Nursing Home Cost Studies and Reimbursement Issues

by Christine E. Bishop

This review of nursing home cost function research shows that certain provider and service characteristics are systematically associated with differences in the average cost of care. This information can be used to group providers for reasonable cost related rate-setting or to adjust their rates or rate ceilings. However, relationships between average cost and such service characteristics as patient mix, service intensity, and quality of care have not been fully delineated. Therefore, econometric cost functions cannot yet provide rate-setters with predictions about the cost of the efficient provision of nursing home care appropriate to patient needs. In any case, the design of reimbursement systems must be founded not only on technical information but also on public policy goals for long-term care.

The Context: Cost Related Reimbursement

By Federal statute, State Medicaid programs must pay for nursing home care provided to Medicaid beneficiaries on a "reasonable cost related basis."[1] This basic reimbursement principle has wide application, since Medicaid is the primary source of support for nearly half of all nursing home patients (National Center for Health Statistics, 1979). Each State has the authority to design and implement its own reasonable cost related method of payment, subject to approval by the Health Care Financing Administration.[2] States have exercised considerable latitude in designing rate-setting systems, and a wide variety of methods has met with Federal approval as "reasonable cost related." Some States retrospectively reimburse each provider for the average cost expended in supplying nursing home care, while others use cost information for groups of providers to set ceilings and retrospectively reimburse each provider's expended cost only up to those ceilings. Several States set prospective rates for individual providers by applying inflation factors to their past costs, often screening for reasonableness using group cost ceilings. Still other States use information about average costs to set uniform prospective rates for groups of facilities and pay all providers within each group at the same rate. While these methods are diverse, they all conform to the provisions of Section 249 by basing rates on provider cost information. Most rely on average cost information for groups of providers either to set prospective uniform class rates or to set group cost ceilings.

By limiting rates according to group cost experience, rate policy makers imply first that they expect costs to be different for the different groups. Second, they imply that they are willing to pay higher rates to providers in the higher cost categories. In this way, rate-setting methods can be related to the actual cost experience of providers, conforming to Section 249, and can simultaneously work to meet policy goals, including the control of costs, maintenance of adequate quality of care, and access of Medicaid patients to care.

While State rate-setting authorities are making increasing use of provider cost information, another source of information about nursing home costs has seldom been tapped. This is the growing body of economic cost function literature that investigates the determinants of nursing home cost. These studies indicate differences in the average cost of providing nursing home care for facilities with different characteristics and producing different types of care.

The major purpose of this paper is to review a number of nursing home cost studies to identify the characteristics of providers and services that appear to result in different average costs. These provider and product characteristics may be considered by State rate-setting authorities for use as grouping criteria or criteria for adjusting group ceilings or rates.

After a background discussion of cost function analysis, the review presents findings of past studies, highlighting gaps and problems that should be borne in mind by users. The concluding section of the paper

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[1] Section 249, P.L. 92-603, the 1972 Amendments to the Social Security Act.

[2] 45 CFR 250.30, effective July 1, 1976.

presents some implications of the studies for reimbursement.

Studies of Nursing Home Cost

THE COST FUNCTION IN ECONOMIC THEORY

The cost function for a producer is the relationship between his rate of output (steel ingots per month; automobiles per week; patient days or cases per year) and average cost per unit of output, holding constant technology and input prices. The first problem for analysis is the choice of an appropriate unit of output, so that a cost per unit can be computed. This is an easy decision when the producers make a standardized product, but it is difficult when the product is clearly not standardized, as in nursing home care. A second important question involves determination of which cost data capture the value of the resources used to produce the output. Payroll and supply expenses clearly reflect cost, but plant and equipment costs are more difficult to measure. Capital-related expense data show the historical accounting cost of capital, which depends on the age of plant and equipment and on financing methods. These expense figures are unlikely to reflect adequately the economic cost of capital resources.

In theory, the producer is assumed to choose his rate of output and his input combination in an optimal way in light of his objectives, given the prices of inputs and the revenue he receives for his output. This means that he can be assumed to employ inputs in the best manner available to him, without waste. Since each producer is observed at only one rate of output, with an associated average cost, it is necessary to assume that similar producers are making similar decisions and are operating along the same average cost curve. The average cost values (dependent variable) and rates of output (independent variable) can then be used to fit a cost relationship that should hold for any one producer should he change his rate of output. To put this another way, the variation in the rate of output and the average cost observable over a cross-section of producers allows the estimation of a single cost function which is assumed to hold for all of them.

However, different types of producers may be more or less successful in getting outputs from their inputs. They may be seen as operating along different cost functions, with the same basic relationship between cost and output, but with lower or higher average cost all along the cost curve. This is the reason for including provider characteristics, like nonprofit ownership or hospital-based status, in a nursing home cost function. Producers in higher cost locations must also operate on a higher cost curve, so location indicators or indices reflecting actual input prices are typically included to capture these cost differences. A more difficult problem arises if producers cannot be assumed to produce the same product, or if they produce varying mixes of heterogeneous products. Costs can be assumed to vary systematically by product characteristics: red "widgets" might cost more to produce than blue "widgets" for every rate of output. This is the reason for including product characteristics, such as level of care and quality, in nursing home cost functions.

The cost function of economic theory is thus a relationship between a measure of average cost per unit output and rate of production; the cost function also allows average cost to vary systematically by provider type, input price level, and output type.

NURSING HOME COST FUNCTION STUDIES

A number of recent studies deal with the determinants of the cost of nursing home care (Table 1). These studies use regression analysis to identify variables that are significant in explaining cost variation across providers and assess the magnitude and direction of their effects.[3]

It is extremely difficult to compare the results of diverse cost research. Even the definition of the dependent variable differs across the studies. Different specific variables were used within each class of explanatory variables, with the choice dictated by theoretical considerations, or, more frequently, by data availability. Researchers used different functional forms. Sample sizes varied widely, and providers were observed in different years, from 1965 to 1976. Most important, the average costs of providers in different States at different times must have been determined not only by nursing home technology and input prices, but also by the varying environments in which they operated. The observed costs and product and provider characteristics are affected by State specific reimbursement practices, enforcement of quality standards, utilization review, capacity planning, and private patient demand. Methods of accounting for these factors in cost function studies have not been fully satisfactory.

