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RESEARCH ARTICLE

Has the Medicare Prospective Payment System Led to Increased Nursing Home Efficiency?

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Research Objective. To assess the impact of recent Medicare prospective payment system (PPS) changes on efficiency in skilled nursing homes.

Data Source/Study Setting. Medicare Cost Reports (MCR), On-line Survey Certification and Reporting System (OSCAR), Area Resource Files (ARF), a Centers for Medicare and Medicaid Services (CMS) hospital wage index website, a Consumer Price Index (CPI) database, and a survey of state Medicaid reimbursement rates. The sample was 8,361 nursing homes in the Medicare Cost Report databases from the years 1997 to 2003.

Study Design. Data-envelopment analyses (DEA) calculated efficiency scores for three separate DEA models: unadjusted, acuity-adjusted, and acuity-and-quality-adjusted efficiency. The efficiency scores from these models were regressed on the Medicare PPS changes (the Balanced Budget Act [BBA], the Balanced Budget Refinement Act [BBRA] and the Benefits Improvement and Protection Act) and other organizational and market explanatory variables using a panel-data truncated regression.

Principal Findings. Mean values for all efficiency measures decreased over time, the acuity-quality-adjusted efficiency measures decreasing the most. All policy variables were significantly negatively related to all efficiency measures. Higher nurse staffing was negatively related to efficiency in all but the acuity-quality-adjusted model. Other explanatory variables varied in their relationships to the efficiency variables.

Conclusions. The results suggest that the reimbursement policy changes had a significantly negative impact on efficiency. Higher nurse staffing contributed to lower efficiency only when efficiency was not adjusted for quality. Various organizational and market factors also played significant roles in all efficiency models.

Key Words. Nursing home efficiency, SNF PPS, BBA, nurse staffing and nursing home efficiency, DEA analysis of efficiency in nursing homes

The Medicare prospective payment system (PPS) for skilled nursing facility (SNF) reimbursement was implemented with the Balanced Budget Act (BBA) of 1997 in order to reduce nursing home costs and align reimbursement with

resource intensity. The initial payment system was phased in over four years starting in 1998, with the fixed prospective portion raised 25 percent each year (GAO 2002a, b). Adjustments to the system were soon deemed necessary due to nursing home complaints of financial difficulties. To that end, the Balanced Budget Refinement Act (BBRA) and the Benefits Improvement and Protection Act (BIPA) increased baseline payments in 2000 and 2001, respectively (GAO 2002a).

In implementing the PPS for skilled nursing home care, Centers for Medicare and Medicaid Services (CMS) expected that the stricter and more rational payments would motivate nursing homes to operate more efficiently but would not negatively affect compliance with regulatory standards or the quality of care (CMS 1999; Lee and Turnbull 2001; GAO 2002b; Mueller 2002). However, if nursing homes were already operating efficiently or did not have the resources to become more efficient, the PPS would not produce greater efficiency, but could compromise financial stability and/or quality of care. Under efficiency-seeking behavior, quality could be negatively affected if there was a reduced investment in work environment or workforce, as for example cutting nursing staff, that disrupted routines, reduced needed resources, or created too heavy workloads. A nursing home could fail at *both* efficiency and quality. In sum, it could be that the Medicare PPS resulted in: (1) greater efficiency with unchanged or better quality; (2) greater efficiency with worse quality; (3) neither greater efficiency nor unchanged nor better quality.

There are indications that the PPS may not have resulted in greater efficiency in some nursing homes, but merely financial distress: within a year of its implementation, facilities began reporting financial difficulties, even to the point of bankruptcy (GAO 2002a, b). There are also indications that if there were gains in efficiency, there may have been an efficiency–quality tradeoff. Studies of the impact of the PPS show negative relationships with quality in general (Konetzka, Norton, and Kilpatrick 2004; Unruh, Zhang, and Wan 2006), and with rehabilitation services in particular (Murray 2005).

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To our knowledge, no research has looked at the relationship between the PPS and nursing home efficiency. This study assesses the following questions: (1) Has the implementation of a Medicare PPS under the 1997 BBA improved efficiency in skilled nursing homes when efficiency is adjusted for quality? (2) Has the implementation of the 1999 BBRA or the 2000 BIPA attenuated BBA impacts? (3) Have other market and facility factors influenced efficiency?

