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Nursing Home Costs and Quality Of Care Outcomes

Executive Summary

- Two major issues facing most skilled nursing facilities include concerns over quality of care and declining Medicaid reimbursement.
- The authors examined the relationship between variable costs and four specific quality measures: decline in ADLs, development of pressure ulcers, weight loss, and psychotropic drug use.
- The results revealed that variable costs can be influenced negatively by quality of care, particularly when all dimensions of quality are examined together.
- As expected, declining ADLs and worsening pressure ulcers accelerate care costs.
- Risk-adjusted patient days explained the largest variance in cost suggesting that bulk of patient care consuming the largest amount of staffing dollars must be provided regardless of the quality of care delivered.

SUBSTANTIAL UNCERTAINTY surrounds the issue of the relationship between nursing home costs and quality of care. When individuals need long-term services for themselves, or family members, because they can no long manage at home, they are demanding that the necessary nursing home care be available, and that the care be good quality. Consumers are also demanding mechanisms that will allow them to evaluate the quality of care provided in nursing homes. In addition to consumers, policymakers, who are responsible for oversight of the public funding of more than 70% of patient days in nursing home care and approximately two-thirds of expenditures on nursing home care, want assurance that monies are contributing to better quality care (Grabowski & Hirth, 2003; Levit et al., 2003).

The inadequacy of the quality

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of care delivered in nursing homes has long been an issue. Following a 1986 Institute of Medicine report on prevalent problems with the quality of care in nursing homes (IOM, 1986), a number of laws, regulations, and efforts have been introduced to address the problems. Despite improvements in a number of areas, problems with quality of care continue to persist, as evidenced by an increase in 13 of 25 quality of care deficiencies and an increase in ombudsman complaints in recent years (Office of Inspector General, 1999). Also, a recent study found that over 25% of nursing homes "had potentially life threatening problems in delivering care and were harming residents" (Harrington, 2001, p. 507).

A common perception is that higher quality is associated with higher costs. If this is found to be true, then improving quality in nursing homes will face substantial obstacles, especially in these times of state budget deficits and the federal proposals to convert Medicaid funding to block grants (U.S. Department of Health and Human Services, 2003). Since Medicaid is a major funding source for nursing homes, paying over 50% in 2002 (Levit et al., 2003), if there is a direct relationship between costs and quality, then efforts to improve quality in nursing homes may be increasingly difficult.

A number of studies (Arling, Nordquist, & Capitman, 1987; Birnbaum, Bishop, Lee, & Jenson, 1981; Hicks et al., 1997; Holmes, 1996) attempted to assess the factors contributing to the variations in the costs of care in nursing homes. An underlying assumption in these studies was the existence of a direct relationship between costs and the efficient provision of services appropriate to patient needs. However, two prior studies (Fleming, 1991; Mukamel & Spector, 2000) in nursing homes and hospitals, respectively, have found that higher quality may be associated with lower costs. This finding is also supported by the tenets of the quality improvement movement, which maintains that by re-engineering the processes of care, improvements in quality and reductions in cost can be achieved simultaneously. If it can be shown that it is possible to improve quality without increasing costs, then nursing homes may be able to enhance quality, even in this era of dwindling resources.

The objective of this study was to test the hypothesis that higher quality may be associated with lower costs in an environment and for quality dimensions different from those studied earlier by Mukamel and Spector (2000). Specifically, data were examined from a state that is not as highly regulated and does not have as rich a Medicaid payment system as New York, and incorporates different quality measures than previously analyzed. In this study, indicators of resident conditions contained in the Minimum Data Set (MDS) were used to reflect quality, rather than data from the New York Patient Review Instrument on resident health status, case mix, medical conditions, and treatments. The MDS is a multidimensional resident-specific instrument routinely used on all residents at time of admission, at times of significant change in condition, annually, and quarterly for selected items; the MDS is federally mandated for all facilities participating in Medicaid and Medicare. The MDS provides assessment data on a broad range of resident care needs and treatments, such as skin condition, incontinence, decline in activities of daily living (ADL), medication use, and weight loss.

While many question the accuracy of the MDS and the quality indicators (QIs) derived from these data, a national validation study (Morris et al., 2002) concluded that many of the MDS QIs capture important aspects of the performance of nursing care facilities. Two General Accounting Office (GAO) reports (Ochinko, 2002a; Ochinko, 2002b) have also examined the issues of accuracy and public reporting and, while recognizing the limitations of some of the measures and the opportunity for confusion on interpretation, conclude the data can be used to measure good and poor quality of care practices. The multidimensional resident-specific aspects of the MDS data provide more direct measures of quality of care than do more indirect proxy measures, such as facility survey citations, which measure quality as compliance with minimum standards.