Nevertheless, the studies have been moderately successful in accounting for variation in average costs: the proportion of the variation explained (R^2) has ranged from .47 to .77. In comparing the studies, it is possible to state whether different researchers found variables of one type or another to be important in explaining average cost. These general statements at least form a basis for choosing variables for future study. Specific findings about the correlates of average cost may also be useful to rate-setting authorities.

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[3] Regression analysis is a statistical technique that quantifies the effect of independent or explanatory variables (provider type, size, and so on) on a dependent variable (for example, average cost per patient day). In regression analysis, a coefficient or "multiplier" is estimated for each independent variable. It shows the size and direction (positive or negative) of the effect of the explanatory variable on the dependent variable. The reliability of these coefficients is assessed using significance tests showing the probability that the estimated coefficient is the result of chance, rather than representing a true effect. When the coefficient of an explanatory variable is said to be "significant," the probability that the true coefficient is zero (i.e. the probability that the variable does not affect costs) is very low.

TABLE 1

Nursing Home Cost Studies

Study, Dependent Variable	Data Description			R^{2}[1]
	Number of Facilities	Location	Date	
Average Total Cost				
Ruchlin and Levy (1972)	638	Massachusetts	1965-1969	.61
Mennemeyer (1979)	405 to 516	New York	1975, 1976	.51-.66
Bishop (1980)	417	Massachusetts	1976	.70
Average Operating Cost				
Christianson (1977)	30	Montana	1974	.51
Reis and Christianson (1977)	50	Montana	1974	.51
Walsh (1979)	136	Illinois	—	.57
Jensen and Birnbaum (1979)	1127	National	1973	.58
Lee and Birnbaum (1979)	479 to 504	New York	1974-1976	.65-.77
Bishop (1979)	438 to 468	Massachusetts	1973-1975	.66-.72
Jensen (1979)	78 to 86	Indiana	1973-1975	.47-.63
Lee *et al.* (1979)	1127	National	1973	—
Private Price				
Deane and Skinner (1978)	4000 private pay patients	National	1973	.60

[1] Proportion of variation explained by the regression.

The sections that follow consider a variety of issues explored by cost function estimation, starting with the choice of dependent variable and presenting findings about the effect of particular independent variables on average cost. In some cases, actual coefficient values are compared across studies for a group of independent variables.[4] It can be misleading to compare these values out of context, since the other variables "held constant" by regression analysis differ across the studies. Potential users of study results are strongly advised to refer to the original studies. For some variables, however, the studies have consistent results with respect to the direction (positive or negative) and size of effects, and this is worth noting.

CHOICE OF DEPENDENT VARIABLE

Most researchers have used costs per patient day as the dependent variable in their cost equations. They thus implicitly define the product of nursing homes as the *patient day* rather than the case treated. Since nursing homes generally provide ongoing supportive and residential services to individual patients with chronic disabling conditions, rather than focusing on the treatment of episodes of illness or "cure" of illness, it would be hard to justify the use of the episode or case as the unit of output.

Some studies used average total expense per patient day as the dependent variable, and one study (Deane and Skinner) used the price charged to private patients as a dependent variable, with the assumption that this price is closely tied to cost. However, most

[4] An estimated regression coefficient is a multiplier for the independent variable showing its effect on the dependent variable. For example, suppose a coefficient of -.0002 has been estimated as the impact of an independent variable measuring firm size in number of beds on the dependent variable, average operating cost per patient day. This means that for each one unit increase in size, average operating cost declines by $.0002. Some independent variables indicate the presence or absence of a particular characteristic by taking values of one or zero. For example, an ownership variable might be set equal to one if the facility is under nonprofit ownership, zero for proprietary ownership. The estimated coefficient for such a variable shows the difference in average cost for nonprofit ownership as compared with the reference case, for profit ownership. If a coefficient of $2.56 is found for such a zero-one or dummy variable in a regression using average total cost as the dependent variable, it indicates that nonprofit providers have costs higher by $2.56, other things constant.

researchers have used average nursing home operating cost, that is, average total cost net of reported capital-related expense, as their dependent variable. Reported costs reflecting expenditures for plant and equipment (depreciation, interest, rent) are unlikely to vary systematically with the independent variables reflecting scale and product mix, because these expense figures are determined by historical construction costs, age of the facility, method of financing, and ownership type, as well as by the type and number of patient days provided.[5] Of course, a reimbursement system must pay providers for the use of their plant and equipment as well as for their provision of labor services and supplies, but reimbursement of capital cost can be considered as a separate issue (Battelle Memorial Institute, 1975; Shulman and Gallanter, 1976; McCaffree, Malhotra, and Wills, 1979). As long as there is little substitution between capital and labor in the production of patient days, this focus on operating cost makes sense.

SCALE OF PRODUCTION

Studies have inconsistent findings for the effect on cost of size (measured in number of beds) and capacity utilization (represented by occupancy rate). An alternative measure of the rate of production is patient days per unit time, for example, total patient days per year or average daily census (ADC).[6] These results are reviewed in Table 2. Some researchers have shown average costs to increase as the number of beds increases, while others show declining costs.[7] Costs per day have been shown to fall as the use of capacity (occupancy rate) increases. No study has found overwhelming results with respect to optimal facility size. The small effect of scale on cost—no more than a few cents per day for each additional bed or percentage point of occupancy rate—means that incentives inducing small changes in the number of beds per facility or in occupancy rates would have little effect on costs.

[5] From the point of view of economic theory, accounting costs of capital are unlikely to reflect the opportunity cost of capital. This is another reason for using operating costs, that is, total costs net of capital-related expense. Bishop (1980) uses total cost per patient day but includes reported capital related expense per bed as an independent variable to adjust for this.

[6] These measures are equivalent, since average daily census equals occupancy rate times number of beds, and the number of total patient days is equal to average daily census times a constant, 365.

[7] The size distribution of facilities by age may be responsible for the positive association of bed size and average total cost: because of rising construction standards and increasing sophistication of the nursing home industry, newer facilities tend to be both larger and more expensive, especially when average capital-related costs are included. Consistent with this, Ruchlin and Levy found a negative impact for size once they held age of facility constant. Mennemeyer, however, found a generally positive effect of size on cost, holding age constant.