THEORETICAL FRAMEWORK

Definition of Efficiency

Economists define three main types of efficiency: technical, allocative, and productive (Worthington 2004). Technical efficiency is the maximum possible output from a given set of inputs. Allocative efficiency is the most efficient combination of inputs given their prices and production technology. Productive or total economic efficiency is when both technological and allocative efficiency exist.

In addition, economists also speak of X-efficiency, which is the maximum effective use of inputs due to internal motivational and external environmental and market pressures. X-efficiency differs from technical efficiency, in that technical efficiency assumes that profit maximizing behavior in a market environment motivates the efficient use of given inputs to produce the maximum outputs, whereas X-efficiency assumes that other internal behaviors and external situations may motivate inefficient use of inputs. Owing to managerial and environmental reasons, organizations may not minimize costs and maximize profits. X-*in*efficiency is the degree of difference between maximal possible effectiveness of the utilization of inputs and the actual effectiveness (Leibenstein 1966; Leibenstein and Maital 1992; Anderson, Lewis, and Webb 1999; Anderson et al. 2005).

X-efficiency applies to this analysis since the profit motive in nursing homes is less strong than in non–health care markets, and market mechanisms are weaker. The environmental pressure brought by the Medicare PPS represents a coercive nonmarket mechanism. Managers may not have the knowledge, resources, or motivation to find new efficiencies given the reimbursement cuts. Attempts to reduce input costs to levels that match the lower revenues may drive input utilization below that needed to maintain the same level and quality of outputs.

Data Envelopment Analysis (DEA)

DEA is a nonstochastic frontier approach to determine efficiency that is particularly useful for studying X-efficiency in health care facilities (Seiford and Thrall 1990; Brown 2003). It is a relative measure that establishes the most efficient producers, which are given an efficiency score of 1, and rates all peers against the lead producers (Worthington 2004). Under DEA, for example, if a lead firm produces 100 units of output with certain inputs, yet another firm produces only 90 with the same inputs, the second firm's efficiency rating is 0.9 (Rosko et al. 1995).

DEA can measure efficiency under constant or variable returns to scale. Under constant returns to scale, DEA assumes that there is a proportional relationship between input and output (Charnes, Cooper, and Phodes 1978), while under variable returns to scale it assumes that changes in inputs will result in varying degrees of changes in outputs (Banker, Charnes, and Cooper 1984). DEA analysis also considers whether the efficiency orientation is input-oriented, in which inputs such as labor can vary, or output-oriented, in which outputs can vary.

DEA has been used in the health care industry to study efficiency in hospitals (Valdmanis 1990; Chern and Wan 2000), health maintenance organizations (Siddharthan, Ahern, and Rosenman 2000), dialysis centers (Ozcan and Ozgen 2002), and finally, nursing homes (Nyman and Bricker 1989; Sexton et al. 1989; Nyman, Bricker, and Link 1990; Fizel and Nunnikhoven 1992, 1993; Kooreman 1994; Rosko et al. 1995; Ozcan, Wogen, and Mau 1998). In nursing home studies, DEA scores are calculated from a number of inputs and outputs. Common inputs are physician, nursing, therapist, rehabilitation, and other staff hours or FTEs (Nyman and Bricker 1989; Sexton et al. 1989; Nyman, Bricker, and Link 1990; Fizel and Nunnikhoven 1992, 1993; Kooreman 1994; Rosko et al. 1995). Outputs are commonly distinguished along payer types (Medicaid, Medicare, and private-pay resident days) or resource intensity categories (skilled nursing or intermediate residents or resident days). DEA scores are commonly used to examine the determinants of efficiency (Sexton et al. 1989; Nyman, Bricker, and Link 1990; Kooreman 1994; Rosko et al. 1995; Ozcan, Wogen, and Mau 1998).