Methods

The relationship between nursing home variable costs and four quality of care outcome measures — decline in ADLs, development of pressure ulcers, weight loss, and psychotropic drug use — was examined. These quality indicators were selected because of the perceived direct relationship between clinical actions and quality outcomes and the ability to be affected by care management. Final 1999 Medicaid cost report and MDS assessment data were used in this analysis for all certified nursing facilities in Missouri. The MDS was selected because it has established reliability (Hawes, Phillips, Mor, Fries, & Morris, 1992; Hawes et al., 1995; Morris et al., 1990; Morris et al., 1994; Phillips, Chu, Morris, & Hawes, 1993; Phillips, Hawes, Mor, Fries, & Morris, 1996; Snowden et al., 1999); has focused attention on care needs and resident outcomes in nursing homes (Hawes et al., 1992; Hawes et al., 1995; Rantz et al., 1996; Rantz et al., 2001); and has been previously used in research (Brandeis, Baumann, Hossain, Morris, & Resnick, 1997; Mor et al., 1997; Rantz, 1995; Williams & Betley, 1995), including research conducted by this team (Rantz et al., 1996; Rantz et al., 1997a; Rantz et al., 1997b;

Rantz et al., 2000; Rantz et al., 2001).

Sample. Cost data from 474 nonhospital-based nursing facilities in Missouri were matched to facility-specific MDS data. Twenty-eight facilities were excluded due to missing data on key variables or to implausible values on the cost variables (for example, negative salary expenses), resulting in a sample of 446. The characteristics of the omitted facilities were varied in terms of size, ownership, and location.

Cost and facility characteristics. Costs were based on 1999 expenditures, excluding costs less responsive to changes in service delivery and less likely to affect quality of care. Facility characteristics included in the initial cost model were patient days, RN and nursing assistant (aides and orderlies) wages, competition, facility size, location, and ownership. Patient days were case-mix adjusted using resident level RUGS III scores. RN and nursing assistant wages were based on total compensation (wages plus benefits). Competition was measured by the Herfindhal-Hirschman Index, which ranges between 1 (monopoly) and 0 (perfect competition), and is defined as the sum of squared market shares (Feldstein, 1999; Grabowski & Hirth, 2003). Facility size was categorized as small (60 beds), medium (61-120 beds), and large (121 or more beds), and was used to account for economy of scale in the model. Facility size is conceptualized as a characteristic of the facilities, not as a measure of capital cost. Location was defined as metropolitan, urban, or rural according to a U.S. Department of Agriculture county typology (Cook & Mizer, 1989). Ownership was defined as investor-owned or tax-exempt (including governmental).

The dependent variable in the analysis was the natural logarithm of variable costs reported by each facility. Variable costs were defined as expenditures related to patient care, ancillary services, and administration as reported on Schedule B of the state Title XIX (Medicaid) Cost Reports. The categories of capital, depreciation, taxes, and "other" were excluded from the costs considered, as these reflect more fixed costs, and are less responsive to changes in services provided to residents that are likely to influence quality of care.

Quality measures. In this study, four resident-level measures of quality from the MDS data were used: ADL (activities of daily living) decline, pressure ulcers, weight loss, and use of psychotropic drugs (antidepressant and antipsychotics use). These four measures were selected because they are sensitive to changes in resident functional decline. In this analysis, quality measures are based on admission MDS data and the changes that occurred in a later followup assessment. Each of the outcomes is an incidence measure, because subjects positive for the condition on admission were excluded from the analysis. The followup period was the quarterly review 90 days post admission, defined as the assessment closest to 90 days within a window of 45 to 135 days from admission. For the quality measures, residents were included only when their MDS assessments, both admission and followup, occurred within their facility's fiscal reporting period plus or minus 180 days from the start or close of the reporting period. To examine relevant associations between cost and quality, MDS assessments must be near the fiscal period, yet the window must be wide enough to yield the largest sample size possible.

ADL functioning was measured as a summated scale formed from four MDS items assessing self-performance of bed mobility, transfers, eating, and toileting. Each of the MDS ADL self-performance items was scored on a five-point scale, with 0 indicating independent performance and 4 reflecting total dependence on staff help, giving the summated scale a range of 0 to 16. Incidence of ADL decline was defined as at least a two-point increase in this scale from admission to first quarterly assessment. A minimum change of two points was selected because such a change over a relatively short time period (90 days) reflects either a dramatic decline in ability to perform one late-loss ADL, or a more general decline in multiple late-loss ADLs. Residents with a score of 16 on admission were excluded from the analysis, because their status could not decline.

The other quality measures used in this study were weight loss, as measured by the MDS item being checked that a resident had experienced a 10% loss in 6 months. Pressure ulcers were measured by the MDS item indicating that the resident had a stage 1 to 4 pressure ulcer. The psychotropic drug use measure was defined as the resident having a new use indicated for antipsychotics or antidepressants.

Most of the independent variables used in the risk models are single MDS items. The exceptions are the ADL scale discussed above, an indicator for the signs and symptoms of depression on admission (Burrows, Morris, Simon, Hirdes, & Phillips, 2000), and the Cognitive Performance Scale, a seven-point scale with larger values reflecting greater cognitive impairment (Morris et al., 1990).

Table 1 provides an overview of the quality measures by facility ownership type and facility size in the study. Table entries are the median values of the expected minus observed incidence rates used as measures of quality. The summary statistics in Table 1 are for the quality measures expressed on the percent scale. Ninety-five percent confidence intervals for the median values are also included to appreciate variability in these measures better.