PROVIDER TYPE: OWNERSHIP, HOSPITAL AFFILIATION

Cost studies have consistently found that facilities owned and operated by nonprofit voluntary and government organizations have higher costs than for-profit nursing homes by at least several dollars per day (Table 3). It is possible that the profit incentive of for-profit operators encourages them to be more efficient so that they produce similar outputs with fewer inputs and thus with lower costs. It is also possible that nonprofit facilities serve different patients and/or provide different services. Some studies have controlled for patient mix and services offered, and a few studies have attempted to control for quality of care. Nonetheless, the cost differential between for-profit and nonprofit and/or government providers persists.[8]

Hospital-based nursing home care was found to be significantly more expensive (by between $3.98 to $8.06 per patient day) by the only study (Mennemeyer) that included hospital-based units in its data set.

LOCATION

Cost studies have found that average costs vary significantly across the nation and across areas within States (Table 4), apparently due to variation in input prices and other locational factors. Cost function estimates have included regional dummy variables and indicators of urban location, for example, dummy variables for SMSA (Standard Metropolitan Statistical Area) location or population density variables. An alternative approach shows that costs vary with indicators of area input price levels (specifically, wage rates)[9] directly included in the estimated equation.[10]

[8] Evidence about the causes of for-profit/nonprofit cost differentials is meager. Examining a small matched sample of for-profit and nonprofit facilities in Washington, Winn (1974) found no statistically significant differences in mean nursing hours by operator type; in contrast, Bishop (1980) found nonprofit facilities in Massachusetts providing significantly more nursing hours per patient day once available patient status variables and the proportion of private pay patients were held constant.

[9] The actual wages paid by a particular provider may not be a good indicator of the wage rates in its labor market, since a nursing home may choose to hire workers with more or less training, experience, and so on, than the average for its market area.

[10] A third approach would be to deflate certain cost components by price indices to standardize costs across areas; this has not been done in cost function estimation to date but is the approach implicit in recent Health Care Financing Administration Medicare ceiling computations (USDHEW, 1979), where an index that varies across SMSAs and rural regions of States is used to adjust group ceilings.

TABLE 2

Effect of Scale

Study, Dependent Variable	Independent Variables: Beds	Occupancy Rate	Total Patient Days or ADC
Average Total Cost			
Ruchlin and Levy	Insignificant	Negative: $.06 per percentage point.	—
Mennemeyer	Positive	Negative	—
Bishop (1980)	—	Inverse of occupancy rate positive: + $13,232, implying a negative effect of about − $.20 to −$.13 per percentage point for occupancy rates between 80 and 100 percent	Insignificant
Average Operating Cost			
Ries and Christianson	Quadratic form significant: costs fall over range toward minimum at 122 beds	Insignificant	—
Walsh	Negative: − $.0002 per bed	Negative: − $.0957 per percentage point	—
Jensen and Birnbaum	—	—	Negative, then insignificant: cost falls by $.20 per unit ADC for range 1-20, flat thereafter
Lee and Birnbaum	Negative or insignificant	Negative to 90%, then insignificant	—
Bishop (1979)	Negative	Negative then positive: − $.12 to − $.24 per percentage point for 0-90% range; increasing over some ranges above 95%	—
Lee *et al.*	Positive: + $.007 per bed	Negative: −$.02 per percentage point.	—
Private Price			
Deane and Skinner	Positive: + $1.52 for facilities with 60+ beds	Positive: + $.52 for facilities with 93% + occupancy	

PRODUCT CHARACTERISTICS

The description of the product of the nursing home for inclusion in cost functions is the most difficult problem for nursing home cost studies. Cost function estimation can only proceed if the product can be assumed to be homogeneous, or if product differences can be accounted for by including product mix descriptors among the independent variables. Three types of product descriptors have been used in nursing home cost studies: certified level of care, measures of service availability and intensity, and patient characteristics. Patient turnover and source of payment may also be treated as patient characteristics or product descriptors.

Certified Level of Care

Direct indicators of product type are found in certification status, since skilled nursing facilities (SNFs) and intermediate care facilities (ICFs) must meet different standards. However, the definition and enforcement of these standards, while subject to Federal guidelines, differ across States. Consequently, the services provided by an SNF in one State may not be the same as care in an SNF in another State (Holmes *et al.*, 1976, and National Geriatrics Society, 1976). Certification level also represents the type of patients actually served by a facility, if patients are placed systematically according to need; again, however, the effectiveness of the process that matches level of

TABLE 3

Effect of Ownership

Study, Dependent Variable	Independent Variables: Nonprofit Voluntary	Government
Average Total Cost		
Ruchlin and Levy	+ $2.56[1]	—
Mennemeyer	+ $6.79 to + $9.13 for nonprofit and government combined	
Bishop (1980)	+ $2.63	—
Average Operating Cost		
Ries and Christianson	+ $2.70	—
Walsh	+ $2.68	+ $5.17
Jensen and Birnbaum	+ $1.74	+ $2.52
Lee and Birnbaum	+ $9.43 to + $11.60	+ $4.00 to + $7.08
Bishop (1979)	+ $2.73 to + $3.66	—
Lee *et al.*	+ $1.36 for nonprofit and government combined	
Private Price		
Deane and Skinner	− $1.92	—

[1] Each coefficient shows the estimated increment to the dependent variable associated with nonprofit or government ownership, in comparison with the reference group, for-profit ownership.

need to level of care apparently differs across States. Cost function studies have shown that more complex levels of care are indeed associated with higher cost (Table 5), but the cost differential varies across States. Certification for Medicare is associated with higher costs. Provision of care in facilities offering both SNF and ICF care has been shown to cost more in some studies and less in others.

Services

The findings of the studies with respect to services are especially difficult to compare because of markedly different variables used to indicate the services available or actually provided in a facility. These variables have generally been found to be significant in explaining nursing home cost (Table 6). The availability variables imply that a day of care in a facility providing physical therapy or care in private rooms is different from a day of care where such services are not available; the intensity variables indicate number of "doses" of particular services provided per patient and nursing hours per patient day.