Quality-Adjusted Efficiency

In order to compare efficiencies the quality of the product must be comparable across units and/or over time. While many analyses of efficiency assume constant quality, this may not be the case (Braeutigam and Pauly 1986;

Anderson et al. 2005). In a study of the automobile insurance industry, Braeutigam and Pauly (1986) suggest that quality may be adjusted by the firm in order to maintain profit maximization. Gertler and Waldman (1992) argue that failure to account for the endogeneity of quality in cost function studies of the nursing home industry leads to biased results. Kooreman (1994) finds that higher quality requires more resources.

If quality is observable, suggested methods for assessing efficiency range from including quality in the explanatory variables (Nyman, Bricker, and Link 1990; Fizel and Nunnikhoven 1992), to using two-stage least squares or simultaneous equations (Braeutigam and Pauly 1986). If quality is unobservable, the efficiency measure can be adjusted for quality using a policy-cost elasticity of quality derived from other empirical studies (Gertler and Waldman 1992).

Factors Influencing Efficiency in Nursing Homes

Nurse staffing levels and skill mix may influence efficiency. In general, the more staff used for any unit of output, the lower the efficiency. However, the relationship may not be linear. That is, at some point fewer staff may lead to disorganized care and lower output (Zhang et al. 2006).

Because the skilled nursing home industry is around 66 percent for-profit, the issue of ownership is important to look at. It is believed that the incentive for efficiency is reduced in nonprofit facilities because they have more stakeholders, more varied goals, and may receive charitable subsidies (Rosko et al. 1995). Empirical studies generally indicate that for-profit status has a positive effect on efficiency (Nyman and Bricker 1989; Sexton et al. 1989; Nyman, Bricker, and Link 1990; Fizel and Nunnikhoven 1992; Chattopadhyay and Heffley 1994; Rosko et al. 1995; Anderson, Lewis, and Webb 1999; Knox, Blankmeyer, and Stutzman 1999, 2001).

A higher occupancy rate may indicate the efficient use of inputs or it may be related to efficiency losses due to congestion. Ozcan, Wogen, and Mau (1998) find that occupancy rate is positively associated with efficiency, whereas Sexton et al. (1989) find the opposite.

Economies of scale—when costs increase by a lesser amount than output increases—is another factor in nursing home efficiency. Larger facilities and members of chains may have economies of scale because they can share technology and resources and may have bargaining power (Chen and Shea 2004). Nyman and Bricker (1989) find no significant relationship between size and efficiency, whereas Nyman, Bricker, and Link (1990) find a positive

relationship up to around 170 beds, at which point diseconomies kick in. This is further supported by Rosko et al. (1995), but contradicted by Kooreman (1994). Anderson, Lewis, and Webb (1999) find less cost efficiency in nursing homes that are members of chains. In contrast, when costs *and* profits are analyzed, nursing homes in chains are found to be more efficient (Knox, Blankmeyer, and Stutzman 2001). Fizel and Nunnikhoven (1992, 1993) find a positive relationship between efficiency and both size and chains. Sexton et al. (1989) find a negative relationship between efficiency and size but a positive one between efficiency and chain membership.

Market competition may affect efficiency by motivating the organization to produce efficiently in order to stay competitive. The Herfindahl–Hirschman index (HHI) indicates the number of firms in the market, with higher values indicating fewer firms in the market. Studies using HHI have found that market competition increases efficiency (Fizel and Nunnikhoven 1992, 1993), or is not related to efficiency (Rosko et al. 1995).

Payer mix may affect efficiency if nursing homes with a high concentration of low reimbursement payers are motivated to be more efficient. Most studies show that a high proportion of Medicaid residents is a predictor of efficiency (Nyman, Bricker, and Link 1990; Rosko et al. 1995; Ozcan, Wogen, and Mau 1998), but the proportion of Medicare patients may increase (Rosko et al. 1995), or decrease efficiency (Nyman and Bricker 1989; Ozcan, Wogen, and Mau 1998).

METHODS

Study Design

This study is a longitudinal analysis of nursing home efficiency in 8,361 U.S. free-standing skilled nursing homes certified by Medicare or dually certified by Medicare and Medicaid from 1997 to 2003. The analysis is conducted by generating unadjusted, acuity-adjusted, and acuity-and-quality-adjusted DEA efficiency scores for each nursing home (stage one), then regressing those scores in separate models on explanatory variables (stage two).