Table 1.
Quality Measures by Facility Ownership and Facility Size
Median Values with 95% Confidence Intervals of the Median

Ownership	Bed Size	Outcome	Median	Lower 95% CL	Upper 95% CL
Investor-owned	≤60	ADL decline	1.12	-1.48	2.97
		Pressure ulcers	3.24	1.10	3.82
		Psychotropic drug use	0.59	-2.26	3.22
		Weight loss	1.77	-0.38	3.33
Investor-owned	61-120	ADL decline	0.34	-0.24	1.45
		Pressure ulcers	0.53	-0.01	0.99
		Psychotropic drug use	1.86	0.80	3.44
		Weight loss	0.66	-0.19	1.78
Investor-owned	<120	ADL decline	0.97	-0.23	1.84
		Pressure ulcers	0.10	-0.77	1.11
		Psychotropic drug use	-1.30	-3.14	1.11
		Weight loss	0.31	-0.99	0.85
Tax-exempt	≤60	ADL decline	1.41	-2.12	3.10
		Pressure ulcers	0.87	-0.84	2.89
		Psychotropic drug use	5.32	1.48	7.52
		Weight loss	2.14	0.30	4.77
Tax-exempt	61-120	ADL decline	0.54	-1.72	1.80
		Pressure ulcers	0.76	-0.85	1.65
		Psychotropic drug use	0.54	-2.06	3.13
		Weight loss	0.98	-0.32	2.37
Tax-exempt	<120	ADL decline	-2.58	-4.49	2.18
		Pressure ulcers	-0.62	-2.25	2.39
		Psychotropic drug use	-1.97	-6.18	0.19
		Weight loss	-1.37	-3.15	1.31

The risk adjustments for each quality of care measure were based on resident-level characteristics identified by the clinical experts in the research team. Random intercept logistic regression methods were used to identify a combination of resident-level variables that predict each quality measure. The inclusion of a random intercept allows the baseline log-odds of an event to vary from facility to facility, while the effects of the risk factors are assumed to be the same across facilities. For each quality measure, an initial logistic model was fit that included all candidate risk factors. Statistically nonsignificant (p>0.05) terms were sequentially removed, starting with the least significant, to derive simplified resident-level risk models. The reduced models were then used to form risk-adjusted quality measures.

In a few cases, predictors that were not significant at the 0.05 level were retained because they were judged to be clinically important, or because they were included in statistically significant interaction terms. For example, age and gender were not individually significant in the risk model for pressure ulcers, but were retained because of the statistically significant age-gender interaction. Generalized additive models (Hastie & Tibshirani, 1990) were used to explore the need for nonlinear terms for quantitative predictors and to identify possible ways to collapse ordinal level independent variables.

In the resident-level risk models, the importance of each predictor variable was quantified by the odds ratio, along with 95% confidence intervals for the odds ratio. The ability of the risk models to discriminate between high-risk and low-risk residents for a given outcome was quantified by the C-statistic. The c-statistic is the area under the receiver operating characteristic curve (Hanley & McNeil, 1982). For any reasonable model

Table 2.
Risk-Adjustment Models for Quality of Care Measures

ADL DECLINE *C Statistic 0.68*						
					95% Confidence Intervals for the Odds Ratio	
Effect	**Regression Coefficient**	**Standard Error**	**Significance Level**	**Odds Ratio**	**Lower Limit**	**Upper Limit**
Intercept	-3.07	0.20	<0.0001	0.05	0.03	0.07
Age	0.01	0.00	<0.0001	1.01	1.01	1.02
Cancer	0.33	0.07	<0.0001	1.40	1.22	1.60
Stroke	0.10	0.05	0.0617	1.11	1.00	1.60
Infection	0.09	0.50	0.0826	1.09	0.99	1.20
Unstable disease	0.15	0.05	0.0008	1.17	1.07	1.28
End-stage disease	0.72	0.16	<0.0001	2.06	1.50	2.83
Urinary incontinence	0.28	0.05	<0.0001	1.32	1.20	1.47
Admission ADL score	0.08	0.02	<0.0001	1.09	1.05	1.13
Quadratic term for admission ADL score	-0.01	0.00	<0.0001	0.99	0.98	0.99
CPS1	-0.14	0.07	0.0572	0.87	0.75	1.00
CPS2	-0.05	0.07	0.5375	0.96	0.83	1.10
CPS3	0.18	0.06	0.0057	1.19	1.05	1.35
CPS4	0.42	0.10	<0.0001	1.53	1.25	1.86
CPS5	0.45	0.09	<0.001	1.57	1.33	1.86
CPS6	0.79	0.21	0.0002	2.20	1.46	3.34
NOTE: *CPS1 - CPS6 are indicators for each level of the Cognitive Performance Scale, with a CPS of zero (unimpaired) as the reference level.						