The service intensity approach raises methodological problems. While it is reasonable to assume that a day of nursing home care which includes three hours of licensed nursing care is a different product from a day with minimal nursing input, inclusion of a variable representing nursing hours per patient day will merely underline the obvious: nurses cost money, so a day of care with higher nursing intensity costs more.[11] Inclusion of variables for "intermediate" products, like units of services provided to patients (for example, the percent of patients receiving oxygen therapy, nasal feeding, catheterization, and so on, as in Jensen and Birnbaum) is theoretically preferable to direct inclusion of input variables. Equations including such service variables will estimate the average cost of providing the services as "add-ons" to the basic nursing home day of care.

There are problems with using such service intensity variables as product descriptors. If more nursing hours are seen to change the product of a nursing home, a facility that uses nurses wastefully will not be identified as inefficient, but will be seen as producing an above-average type of care. A facility providing excessive amounts of particular services (and perhaps keeping patients overly dependent) would be seen as providing a different product from more efficient counterparts that serve similar patients effectively with fewer "doses" of service. If patients could be assumed to receive adequate care across the cross-section of facilities, patient status variables could be used to account for product differences, and there would be no need to include actual services provided. However, such an approach has not been possible because of inadequacies of both quality and patient status indicators.

[11] The estimated coefficient for nursing hours is likely to be about equal to the nursing wage.

TABLE 4

Effect of Location and Input Prices

Study, Dependent Variable	Independent Variable	Effect
Average Total Cost		
Ruchlin and Levy	Boston area	Insignificant
Mennemeyer	8 planning regions	Significant
Bishop (1980)	Boston area	Positive, significant
	Township population density	Positive, significant
Average Operating Cost		
Ries and Christianson	Town under 2000 population	Insignificant
Jensen and Birnbaum	4 regions	Significant
	SMSA	Insignificant
	County retail wage	Positive, significant
	Facility nurse wage	Positive, significant
Lee and Birnbaum	7 regions	Significant
	County population density	Insignificant
	County retail wage	Positive, significant
	Facility LPN wage	Positive, significant
Bishop (1979)	8 planning regions	Significant
	County retail wage	Insignificant
Private Price		
Deane and Skinner	10 census regions	Significant

Jensen and Birnbaum compared inclusion of services available and services actually provided for effectiveness in explaining cost variation and found that services *offered* were more important to cost than services actually *delivered.* This finding is symptomatic of a larger issue with respect to the provision of long-term care: it is possible that facilities are staffed at a certain level and geared to providing a certain complexity of service, leading to a particular cost per patient day. Patients are then provided with the care available in the institution, which may be more or less than they need, since placement is far from perfect. The accuracy of placement, both upon admission and over time, may then be the most important determinant of whether needs are met appropriately (Willemain, Bishop, and Plough, 1980). A corollary of this is that case-mix variables will be strongly related to cost per day only when placement works well, so that patients are placed in facilities that provide the care resources they need.

Patient Characteristics

It is generally believed that days of care provided to different types of patients are different products. Therefore, cost studies have typically used patient descriptors as product characteristics, so that the estimated cost function predicts the average cost of a basic nursing home day with cost "add-ons" for the characteristics of a given facility's patient population. The validity of these efforts can be questioned on two grounds. First, patient status is difficult to measure for inclusion in cost functions. Second, it may not be valid to assume that the "product" of nursing homes varies systematically with the patient mix served. The key issue here is variation in quality of care across facilities.

TABLE 5

Effect of Certified Level of Care

Study, Dependent Variable	Independent Variables[1]	Effect
Average Total Cost		
Ruchlin and Levy	Certified for Medicare	+ $1.55
Mennemeyer	SNF	+ $13.48 to + $14.94
Bishop (1980)	Proportion SNF beds	+ $2.27
	Proportion Medicare certified beds	+ $1.33
	Mixed SNF-ICF	Insignificant
Average Operating Cost		
Ries and Christianson	Proportion SNF beds	+ $5.54
Walsh	Proportion SNF patients	+ $3.02
Jensen and Birnbaum	SNF	+ $2.13
	Mixed SNF-ICF	Insignificant
Lee and Birnbaum	SNF	+ $8.82 to + $11.20
	Mixed SNF-ICF	− $1.79
Bishop (1979)	Proportion SNF beds	+ $4.24 to + $5.77
	Proportion Medicare certified beds	+ $3.19 to + $3.97
	Mixed SNF-ICF	+ $ .80 to + $1.33
Private Price		
Deane and Skinner	Certified for Medicare	+ $1.87
	SNF, Medicaid only	+ $ .63

[1] Dummy (zero-one) variables or proportion variables are used to indicate level of care and certification. The estimated coefficient of a dummy variable shows the increment in the dependent variable associated with each provider characteristic in comparison with a reference class (for example, *not* certified for Medicare, *not* SNF, *not* mixed SNF-ICF). The coefficient of a proportion variable shows the effect of varying the proportion of beds or patients with certain characteristics from zero to one. For example, a coefficient for the proportion of SNF beds equal to + 2.27 shows average cost for a facility with 100 percent SNF beds will be higher by $2.27 than that of a facility with no SNF beds; a facility with 50 percent SNF beds will have cost higher by .5 × $2.27 = $1.14, and so on.

TABLE 6

Effect of Service Variables

Study, Dependent Variable	Independent Variables[1]: Service Availability in Facility	Service Delivered to Patients	Nursing Service Intensity
Average Total Cost			
Bishop (1980)	Proportion beds in rooms of four sizes: significant		Nursing hours per patient day: + $4.58 per hour
Average Operating Cost			
Jensen and Birnbaum	7 offered services significant as a group; for example: Occupational therapy (OT): + $ .86 Physical therapy (PT): + $ .91 Proportion of beds in rooms of 3 sizes: insignificant	13 variables representing percent receiving specific services: insignificant as a group	
Lee and Birnbaum	7 offered services: insignificant Percent beds in single rooms: + $ .03	8 variables representing number of services by type per patient day: significant as a group; e.g., + $3.14 per PT visit per patient day	
Bishop (1979)	PT: + $. 85 Proportion beds in rooms with one, two, three, or four + beds: significant; cost decreases as number of patients per room increases		
Lee *et al.*	Proportion beds in rooms of three sizes: significant	Index of services delivered: significant	Nursing hours per patient day: + $3.29 per hour
Private Price			
Deane and Skinner	OT: + $1.17 Speech and hearing therapy: + $1.14 Average beds per room: price decreases over 3 average size groups.	Receives PT: + $ .99 Patient in a private room: + $1.45	Licensed nurses per 100 residents: + $ .21 per nurse Nurse aides per 100 residents: + $ .16 per aide

[1] The variables used to indicate services are dummy (zero-one) variables showing the presence of a service and continuous variables showing proportions of beds or patients or service intensity (for example, number of nursing hours per patient day). The reported coefficient for a dummy variable shows the increment in the dependent variable associated with the presence of the service; for a continuous variable, the coefficient shows the change per unit increase in service intensity.