Measures: Output/Input Ratios (Used in the First Stage Analysis to Determine DEA Scores)

The ratio of nursing home outputs over inputs formed the basis for the derivation of DEA efficiency scores in the first stage of the analysis. For the outputs, we used three separate types of resident days during a fiscal year:

skilled nursing; intermediate nursing; and other long-term care, such as hospice and mentally retarded care.

Outputs were adjusted by resident acuity and nursing home quality. The acuity index, developed by Cowles Research Group, is the summation of an activities of daily living (ADL) index (the weighted sum of the proportion of residents with certain levels of ADL) and a special treatments index (the weighted sum of the proportion of residents receiving respiratory care, suctioning, intravenous therapy, and other special treatments (Cowles 2002; Feng et al. 2006). The range of the final acuity index is from 0 to 38, with severity increasing as the score increases. The output measures were multiplied by this acuity score, thus adjusting outputs upward when acuity is high and vice versa.

Quality was measured negatively by the summation of all deficiency citations, including clinical, administrative, resident rights, and physical environment. Deficiencies were preferred over resident-level measures because deficiencies are a more comprehensive indicator of quality. Using rating methods developed by Gannett News Services and Florida Agency for Health Care Administration, scopes and severities of citations were arrayed in a 3×4 matrix producing total scores ranging from 0 to 60 (Matthews-Martin et al. 2003). Outputs were then multiplied by the inverse of the quality scores. With this quality correction, output is adjusted upward when the quality score is high and vice versa.

For inputs, resource expenditures were reflected in three operational expenses: general service (including administrative, employee benefits, social services, and others); routine services; and ancillary services (laboratory, physical therapy, and others). These were adjusted across regions with a CMS hospital wage index, and over time with the CPI national inflation index.

Measures: Explanatory Variables (Used in the Second Stage Analysis)

Policy measures were the PPS changes in nursing homes: the BBA, BBRA, and BIPA, implemented in 1998, 2000, and 2001, respectively. Because there are no direct measures of these policies, we used time markers. This method was used in two prior studies (Konetzka, Norton, and Kilpatrick 2004; Unruh, Zhang, and Wan 2006). For the BBA, the time marker on baseline year 1997 is 0. The 4-year phased-in fixed reimbursement changes received incremental markers from 1 in 1998 to 4 in 2001–2003. For the BBRA and BIPA, which were not phased in, a binary system of 0/1 indicated baseline years and active years.

Organizational factors were: RN/resident day, RN/total nursing personnel, ownership, chain membership, percentage of Medicare and Medicaid residents, size of facility, and occupancy rate. Nursing home ownership (for-profit, not-for-profit, and government), and chain membership were categorical variables. Size was measured by number of beds/100 residents squared. Occupancy rate was the total number of residents divided by the total number of beds.

Two market factors were the HHI and the state average Medicaid reimbursement rate (in hundred dollars). Because these rates do not increase greatly over time, we used a time-invariant Medicaid payment rate of 1999.

Data Sources

The output/input information for the DEA score came from the Medicare Cost Report (MCR), which contains itemized utilization and cost allocation information. (Cohen and Dubay 1990; Konetzka, Norton, and Kilpatrick 2004). On-line Survey Certification and Reporting (OSCAR) data, a national collection of state surveys from all U.S. nursing facilities certified for Medicare and Medicaid, provided information regarding nursing home staffing, acuity, quality indictors, payer mix, and other facility characteristics.

Market variables were acquired from the Area Resource Files (ARF). The wage index was obtained from the CMS website. Because a nursing home wage index is not available, we used the acute inpatient PPS wage index. The Consumer Price Index (CPI) was extracted from the U.S. Department of Labor database. A final data source was a survey by Grabowski et al. (2004), reporting state Medicaid reimbursement rates per resident day in 1999.

In order to eliminate outliers, nursing homes were excluded if they had: (1) five or fewer residents; (2) RN hours per resident day <0.02; (3) a ratio of maximum to minimum input for the same facility >3; (4) a ratio of maximum to minimum output >5; and (5) a ratio of maximum to minimum output/input >3. After data merging and cleaning, the study had 8,361 nursing homes, for a total of 58,527 for 7 years.