PRESSURE ULCERS *C Statistic 0.70*						
					95% Confidence Intervals for the Odds Ratio	
Effect	**Regression Coefficient**	**Standard Error**	**Significance Level**	**Odds Ratio**	**Lower Limit**	**Upper Limit**
Intercept	-3.63	0.4	<0.0001	0.03	0.01	0.06
Age	-0.00	0.00	0.7256	1.00	0.99	1.01
Male	-1.08	0.66	0.1015	0.34	0.09	1.24
Age (Male)	0.02	0.01	0.0354	1.02	1.00	1.03
Cancer	0.21	0.12	0.0702	1.23	0.98	1.54
Stroke	-0.26	0.09	0.0030	0.77	0.65	0.92
Unstable disease	0.16	0.07	0.0249	1.18	1.02	1.36
End-stage disease	0.93	0.22	<0.0001	2.54	1.64	3.92
CPS	0.09	0.02	<0.0001	0.91	0.87	0.95
Admission ADL score	0.14	0.01	<0.0001	1.15	1.13	1.17

Table 2. (continued)
Risk-Adjustment Models for Quality of Care Measures

WEIGHT LOSS *C Statistic 0.68*						
					95% Confidence Intervals for the Odds Ratio	
Effect	**Regression Coefficient**	**Standard Error**	**Significance Level**	**Odds Ratio**	**Lower Limit**	**Upper Limit**
Intercept	3.42	0.23	<0.0001	0.03	0.02	0.05
Age	0.01	0.00	0.0004	1.01	1.00	1.02
Male	0.13	0.05	0.0098	1.14	1.03	1.27
Depressed	0.28	0.07	<0.0001	1.32	1.16	1.52
Cancer	0.25	0.08	0.0019	1.28	1.10	1.50
COPD	0.16	0.06	0.0114	1.18	1.04	1.33
Stroke	-0.11	0.06	0.0690	0.90	0.80	1.01
Infection	0.11	0.05	0.0363	1.12	1.01	1.25
Edema	0.23	0.05	<0.0001	1.26	1.14	1.40
Unstable disease	0.25	0.05	<0.0001	1.28	1.16	1.42
End-stage disease	0.46	0.20	0.0179	1.59	1.08	2.33
Deteriorating incontinence	0.18	0.06	0.0036	1.20	1.06	1.36
Admission ADL score	0.05	0.01	<0.0001	1.05	1.04	1.07
PSYCHOTROPIC DRUG USE *C Statistic 0.68*						
					95% Confidence Intervals for the Odds Ratio	
Effect	**Regression Coefficient**	**Standard Error**	**Significance Level**	**Odds Ratio**	**Lower Limit**	**Upper Limit**
Intercept	4.66	1.53	0.0025	0.01	0.00	0.19
Age	0.09	0.04	0.0226	1.09	1.01	1.18
Age squared	-0.00	0.00	0.0076	1.00	1.00	1.00
Bipolar disorder	0.64	0.32	0.0475	1.89	1.01	3.54
Schizophrenia	0.78	0.26	0.0026	2.19	1.31	3.65
Deteriorating behavior	0.52	0.09	<0.0001	1.70	1.41	2.04
Behavior	0.45	0.08	<0.0001	1.58	1.36	1.83
Wandering	0.40	0.08	<.0001	1.49	1.27	1.74
Admission ADL score	0.02	0.01	0.0038	1.02	1.01	1.03
CPS123	0.28	0.05	<0.0001	1.32	1.19	1.47

NOTE: CPS123 is an indicator of admission CPS score of 1, 2, or 3 versus 1, 4, or 5.

Table 3.
Facility Characteristics

	Total N=446	≤60 Beds n=102	61-120 Beds n=251	>120 Beds n=93
Location				
Metropolitan	211	27	109	75
Urban	172	50	105	17
Rural	63	25	37	1
Ownership				
Investor-owned	329	65	195	69
Government	35	16	13	6
Tax-exempt	82	21	43	18
	Mean	**(SD)**		
Occupancy	79.36%	(13.85)		
Average case mix	0.77	(0.05)		
Case mix adjusted resident days	23,323	(12,992.46)		
Resident days	30,181	(1,627.87)		
HHI: Market share	0.26	(0.24)		
RN wages	$19.81/hour	(3.16)		
Nurse assistant wage	$8.37/hour	(1.49)		
Log of Variable Costs	**Total**	**<60 Beds**	**61-120 Beds**	**>120 Beds**
Mean (SD)	N=446	n=102	n=251	n=93
Investor-owned	329	13.90 (0.27)	14.42 (0.36)	15.07 (0.43)
Government/Tax-exempt	117	14.09 (0.27)	14.66 (0.31)	15.30 (0.50)

(that is, the model does not do worse than chance in predicting an outcome), C has a range from 0.5 to 1.0, with 0.5 indicating that a model has no discriminatory power, and 1.0 reflecting perfect discrimination.

Based on the fitted logistic models, each resident has an estimated probability of having the condition under consideration — in effect, his/her risk. These probabilities are then aggregated to the facility level to form the facility's expected proportion of residents having the condition. The quality measures used as independent variables in this study are the differences between expected and observed quality scores, where the observed score is simply the proportion of residents positive for the condition, without risk adjustments. Because the quality measures are defined as the difference between expected and observed proportions, positive values reflect better quality (the expected incidence was greater than the observed incidence). Similarly, negative values reflect poorer quality because the expected incidence was lower than the observed incidence. From this point forward in this manuscript, "quality measure" refers to these expected, observed difference scores.

Cost analysis. The dependent variable for the cost analyses is the natural logarithm of variable cost. Several factors motivated the decision to use the log transformation. Ordinary linear regression assumes a normal error distribution with constant variance. In this data set, the distribution of variable costs had substantial positive skew. The log transformation produced a better fit to normality as reflected, and effectively stabilized the error variance. Graphical methods were used to check the regression residuals from the log-transformed model for normality and constant variance. Both assumptions were reasonably satisfied.