To deal with case-mix measurement, some researchers have developed indices of patient status from the patient-related data available to them, while others have tried to keep patient mix indicators as disaggregated and complete as possible, despite limited data. Including an index of patient status in a linear cost regression assumes a linear relationship between the index and the cost of care: a one unit increase from an index of 11 to an index of 12 must have the same impact on cost as an increase from 111 to 112. For example, cost will probably increase with a case-mix index constructed from the sum of patient dependencies in activities of daily living (ADL), so that the econometric cost function will show a significant positive relationship between cost and such an index. However, the addition to costs entailed in caring for a patient dependent in five ADL categories may be more than five times the additional cost needed for a patient with one dependency.[12] Further, the facility average of individual patient indices may not be a good independent variable since the combined effect of a mix of patient types on cost is unlikely to be additive.[13] In sum, even a "perfect" index that correctly ranks patients from least to most needy might not effectively hold case-mix constant, and is unlikely to capture accurately the effect on cost of case-mix differences. Cost studies have not adequately tested their assumptions about the relationship between case-mix measures and cost.

Grouping patients according to an index (Deane and Skinner) allows for some nonlinearity, but subsumes much information that may be valuable in predicting cost. All available information on patients may be used by including the proportions of patients with certain characteristics as independent variables (Jensen and Birnbaum, Mennemeyer, and others). While the question of nonadditive interaction effects still applies, this approach allows estimation of the incremental costs of patients with particular disabilities or diagnoses. However, these are difficult to interpret. Since patients will tend to appear with certain clusters of diagnoses and dependencies, the use of all information will include redundant variables, making it difficult to estimate the independent effect on cost of any one patient characteristic. This problem is not solved by selecting only significant patient descriptors for inclusion, as has been done by some researchers, since it is not clear what clusters of variables the significant variables represent.[14]

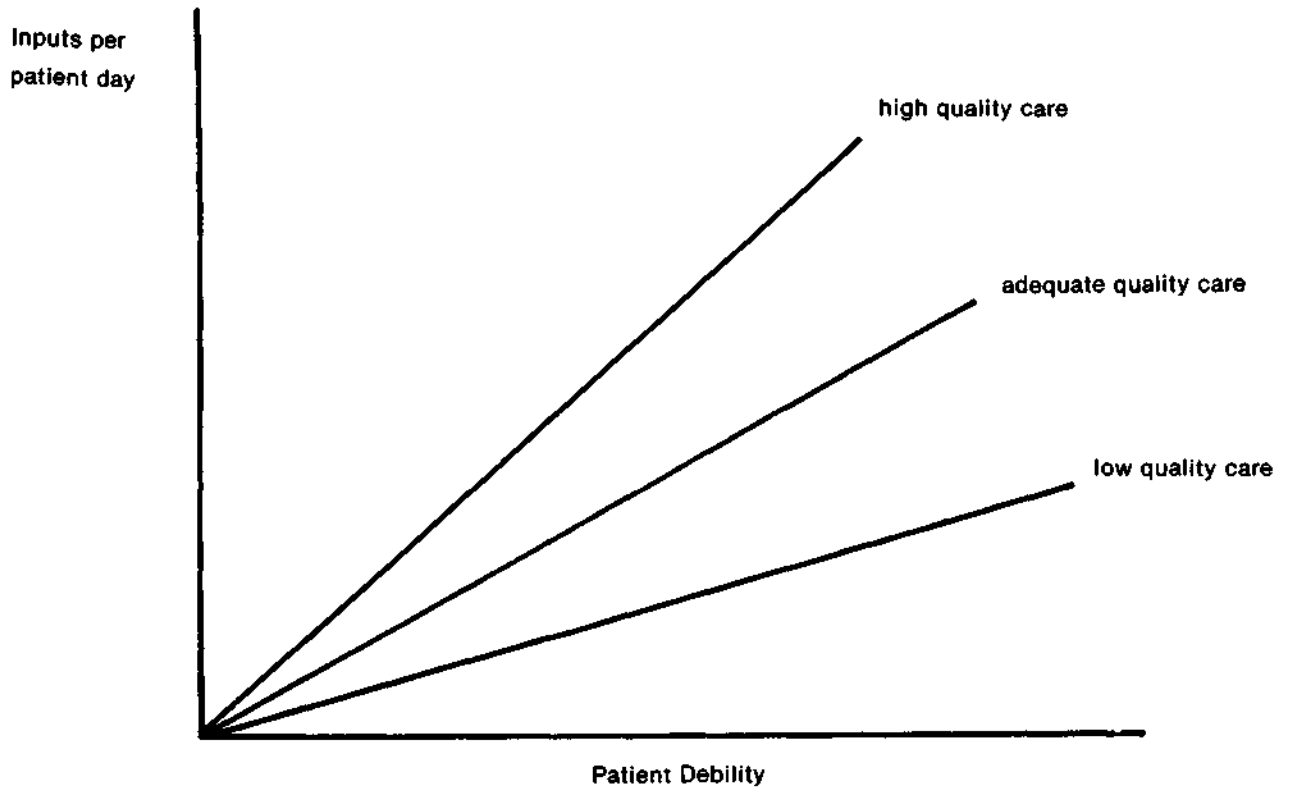
A more serious issue is raised when one considers whether patient health status actually affects the services provided by a facility in a direct way. The assumption underlying inclusion of patient characteristics in the cost function is that a day of care provided to a very sick patient, or to one with a certain condition or diagnosis, is a systematically different product from care provided to a patient with few disabling conditions and illnesses. Logically, this also implies that a patient with certain characteristics will receive similar care in any nursing home. This does not appear to be true. Journalists and legislative hearings (Mendelson, 1974; Townsend, 1971; U.S. Senate Special Committee on Aging, 1974; New York Moreland Act Commission, 1976) have focused national attention on the wide variation in nursing home care. Direct research on nursing home production methods supports the insights of these observers: a patient with a given diagnosis and level of dependence is likely to receive quite different care in the various facilities across this spectrum (McCaffree, Winn, and Bennett, 1976; Mitchell, 1978; and Kane *et al.*, 1979). It may be that providers with high levels of resource input per patient day, given patient status, are providing better care, but it is also possible that the low input homes are more efficient and less wasteful in producing care. Unfortunately, there are as yet no valid outcome indicators that might be used to explore these issues and to describe the product of nursing home care for cost function research. A highly simplified hypothetical model of this problem is shown in Figure 1 (Bishop, Reagan, and Birnbaum, 1977; Willemain, Bishop and Plough, 1980). The three lines show hypothetical relationships between patient debility and inputs per patient day for three levels of quality of care. If the debility of the patient mix increases, all three types of facilities will increase the