Analysis

This analysis was conducted in two stages: the generation of a DEA efficiency score for each nursing home; and the regression of that score on explanatory variables. DEA—a nonparametric method—was chosen over Stochastic Frontier Analysis (SFA)—a parametric method—because SFA requires

assumptions about the distribution between specific outputs and inputs, which are not well known, and because DEA is commonly used in nursing home studies.

In the first stage, the DEA used: (1) a variable returns to scale, allowing input changes to be associated with nonlinear changes in outputs; and (2) an input orientation, assuming that nursing homes have more control over their inputs, such as staffing, than their outputs, such as resident days. DEA estimates were performed on each of the unadjusted, acuity-adjusted, and acuity-and-quality-adjusted output/input measures. DEA analysis was performed using *Frontier Efficiency Analysis with R* (*FEAR*, version 1.0) software (Wilson 2006).

In order to assure compatibility of DEA scores over 7 years, a window analysis was used in conjunction with DEA. Window analysis requires that all 7 years of data are integrated hierarchically and treated as if they are flat data of a single year (Harris, Ozgen, and Ozcan 2000). Furthermore, because the DEA estimations are censored (scores range from 0 to 1 regardless of the actual variation among those who receive 0 and 1), and are serially correlated to one another (all scores are set relative to the lead firms), we performed a bootstrap simulation on the raw DEA scores using FEAR software (Simar and Wilson 2000, 2006, 2007). The bootstrap procedure resulted in bias-corrected efficiency scores between, but not including, 0 and 1, and in a smaller number of facilities with scores indicating higher efficiency. For example, there were only 73 facilities in the DEA score range between 0.8 and 1, and 34 in the acuity-and-quality-adjusted DEA score range between 0.8 and 1.

The second stage of the analysis was to regress DEA scores on the PPS markers and other factors. Two methodological issues were addressed: autocorrelation due to the panel data; and truncated distribution of regression residuals due to the dependent variable DEA scores that are bounded between 0 and 1. A truncation regression with panel data and random effect was conducted using *LIMDEP* 8.0 (Greene 2002). This model's covariance structure corrects biased standard errors due to panel data by taking repeated measures into account and providing robust estimates of regression coefficients. This model also allows a more flexible specification of heterogeneous variances.

Each of the three DEA efficiency measures (unadjusted, acuity-adjusted, and acuity-and-quality-adjusted) were regressed in separate models. Owing to their multicollinearity, the two staffing measures were entered into the models separately. This resulted in six models in total.

RESULTS

Table 1 presents descriptive results that show the usual nursing home characteristics with regard to nurse staffing, payer mix (percent Medicare and Medicaid), average number of beds, occupancy rate, ownership, and chain membership.

Descriptive results by year for our bias-corrected DEA efficiency estimates are in Table 2. It is notable that the DEA efficiency scores for all of the models (unadjusted and adjusted) fell from 1997 to 2003. Those that were adjusted for acuity or acuity and quality started lower and fell more than the unadjusted measures. For example, average unadjusted efficiency scores dropped 12.8 percent from 1997 to 2003; acuity-adjusted efficiency scores dropped 18.3 percent; and acuity-and-quality-adjusted efficiency scores dropped 33.8 percent. While we observe the decrease of nursing home efficiency, the standard deviations of efficiency scores declined as well, indicating that lower efficiency is becoming more common in nursing homes over time.

Table 3 presents the unadjusted efficiency model. Results in the first two columns are those in which RN per resident day is the staffing variable in the model, while results in the second two columns are those for RN skill mix.