Quality measures were entered as a cubic polynomial, thus providing flexible models that include simple linear relationships as a special case. To determine if any relationship exists between cost and quality as they are defined here, preliminary regression analyses were per-

Table 4.
Polynomial Regression of Log of Variable Costs on Quality Measures

Quality Measure	Regression Term	Parameter Estimate (SE)	*p*
ADL decline R^2=0.08	Intercept Linear Quadratic Cubic	14.57 (0.028) -1.42 (0.6411) -22.76 (4.872) -14.23 (34.11)	<0.0001 0.0271 <0.0001 0.6768
Pressure ulcers R^2=0.12	Intercept Linear Quadratic Cubic	14.61 (0.030) -3.65 (0.799) -86.28 (15.37) -257.17 (98.31)	<0.0001 <0.0001 <0.0001 0.0092
Weight loss R^2=0.05	Intercept Linear Quadratic Cubic	14.56 (0.029) 0.05 (0.674) -22.57 (5.016) -82.02 (40.00)	<0.0001 0.9361 <.0001 0.0461
Psychotropic drug use R^2=0.06	Intercept Linear Quadratic Cubic	14.56 (0.028) -1.01 (0.355) -7.25 (1.881) -6.12 (6.069)	<0.0001 0.0045 0.0001 0.3142

Table 5.
Regression of Log of Variable Costs on Facility Characteristics

Independent Variable	Parameter Estimate (SE)	*p*
Intercept	4.26 (0.213)	<0.0001
LCMAPD	0.89 (0.020)	<0.0001
LogWRN	0.11 (0.043)	0.0126
LogWAO	0.47 (0.044)	<0.0001
HHI	-0.11 (0.028)	0.0001
Mid size	0.05 (0.018)	0.0043
Large size	0.12 (0.028)	<0.0001
Tax-exempt	0.09 (0.014)	<0.0001

R^2 = 0.94
LCMAPD = log of case mix adjusted patient day
WRN = wages of RNs
WAO = wages of nursing assistants (aides and orderlies)
HHI = Herfindhal-Hirschman Index of market concentration

formed in which log-variable-cost was regressed on a cubic polynomial for each of the quality measures alone. This was followed by development of a facility characteristic model without consideration of quality. Once this model was determined, the quality measures were individually added to the facility model. The statistical significance of the quality measures was assessed using both univariate and multivariate tests. Three facilities were excluded from the regression analyses due to extreme outlying values on the quality measures (for example, 100% of residents reporting on an indicator is implausible, indicating a potential data reporting problem). These homes were also excluded from the summary statistics for the quality measures, hence the n=443 in Table 6.

Linear, quadratic, and cubic terms are included. In the accompanying tables, the quadratic and cubic terms are denoted by variables suffixed with 2 and 3, respectively. Facility characteristics and quality measures were fit separately to investor-owned and tax-exempt homes. Linear, quadratic, and cubic measures were used to examine different shapes of relationships in the model.

Statistically significant relationships between cost and quality were further explored by transforming log costs back to the actual dollars scale and constructing plots of actual costs as a function of changes in the quality measures. This was done for each facility size, with wage, case mix, and market dominance variables fixed at their mean values for the facility size and type of ownership. In retransforming costs to actual dollars, the naïve estimator (Duan, 1983) of expected costs was used, along with bootstrap methods (Efron & Tibshirani, 1993) to construct point-wise 90% confidence intervals for expected costs.

Results

Resident-level risk models. The resident-level risk models used in forming the risk-adjusted quality measures are given in Table 2. As indicated by C-statistics in the range 0.68 to 0.70, the resident-level risk models do substantially better than chance at identifying the residents at risk for each of the conditions.

Facility characteristics. Table 3 provides a summary of facility characteristics used in this study. As reflected in this table, the dominant home in Missouri is between 61 to 120 beds, located in a metro-

