the need for further consideration of both minimum staffing levels and Medicaid reimbursement rates by public policy makers at the state and federal levels.

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NOTE

1. In this 2SLS model, the following equations were examined:

$$\text{Nurse staff}_i = a + \text{Medicaid rate}^* + \text{Case mix}^* + X_i + E_i \qquad (1a)$$

$$\text{Medicaid rate}_i = a' + \text{Nurse staff}^*_i + \text{Case mix}^*_i + Y_i + e_i \qquad (1b)$$

$$\text{Case mix}_i = a' + \text{Medicaid rate}^*_i + \text{Nurse staff}^*_i + Y_i + e_i \qquad (1c)$$

where i is the facility; Nurse staff$_i$ the average nursing hours per resident day for different types of staff in nursing facilities; Nurse Staff$^*_i$ an instrumental variable estimated using all exogenous variables which represents the estimated staffing level for nurses in each nursing facility; Medicaid rate$_i$ the average nursing home Medicaid rate; Medicaid rate$^*_i$ an instrumental variable estimated using all exogenous variables which represents the estimated average Medicaid Rate for nursing facility

residents; Case mix$_i$ the average resident score for eating, toileting, and transferring for each nursing facility; Case mix$_i^*$ an instrumental variable estimated using all exogenous variables which represents the estimated average case-mix index for each nursing facility; X_i the facility resources, facility characteristics, socioeconomic variables, policy variables, and market variables that were considered to influence the supply and demand for nursing staff levels in nursing facilities; Y_i the facility resources, facility characteristics, socioeconomic variables, and policy variables that were considered to influence the average Medicaid rate and resident case mix; E_i, e_i are the random error terms.

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