Table 1: Explanatory Variables: Descriptive Statistics ($n = 58{,}529$)

Variable Name	*Mean*	*SD*	*Minimum*	*Maximum*
RN/total nursing staff	0.115	0.071	0.001	0.809
RN hours/resident day	0.367	0.317	0.020	4.000
% Medicare residents	0.105	0.112	0.000	1.000
% Medicaid residents	0.650	0.210	0.000	1.000
Number of beds	141.286	189.800	4.000	1,231.000
Occupancy rate	0.850	0.156	0.013	1.000
HHI	0.195	0.233	0.005	1.000
Medicaid reimbursement	102.233	21.908	64.450	162.760

	Frequency	*%*
Ownership		
For-profit	42,756	73.05
Nonprofit	13,738	23.47
Government	2,035	3.48
Chain member		
Yes	35,822	61.20
No	22,707	38.80

Table 2: DEA Efficiency Scores (Bootstrap Bias-Corrected) by Model and Year

	Year						
DEA Model	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*
1. Patient days, unadjusted*							
Mean	0.376	0.365	0.367	0.353	0.339	0.329	0.328
SD	0.105	0.101	0.101	0.096	0.091	0.088	0.086
2. Patient days, acuity adjusted†							
Mean	0.361	0.349	0.345	0.330	0.314	0.300	0.295
SD	0.102	0.098	0.098	0.091	0.086	0.082	0.079
3. Patient days, acuity and quality adjusted‡							
Mean	0.198	0.188	0.172	0.156	0.140	0.136	0.131
SD	0.148	0.138	0.128	0.116	0.101	0.099	0.093
N	8,531	8,999	8,581	8,564	8,318	8,254	7,282

*DEA scores obtained from unadjusted output/input measures.

†DEA scores obtained from output/input measures, adjusted for acuity.

‡DEA scores obtained from output/input measures, adjusted for acuity and quality.

Results were similar for both models. All three policy variables were significantly negatively related to lower efficiency. A higher number of RNs per resident day and higher RN skill mix were related to lower efficiency. A higher percentage of Medicare residents, higher Medicaid reimbursement per resident day, and nonprofit or government-owned status also indicated lower efficiency. Nursing homes with a higher percentage of Medicaid patients, greater number of beds, higher occupancy rate, higher HHI, or that are members of chains had higher efficiency.

Table 4 presents the model in which efficiency is adjusted for acuity. As in Table 3, the first two columns are the results of the regression using RN per resident day, and the second two columns are the regression using RN skill mix. Indications are that, like the unadjusted model, all of the policy changes had a negative impact on acuity-adjusted efficiency. Covariates had the same significance and sign as in Table 3 except for the percentage of Medicare, which changed to being positively related to efficiency in the model with RN hours/resident day.

Results for efficiency measures that are adjusted for both acuity and quality are reported in Table 5. In both staffing models all policy variables remained significantly and negatively related to efficiency. Many of the covariates had opposite relationships with efficiency found in the prior two models. Both RN hours/resident day and RN/total nursing staff are now positively

Table 3: Relationship between Medicare Reimbursement Changes (BBA, BBRA, and BIPA) and Unadjusted Nursing Home Efficiency: Results by Staffing Category

	RN Hours/Resident Day		*RN/Total Nursing Staff*	
N = 58,529	*Estimate*	*SE*	*Estimate*	*SE*
Policy variables				
BBA	−0.0046***	0.0007	−0.0045***	0.0007
BBRA	−0.0073***	0.0018	−0.0070***	0.0018
BIPA	−0.0162***	0.0013	−0.0152***	0.0013
Covariates				
Nursing staff (see separate columns)	−0.0328***	0.0014	−0.0395***	0.0055
% of Medicare residents	−0.0500***	0.0041	−0.0737***	0.0040
% of Medicaid residents	0.0528***	0.0022	0.0598***	0.0022
Number of beds (/100) squared	0.0047***	0.0001	0.0046***	0.0001
Nonprofit ownership	−0.0332***	0.0010	−0.0350***	0.0010
Government ownership	−0.0289***	0.0022	−0.0312***	0.0022
Occupancy rate	0.0052*	0.0026	0.0163***	0.0025
Chain membership	0.0037***	0.0008	0.0049***	0.0008
HHI	0.0081***	0.0017	0.0102***	0.0017
1999 Medicaid reimbursement/resident/day	−0.0718***	0.0020	−0.0778***	0.0020

*$p < 0.05$,
***$p < .0001$.