Figure 1.
Variable Costs Associated with Activities of Daily Living Quality

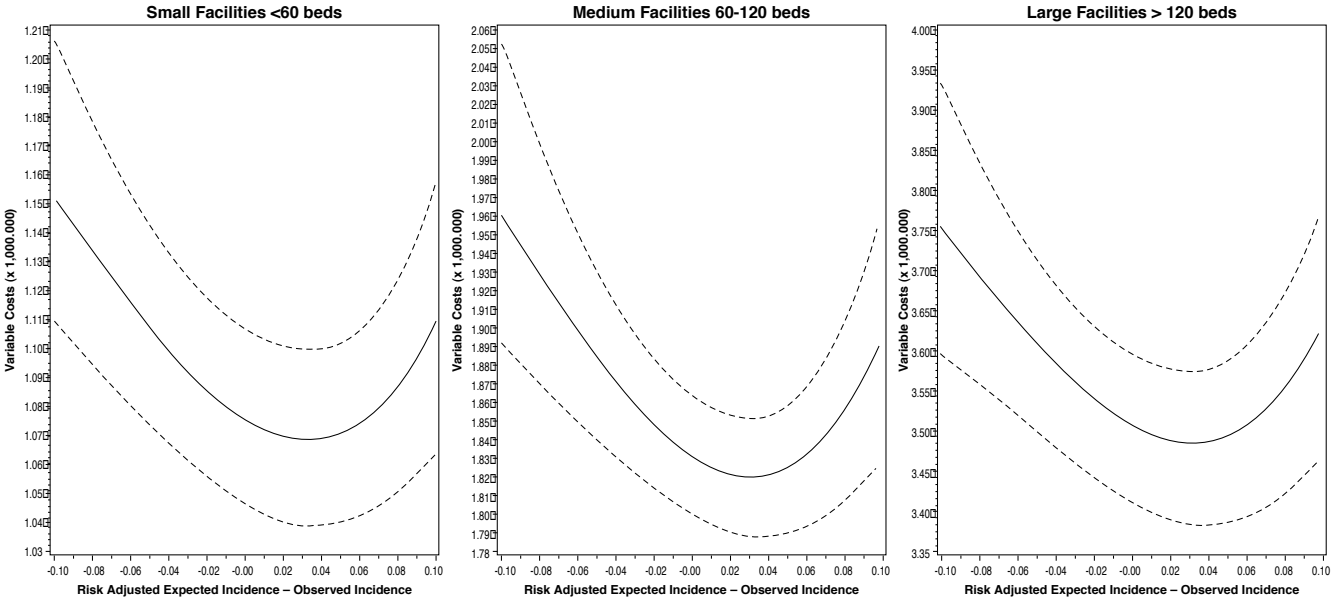
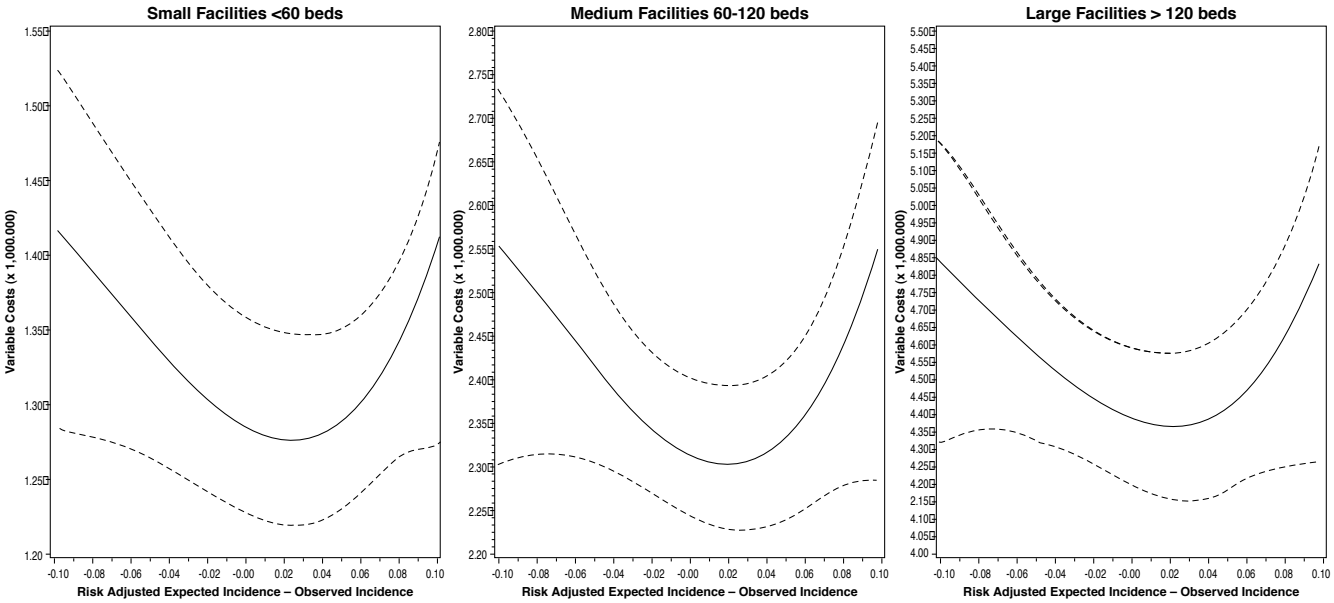


Figure 2.
Variable Costs Associated with Weight Loss Quality



politan area, and is investor-owned. The top part of the table provides descriptive statistics on the number of homes in the state in terms of size, location, and ownership. The center portion of Table 3 provides overall summary statistics on facility case mix, occupancy, market share, resident days, and wages for RNs and nurse aides. The lower portion of the table provides summary statistics for log-variable costs by facility size and type of ownership.