[12] Alternatively, additional dependencies might have progressively lower incremental cost, so that care of a patient with five dependencies would add less than five times as much to cost as a patient with one dependency.

[13] For example, the cost of caring for 100 patients with two ADL dependencies (index 2) may be different from the cost of caring for 25 patients with index 5 and 75 patients with index 1; both patient populations have average dependency levels equal to 2.

[14] See individual studies for methodological discussion of patient descriptor variables and index construction. Birnbaum et al., 1979, Volume II, pp. T-4-46 to T-4-49 is especially useful. A further problem with patient mix variables is that data may be available for only a sample of patients from a facility. The proportion of patients with a certain diagnosis or level of functional disability found in a random sample of patients is an unbiased estimate of the proportion of patients in the facility with that diagnosis or disability, but the variance of this estimate depends on the true proportions in the facility and on the number sampled. Use of the sample proportion as an independent variable to represent case-mix opens the regression analysis to a classic "errors in variables" problem (Kmenta, 1971, pp. 315-316). True positive coefficients are biased downward and true negative coefficients upward, in other words, toward zero and insignificance. Thus it is not surprising that studies using sample patient mix proportions in this way have found little significant effect for patient descriptors. This problem will continue to plague studies of facility cross-sections from the National Center for Health Statistics Nursing Home Surveys, 1973 and 1977, which sample at most 10 patients from a facility's population on one day during the year. The problem is less severe for studies which use patient proportions from a complete (as opposed to sampled) one-day census of a facility to stand for the case-mix for the patient days provided during a year of nursing home services.

FIGURE 1



amount of care inputs, and thus costs, but by differing amounts. The statistical relationship between patient debility and cost per patient day depends on the mix in the sample of high, medium, and low quality facilities. The situation would be confused still further if there were significant correlation between quality and patient status, for example, if high quality facilities were able to select less disabled patients. Since most cost analyses have not included independent quality indicators among the product descriptors, any systematic relationship found between case-mix and cost is an average over high, medium, and low quality facilities. The interpretation and implementation of the research results on case-mix are therefore problematic: a nursing home whose costs are high relative to the predicted cost for its case-mix may indeed be inefficient or wasteful in providing care, but it may also be providing care of higher than average quality.

Two cost studies that include both direct quality indicators and case-mix have found results consistent with the prevalent belief that higher quality care requires more care inputs and thus costs more.[15] Walsh found a significantly positive relationship between average cost and a quality index that included information from licensure inspections, medical review, and consumer complaints; Lee and Birnbaum found a significantly lower cost (-$1.87 to -$2.16 per patient day) for facilities rated as lower quality ("needs improvement") by inspectors. These two studies also found significant relationships between case-mix variables and cost, once quality was held constant.

To summarize, patient characteristics have been difficult to describe in a manner useful for cost function estimation. More important, quality of care has typically not been held constant in studies of nursing home cost, so the estimated incremental cost of caring for a particular type of patient can only show the cost of some kind of average care. The reader must bear these caveats in mind while considering the study findings reported in Table 7.

[15] Christianson (1977) found that the number of licensing violations had no significant effect on average cost per patient day; the study did not hold case-mix constant.

TABLE 7

Effect of Patient Characteristics

Study, Dependent Variable	Independent Variable	Effect
Average Total Cost		
Mennemeyer	Needs assistance in breathing	Positive
	Age	Insignificant
Bishop (1980)	Age, diagnoses, and activities of daily living (ADL) variables had significant effects on nursing hours, which in turn affected cost.	
Average Operating Cost		
Walsh	Average point score for patients in facility; points based on aspects of patient assessment, weighted by judgments about relative cost effects	Nonlinear relationship: cost increases at a decreasing rate with point score
Jensen and Birnbaum	ADL	Insignificant
	Diagnoses	Significant
	Mental status	Depressed patients add significantly to cost
Lee and Birnbaum	ADL	Significant
	Age	Insignificant
Bishop (1979)	Proportion nonambulatory	Positive
	Diagnoses	Insignificant
	Age	Oldest elderly add to cost
Private Price		
Deane and Skinner	3 disability groups based on ADL index	Price increases with disability

Patient Turnover

Average length of stay may be seen as a patient characteristic variable, distinguishing short-stay patients recuperating from acute illnesses or needing rehabilitation from those requiring long-stay chronic nursing and personal care. Such a variable also may be seen as describing the type of care (maintenance or rehabilitation) and discharge policies of the facility. In addition, this variable may stand in for source of funding for patients, if a patient with a given number of days of third party coverage is likely to be discharged before the limit is reached. Studies have shown high patient turnover to be associated with higher per diem cost, whether because of fixed costs per admission (administrative costs, high cost of early days of care) or because of patient and care type (Table 8).

Source of Payment

Conceptually, the source of payment for a given patient should not be used as a product descriptor unless patient needs or care provided are believed to vary systematically by payment source. In reality, however, a facility's product type may vary by whether it serves mainly private or public (Medicaid) patients, or a mix. Walsh included proportion by payment source to indicate amenity level differences in the care provided by facilities, and similar reasoning is used by Ruchlin and Levy and by Mennemeyer. Other studies (Jensen and Birnbaum, Lee and Birnbaum, Bishop, 1979) include the percent private pay to indicate the effect of rate-setting, utilization review, and standard enforcement in facilities serving many public patients.