BBA, Balanced Budget Act; BBRA, Balanced Budget Refinement Act; BIPA, Benefits Improvement and Protection Act; SE, standard error; HHI, Herfindahl–Hirschman index.

related to efficiency. This indicates that when efficiency is adjusted for both resident acuity and the quality of care, greater RN hours per resident day and a higher proportion of RN staff contribute to greater efficiency. The measure for size (number of beds) dropped out of the equation due to lack of convergence.

In contrast to the prior models, a higher percentage of both Medicare and Medicaid residents, higher occupancy rate, and chain membership are now related to lower efficiency. As in prior models, nonprofit and government ownership and higher Medicaid reimbursement per resident day are also related to lower efficiency. Also, as before, the HHI is still positively related to efficiency.

DISCUSSION

This study profiled the X-efficiency of skilled nursing facilities in U.S. from 1997 to 2003, expanding upon the methodology of previous studies of nursing

Table 4: Relationship between Medicare Reimbursement Changes (BBA, BBRA, and BIPA) and Acuity-Adjusted Nursing Home Efficiency: Results by Staffing Category

	RN Hours/Resident Day		*RN/Total Nursing Staff*	
N= 58,529	*Estimate*	*SE*	*Estimate*	*SE*
Policy variables				
BBA	−0.0074***	0.0007	−0.0074***	0.0007
BBRA	−0.0064***	0.0017	−0.0063***	0.0017
BIPA	−0.0200***	0.0013	−0.0198***	0.0013
Covariates				
Nursing staff (see separate columns)	−0.0199***	0.0013	−0.0477***	0.0053
% of Medicare residents	0.0150***	0.0039	0.0019	0.0037
% of Medicaid residents	0.0773***	0.0021	0.0797***	0.0021
Number of beds (/100) squared	0.0032***	0.0001	0.0032***	0.0001
Nonprofit ownership	−0.0371***	0.0009	−0.0379***	0.0009
Government ownership	−0.0298***	0.0021	−0.0313***	0.0020
Occupancy rate	0.0356***	0.0025	0.0436***	0.0024
Chain membership	0.0042***	0.0008	0.0046***	0.0008
HHI	0.0058***	0.0016	0.0067***	0.0016
1999 Medicaid reimbursement/resident/day	−0.0767***	0.0019	−0.0791***	0.0018

*$p<0.05$,
***$p<.0001$.

BBA, Balanced Budget Act; BBRA, Balanced Budget Refinement Act; BIPA, Benefits Improvement and Protection Act; SE, standard error; HHI, Herfindahl–Hirschman index.

home efficiency. Our findings are consistent with prior wisdom, but also provide new insights into the impact of public payment policies on unadjusted, acuity-adjusted, and quality-and-acuity-adjusted efficiency in nursing homes.

The study found that the efficiency of SNFs continuously decreased after the 1998 implementation of the PPS. Unadjusted efficiency showed the least decline, while acuity-and-quality-adjusted efficiency showed the greatest decline. Efficiency scores were lower overall than those in prior nursing homes studies because this was the largest study using DEA methodology to date, and the proportion of facilities on the efficiency frontier is inversely related to the sample size (Zhang and Bartels 1998).

Regression analyses indicate that, contrary to what the BBA intended to achieve, all three policies—BBA, BBRA and BIPA—negatively impacted nursing home efficiency. This may have occurred for two reasons: (1) given their existing technology and labor force, nursing homes were already delivering care at an efficient level, so that they could not immediately, without

Table 5: Relationship between Medicare Reimbursement Changes (BBA, BBRA, and BIPA) and Acuity-and-Quality-Adjusted Nursing Home Efficiency: Results by Staffing Category

	RN Hours/Resident Day		*RN/Total Nursing Staff*	
N = 58,529	*Estimate*	*SE*	*Estimate*	*SE*
Policy variables				
BBA	−0.0285***	0.0021	−0.0285***	0.0021
BBRA	−0.0123*	0.0057	−0.0119*	0.0056
BIPA	−0.0245***	0.0045	−0.0235***	0.0045
Covariates				
Nursing staff (see separate columns)	0.0192***	0.0044	0.1360***	0.0180
% of Medicare residents	−0.2493***	0.0143	−0.2363***	0.0140
% of Medicaid residents	−0.0718***	0.0070	−0.0670***	0.0069
Nonprofit ownership	−0.0439***	0.0033	−0.0429***	0.0033
Government ownership	−0.0857***	0.0077	−0.0851***	0.0077
Occupancy rate	−0.1152***	0.0085	−0.1218***	0.0083
Chain membership	−0.0017	0.0027	−0.0023	0.0027
HHI	0.1395***	0.0052	0.1407***	0.0052
1999 Medicaid reimbursement/resident/day	−0.0280***	0.0066	−0.0311***	0.0066

*$p < 0.05$,
***$p < .0001$.