Relationship between costs, quality, and facility characteristics. The results of the initial regression analyses using only the cubic polynomial for each of the quality measures and costs, where costs reflect the variable costs of the institution, are presented in Table 4. Although not all terms are always statistically significant, the

Table 6.
Regression Results: Log of Variable Costs and Quality of Care Outcomes

DECLINE IN ADL *Full sample* *R-Square 0.9424* *N=442*			
Variable	**Parameter Estimate**	**Standard Error**	***p***
Intercept	4.20	0.22	<0.0001
Log of case-mix adjusted patient day	0.90	0.02	<0.0001
Log of hourly RN wage	0.11	0.04	0.0119
Log of hourly aides/orderly wages	0.47	0.04	<0.0001
Herfindhal-Hirschman Index	-0.12	0.03	<0.0001
Midsize	0.06	0.02	0.0027
Large size	0.12	0.03	<0.0001
Tax-exempt	0.10	0.01	<0.0001
ADLs linear	-0.24	0.16	0.1515
ADLs squared	3.31	1.34	0.0142
ADLs cubic	6.92	8.96	0.4401
Joint test of ADL terms (*p*=0.0197)			
Decline in ADL			
Investor-0wned			
R-Square 0.9449			
ADLs linear	-0.39	0.19	0.0367
ADLs squared	5.03	1.55	0.0013
ADLs cubic	20.44	10.03	0.0424
Joint test of ADL terms (*p*=0.0049)			
Decline in ADL			
Tax-Exempt/Government			
R-Square 0.9380			
ADLs linear	0.30	0.41	0.4634
ADLs squared	3.98	3.17	0.2122
ADLs cubic	-46.48	31.58	0.1440
Joint test of ADL terms (*p*=0.2655)			

R^2 for these regressions range from approximately 5% to 12%, suggesting that quality may influence variable costs to a meaningful degree.

The preliminary regression included all proposed facility characteristics and the resulting R^2 value was 0.94, indicating there was not a great deal of variability in costs to be contributed by other variables. The location designations of metropolitan and urban were not statistically significant at the 0.05 level; they were then excluded and the model was refitted. Table 5 provides the final regression results of the log of variable costs for the facility model with only the statistically significant ($p<0.05$) predictors; the resulting R^2 is 0.94.

Table 6 displays the results of the log of variable costs and each

Table 6. (continued)
Regression Results: Log of Variable Costs and Quality of Care Outcomes

WEIGHT LOSS *Full Sample* *R-Square 0.9422* *N=442*			
Variable	**Parameter Estimate**	**Standard Error**	***p***
Intercept	4.16	0.22	<0.0001
Log of case-mix adjusted patient day	0.91	0.02	<0.0001
Log of hourly RN wage	0.10	0.04	0.0262
Log of hourly aides/orderly wages	0.47	0.04	<0.0001
Herfindhal-Hirschman Index	-0.11	0.03	<0.0001
Midsize	0.05	0.02	0.0104
Large Size	0.11	0.03	<0.0001
Tax-exempt	0.10	0.01	<0.0001
WLs linear	-0.04	0.17	0.8356
WLs squared	4.18	1.43	0.0036
WLs cubic	15.31	11.15	0.1704
Joint test for weight loss terms (p=0.0317)			
Weight Loss			
Investor-owned			
R-Square 0.9430			
WLs linear	0.055	0.20	0.7877
WLs squared	2.0	1.70	0.2393
WLs cubic	6.03	15.44	0.6965
Joint test for weight loss terms (p=0.6109)			
Weight Loss			
Tax-exempt/government			
R-Square 0.9423			
WLs linear	-0.51	0.39	0.1905
WLs squared	9.78	2.80	0.0007
WLs cubic	50.16	20.34	0.0155
Joint test for weight loss terms (p=0.0089)			

quality of care outcome for the total sample and for the investor-owned and tax-exempt/governmental facilities. Although the quadratic terms for quality in ADL and weight loss in the total sample were statistically significant, the changes in R^2 are essentially zero. In the ADL decline regression, the investor-owned homes contributed to the significance of the quality measure; in weight loss, the tax-exempt/governmental facilities contributed to the significance. The assumption of normally distributed errors is reasonably well met with these models. Plots of residuals against predicted values did not suggest substantial heteroskedasticity.

In addition, changes in real dollars as a result of changes in quality were analyzed for the statistically significant ADL quality

Table 6. (continued)
Regression Results: Log of Variable Costs and Quality of Care Outcomes

PRESSURE ULCERS *Full sample* *R-Square 0.9419* *N=442*			
Variable	**Parameter Estimate**	**Standard Error**	***p***
Intercept	4.27	0.22	<0.0001
Log of case-mix adjusted patient day	0.89	0.02	<0.0001
Log of hourly RN wage	0.10	0.04	0.0207
Log of hourly aides/orderly wages	0.48	0.04	<0.0001
Herfindhal-Hirschman Index	-0.12	0.03	<0.0001
Midsize	0.05	0.02	0.0067
Large Size	0.11	0.03	<0.0001
Tax-exempt	0.09	0.01	<0.0001
PUs linear	-0.32	0.22	0.1598
PUs squared	2.69	4.35	0.5369
PUs cubic	6.41	32.19	0.8422
Joint test for pressure ulcer terms (p=0.1061)			
Pressure Ulcers			
Investor-Owned			
R-Square 0.9434			
PUs linear	-0.22	0.28	0.4263
PUs squared	1.87	4.78	0.9687
PUs cubic	-24.58	43.88	0.5758
Joint test for pressure ulcer terms (p=0.2174)			
Pressure Ulcers			
Tax-exempt/government			
R-Square 0.9383			
PUs Linear	-0.38	0.45	0.3998
PUs Squared	12.54	11.35	0.2717
PUs Cubic	60.51	68.28	0.3775
Joint test for pressure ulcer terms (p=0.2167)			

measure in investor-owned facilities and the weight-loss quality measure in tax-exempt/government facilities. As illustrated in Figures 1 and 2, minimum cost was achieved when care was such that actual incidence rates were kept slightly lower than expected for the facility's case mix. More generally, if standard care is viewed as having incidence rates no higher than expected given a facility's case mix, then there was no case in which substandard care yielded reductions in costs. Figure 1 illustrates expected variable costs as a function of ADL quality by size of investor-owned facility: small, medium, large. Figure 2 illustrates expected variable costs as a function of changes in the weight-loss quality measure for tax-exempt/government facilities by size: small, medium, large.