TABLE 8

Effect of Admission Rate

Study, Dependent Variable	Estimated Coefficient[1] for Admissions Per Patient Day	Effect on Average Cost of Additional Admission for Typical Provider
Average Total Cost		
Mennemeyer	$912 to $1720	$.034-.072
Bishop (1980)	$385	$.016
Average Operating Cost		
Jensen and Birnbaum	$419	$.017
Lee and Birnbaum	$342 to $1,050	$.014-.044
Bishop (1979)	$262 to $378	$.011-.016

[1] The coefficient on the variable "admissions per patient day" shows the effect on average cost of increasing the rate of admissions (that is, decreasing the average length of stay). The coefficients can be put into perspective in two ways. First, consider the effect on costs per patient day of an additional admission, which depends on the number of patient days. For the average nursing home surveyed by the National Center for Health Statistics in 1976, providing 23,962 patient days in that year, one more admission would have raised the admission rate from .00302 to .00306 (computed from NCHS, 1979). The effect of such a change on average cost per patient day for the cost studies is shown in the table. Alternatively, consider the effect on total annual costs of one more admission per year, again for the same number of patient days. The estimated equation shows the following relationship:

$$\text{average cost} = \frac{\text{total annual cost}}{\text{patient days per year}} = b \times \frac{\text{annual admissions}}{\text{patient days}} + \text{other factors}$$

where b is the coefficient of the admission rate. Multiplying through by patient days,

$$\text{total annual costs} = b \times \text{annual admissions} + \text{other factors}$$

This implies that one more admission adds $b to total annual costs. These values are shown in the estimated coefficient column.

Findings about the effect of the proportion of public pay patients differ across the studies (Table 9). In both Massachusetts studies (Bishop, 1979 and 1980) and for Illinois (Walsh), per diem costs were lower in public pay oriented homes; in both New York studies (Lee and Birnbaum, Mennemeyer), costs were higher where the percent of publicly supported patients was greater. The coefficient of the payment proportion variable was insignificant in a national study (Jensen and Birnbaum); this is not surprising, since the national results must average out market and regulation effects for States like New York and States like Massachusetts and Illinois.[16]

TABLE 9

Effect of Payment Source

Study, Dependent Variable	Effect per Percentage Point of Patients Supported by Public Programs
Average Total Cost	
Ruchlin and Levy	− $.05
Mennemeyer	+ $.045 to + $.156
Average Operating Cost	
Walsh	− $.83
Jensen and Birnbaum	Insignificant
Lee and Birnbaum	+ $.025 to + $.051
Bishop (1979)	− $.036 to − $.062

[16] The empirical relationship between cost and patient payment source has been an impetus for developing more complete models of nursing home cost and production that include private demand for "extra" amenities and services. Such models offer an intuitive explanation for the varying results of impact of private pay patients. Specifically, a private-pay oriented home may be seen as offering more "extra" inputs than public pay oriented facilities in market areas where private demand is strong, while public rates of payment and input requirements are relatively low, and as offering fewer amenities and services in areas where public input standards are strict and rates are generous compared to private demand for amenities. In comparison to public oriented facilities reimbursed on a cost related basis, private oriented facilities are expected to be more efficient, where efficiency is defined in the strict economic sense of producing their chosen product type (which may include more service intensity and amenities) with less input per unit output.

These perceptions support the incorporation in a multiequation model of a demand relationship depending on local demand factors and on the services provided in the facility, and a rate relationship showing how public rates depend on input use. The provider is seen to choose a mix of patients by payment source and a level of service intensity that is best for his particular situation. Preliminary work with such models has had promising results. Lee *et al.* showed that the number of nursing hours per patient day were strongly related to the percent private pay patients served by a facility; average cost was higher as nursing hours were higher and *lower* as the percent private pay was higher, holding nursing hours constant. This can be interpreted as showing that some of the association between percent private pay and average cost found in simple cost models is due to the association between nursing hours and percent private pay. The negative impact of percent private pay on cost when nursing intensity is held constant lends credence to the idea that participation in the private market encourages efficiency. Bishop (1980) estimates facility demand function coefficients, showing significant private willingness to pay for nursing hours and other amenities; a strong relationship is also demonstrated between percent private pay and nursing hours, holding patient characteristics constant.

THE STATUS OF NURSING HOME COST RESEARCH

Analyses of nursing home costs do not yet provide definitive answers about the determinants of nursing home costs. The data available to researchers has not been ideal, particularly for product descriptors. The measurement of quality of care and the interaction among quality, case-mix, and service intensity are special problems that remain to be solved. Rather than using available variables to capture product variation, future studies may have to define and measure new variables that are better suited to this purpose. Basic questions can also be raised about the straightforward cost models most studies have employed. Observed costs and variation in product and provider type emerge from a complex system, shaped by reimbursement practices, quality standards and other State specific policies, and by private demand conditions. Models that do not recognize these forces, especially if they lack the data to capture product differences directly, will not give a clear picture of the factors that influence nursing home costs. In addition, although this review has not undertaken a thorough methodological critique of cost function research, policymakers considering more direct use of cost analyses should be aware of certain statistical problems. While these may not bar economists from using cost analyses to study the behavior of the nursing home industry, they may add enough uncertainty to cost function results to diminish their utility for policymaking.[17]

Nevertheless, nursing home cost function research has succeeded in confirming that certain variables are associated with nursing home costs in a systematic fashion. These include occupancy rate, ownership and provider type, location, and level of care. Costs also vary with patient mix and services offered, but these relationships are not as consistent; this is to be expected given the theoretical and measurement problems of these product descriptors.

[17] One concern is the validity of statistical inference in such studies. Since cost per patient day is a ratio variable, and therefore likely to have a skewed distribution, regression residuals should be examined for the symmetry presumed in normal inference. Furthermore, since the facility is the unit of analysis in such studies, but facility size typically varies by a factor of about four or five, weighted regression techniques are probably called for to compensate for heteroskedasticity (Kmenta, 1971, pp. 322-336). A second concern has to do with the sensitivity of the regression results to unusual facilities. It may be appropriate to use regression techniques more robust than least-squares when attempting to define "typical" performance. Such techniques include least absolute deviations or iteratively reweighted least squares. Again, examination of regression residuals should serve as a guide to analysis. (I am grateful for these comments to Thomas Willemain, who stresses these caveats in his 1980 consideration of the nursing home cost study literature as an input to new rate-setting systems.)