BBA, Balanced Budget Act; BBRA, Balanced Budget Refinement Act; BIPA, Benefits Improvement and Protection Act; SE, standard error; HHI, Herfindahl–Hirschman index.

significantly restructuring those inputs, find increased efficiencies in response to the PPS cuts; (2) in an attempt to quickly increase efficiencies, nursing homes made changes in technology and/or the labor force that unintentionally led to less efficient production.

A higher RN to resident day ratio and RN nursing staff proportion were found to be related to lower efficiency when efficiency is not adjusted for quality. This is as expected, because higher numbers of RNs or skill mix reduces the output to input ratio if quality is not considered. However, when efficiency is adjusted for quality, better staffing is associated with better efficiency. The probable reason for this is that reducing RN staff in order to improve efficiency may compromise quality. Instead, to accomplish efficiency while maintaining quality, the opposite is the case—more RN staffing may be needed.

According to our results, Medicaid rates and revenues have a strong influence on efficiency. Similar to several other studies (Nyman, Bricker, and Link 1990; Rosko et al. 1995; Ozcan, Wogen, and Mau 1998), we find that a

higher percentage of Medicaid patients contribute to greater unadjusted and acuity-adjusted efficiency. We also find that lower state Medicaid payment rates contribute to greater efficiency. However, the relationship between the percentage of Medicaid residents and efficiency does not hold when efficiency is also adjusted for quality, indicating that the way in which nursing homes drive efficiency in response to Medicaid revenues may be through compromises in quality.

Results for the unadjusted and acuity-adjusted efficiency models support prior research that finds larger size, higher occupancy rate, and chain membership to be predictors of efficiency (Fizel and Nunnikhoven 1992, 1993; Ozcan, Wogen, and Mau 1998). However, when adjusted for both acuity and quality, all these factors except the size of the facility show a negative impact on efficiency. Nonprofit and government ownership have the predicted negative relationship with efficiency in the unadjusted model, but less expectedly, are also negatively related to efficiency in the adjusted models. This indicates a strong positive relationship between for-profit and efficiency, even when adjustments are made for acuity and quality.

In all models, HHI is positively related to efficiency, indicating that nursing homes in more concentrated, less competitive, markets are more efficient. Prior research has tended to find the opposite—greater efficiency with a lower index—or an insignificant relationship (Rosko et al. 1995; Fizel and Nunnikhoven 2001, 2002).

A recurring theme in these results is that several factors that are related to *higher* efficiency are not related when quality is also taken into consideration, and may even be related to lower efficiency. Some factors contributing to *lower* efficiency, such as better RN staffing, contribute to higher efficiency when it is also adjusted for quality. These results indicate that a positive impact on efficiency is made, to some extent, at the expense of quality.

This study has the following limitations: First, variations in OSCAR interstate and inter-surveyor deficiency citations create reliability issues with the quality measure used for the adjustment of outputs (GAO 2005). Second, for the acuity measure, we were not able to use Resource Utilization Group scores, which are based on resident clinical characteristics, mainly because of the data quality in early years. Finally, our study was limited to free-standing skilled nursing homes, which reduces its generalizabilty.

In summary, the PPS is most recent effort to restrain Medicare costs, but this has led to concerns about the impact of reimbursement reductions on the quality of care and resident health outcomes. Provider efficiency, also critical, has not received the attention it deserves. It is customary to believe that

revenue reductions should produce an improvement in efficiency. Yet, we find that revenue reductions in nursing homes led to lower efficiency, especially when quality was taken into account. How to drive nursing home costs down while simultaneously maintaining efficiency and quality is an important topic for future study.

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