Table 6. (continued)
Regression Results: Log of Variable Costs and Quality of Care Outcomes

PSYCHOTROPIC DRUG USE *Full Sample* *R-Square 0.9414* *N=441*			
Variable	**Parameter Estimate**	**Standard Error**	***p***
Intercept	4.26	0.22	<0.0001
Log of case-mix adjusted patient day	0.89	0.02	<0.0001
Log of hourly RN wage	0.11	0.04	0.0116
Log of hourly aides/orderly wages	1.48	0.04	<0.0001
Herfindhal-Hirschman Index	-.011	0.03	<0.0001
Midsize	0.05	0.02	0.0064
Large Size	0.11	0.03	<0.0001
Tax-exempt	0.10	0.01	<0.0001
PDs linear	-0.10	0.09	0.2512
PDs squared	0.21	0.50	0.6770
PDs cubic	1.41	1.56	0.3657
Joint test for PD terms (*p*=0.7082)			
Psychotropic Drug Use			
Investor-0wned			
R-Square 0.9430			
PDs linear	-0.14	0.10	0.1745
PDs squared	0.21	0.53	0.6863
PDs cubic	2.02	1.62	0.2141
Joint test for PD terms (*p*=0.5142)			
Psychotropic Drug Use			
Tax-exempt/government			
R-Square 0.9386			
PDs linear	0.27	0.24	0.2663
PDs squared	-0.29	1.67	0.8629
PDs cubic	-10.71	7.59	0.1609
Joint test for PD terms (*p*=0.2614)			

Discussion

As the results of this study indicate, quality of care has an impact on the costs of delivering that care. While each individual quality of care measure does not make a large contribution to the costs, when they are considered, collectively, by the facility, they can have a substantial financial impact on the operations of the home. For example, as ADL of residents in a home decline, costs of providing services accelerate. Similarly, there is an even stronger association with higher costs when quality of care delivered is lower and a higher incidence of pressure ulcers occur.

Regardless of the type of ownership, quality of care does explain some of the variance in providing care to residents. For example, in the decline in ADL

measure, the investor-owned facilities contributed to the significance of the quality measure. However, in the weight-loss measure, it was the tax-exempt facilities that contributed to the significance of the quality measure.

In the model presented in this study, an overwhelming amount of the variance was explained by risk-adjusted patient days in the facilities. This result is plausible and logical, given the large amount of basic care and services that must be provided to patients in a nursing home, regardless of quality of care delivered. As a result, the majority of the costs incurred in a facility exist regardless of the quality of care provided in that facility. However, the results from these four, although very specific and narrow dimensions of quality, indicate that quality of care does have an impact on a portion of the costs. The curves in this study suggest that variable costs may be minimized at a certain quality level, specifically when staffing or other facility resources are allocated in such a way as to reduce incidence levels to slightly less than would be expected for the case mix of the facility. Sacrificing quality does not appear to be an effective method of cost containment; however, as illustrated by the graphs, further reduction of incidence levels below the expected may result in increased costs. Therefore, nursing homes that successfully focus on providing quality of care through innovative protocols and care management strategies can have a positive impact on the costs of the home.

These findings, using MDS data to measure quality of care, are similar to the findings reported by Mukamel and Spector (2000). The results of this study are also consistent with the results provided in the recent GAO report (Dummit, 2002) showing that the average share of total expenditures that is spent on basic resident care activities is relatively high and stable, but that other costs show substantial variations and that some of that variation is related to quality of care in the homes.

In other studies (Harrington, Zimmerman, Karon, Robinson, & Beutel, 2000; Johnson-Pawlson & Infeld, 1996; Spector & Takada, 1991), increased staffing was associated with better quality of care. Bliesmer, Smayling, Kane, and Shannon (1998) also found that licensed nursing hours were related to improved functional ability, increased probability of discharge to home, and decreased probability of death. Felton (1993) found that a higher ratio of registered nurses was associated with higher resident care costs, but lower total costs per resident per day. Studies using simple linear models to show the relationship between costs and quality are absent from the literature.

While this study provides additional information on the association between quality and costs in nursing homes, more research is needed into the specific cost factors that influence different quality of care measures. While the recent GAO report examined aggregate spending on nursing (Dummit, 2002), more detailed examination needs to be made on not only the type and mix of nursing care included in the overall cost, but also the impact of such events as tenure and turnover among staff and management, training levels, and actual processes of care employed in the facility. The results of this study indicate that providing substandard care does not result in cost reductions in nursing homes.**$**

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