Implications of Cost Analysis for Rate-Setting

Despite their drawbacks, studies of nursing home costs can provide some information useful for the design of cost-related rates. However, it is important to distinguish technical statistical analysis from policy analysis. Current rates or limits on reimbursable costs for individual providers are often set by grouping providers with similar cost-related characteristics. The cost experience of each group is then used to set cost-related rates. Alternatively, information about the effect on cost of a particular characteristic can be used to adjust rate ceilings to allow higher rates to certain providers, like those in high wage areas or those serving more disabled patients. Grouping or rate adjustment can be based on a wide variety of factors: large versus small providers, nonprofit versus for-profit, urban versus rural, hospital-based versus freestanding, low occupancy versus high occupancy. Cost analyses have demonstrated that these factors are indeed associated with cost differences across providers. However, implicit in grouping and adjustment rules for determining rates is the idea that if a facility's costs exceed the group cost experience, they are unreasonable or excessive, and this cannot be determined by technical cost analysis alone. Reimbursement policymakers must determine which cost related factors are to be used to establish groups or to adjust rates.

It does not make sense to allow rates to vary according to every factor found to influence cost. Some providers experience high average cost because they use resources wastefully, are underutilizing their capacity, or are providing excessive services to patients. It would be inappropriate to use grouping criteria that put inefficient providers into one group and efficient providers in another, and then to reimburse the inefficient high-cost providers at a higher rate in line with their higher group average costs. It would be equally unproductive to allow upward rate adjustments for any factor that is shown by cost analyses to increase average cost. Thus, it is important to choose grouping and adjustment criteria that represent legitimate reasons for higher costs. These criteria can be identified by considering what the public reimbursement program wants to underwrite as a matter of public policy.

Two rationales for grouping and rate adjustments emerge from consideration of existing rate-setting systems. These are reflected in the following two propositions, with examples from actual and proposed rate methods.

1. Rates should be different when the care provided to patients is different.
   - Rates differ by level of care.
   - Rates may differ by patient mix.
   - High quality care may be paid for at higher rates.

2. Allowable costs should be higher for providers who cannot change their high-cost characteristics, when continued provision of care by high-cost providers is deemed desirable.
   - Geographic groupings or adjustments allow higher costs in high-wage areas, since wide geographic distribution of nursing home care is required for access of patients to care.
   - Because of inflation in construction costs, new facilities have higher allowable capital expenses than similar, older facilities.
   - Rates for large and small facilities may be different, implying public support for size diversity of providers.
   - Nonprofit, government-operated, and hospital-based facilities may have higher cost ceilings, implying support for ownership diversity.

Statistical analysis of the determinants of nursing home cost can only show that certain provider characteristics vary with average costs. These then become candidates for use as cost-related grouping criteria. By placing high cost providers in separate groups, or by making rate adjustments for certain characteristics, policymakers implicitly choose the provider and service characteristics for which they are willing to pay more and hold providers without these characteristics to lower cost standards. These choices have implications for the future configuration of the nursing home industry as well as for the access of public patients to care, quality of care, and cost containment. It is imperative to recognize that the choice of grouping and rate adjustment criteria is ultimately a public policy choice, not a technical statistical issue. Each cost-related characteristic that could be used to establish rate-setting groups or to adjust rates should be carefully considered in this light.

OCCUPANCY RATE

Although providers with lower occupancy rates have been found to have higher costs (Table 2), it does not make sense to use this provider characteristic as a grouping criterion unless rate-setters wish to support the operation of low occupancy, high cost providers. While this may be appropriate in rural areas where high occupancy may be harder to achieve, in most places there are long queues of patients awaiting nursing home placement (see, for example, Scanlon, 1978 and Dumbaugh and Mackler, 1979), so that providers should be able to reach a high utilization rate in most areas. In fact, to set higher cost ceilings for low occupancy providers while Medicaid patients are queuing for nursing home placement would work against the public policy goal of access to care for public patients. Rate-setters may wish to base their standard for reasonable cost on data from high occupancy homes only or to apply an occupancy penalty to the rates paid to low occupancy providers, but this is the only sense in which occupancy should be used as a grouping or adjustment criterion for rate-setting.

OWNERSHIP, PROVIDER TYPE

Cost studies have revealed that costs differ significantly by ownership (nonprofit, for-profit, government; see Table 3) and that hospital-based units have higher costs. If these characteristics are used as grouping criteria, higher ceilings would apply to higher cost facilities, and lower cost groups would be held to a more stringent cost standard. Before following this grouping strategy, policymakers should carefully consider what they are paying for. The higher cost groups may be providing higher quality care or serving more difficult patients, but they may also be providing care wastefully or serving patients too intensively. Further explanations should be sought for the consistent cost differentials across ownership and provider types. Payment of higher rates to high cost providers encourages their continued participation in the care of public patients, increasing access to diverse types of care, but it may be determined that this diversity of ownership and provider type is not worth its cost.

LOCATION

Cost functions have shown that location has an effect on cost (Table 4) so that a State rate-setting authority would be well-advised to determine how location affects cost within its State. Locational groupings can be established to set different rate ceilings where costs differ significantly across areas, and urban-rural groups may also be used. Alternatively, the finding that wage rates and other input prices that vary with location have a significant effect on average cost can argue for the adjustment of ceilings across areas, as is done in recent Medicare regulations (USDHEW, 1979). Although it may be expensive to allow higher rates to providers in high cost areas, this policy acts to increase access to care across geographic regions.

LEVEL OF CARE

Providers supplying SNF services have been found to incur significantly higher costs per patient day than ICF or other providers (Table 5). Public programs have been willing to pay higher rates for SNF care, a more intensive service provided to patients with more nursing needs. However, the SNF-ICF distinction is clearly not a stable product definition appropriate for use across the nation: the estimated SNF-ICF cost differentials vary among State studies, and direct studies of production methods and State regulations have shown that the SNF and ICF designations mean different things in different States. This means that each State rate-setting authority should develop its own analysis of the association between level of care and cost in its State, rather than using rate ceilings based on national data.

SERVICES, PATIENT MIX

Since important questions with respect to the effect of patient mix, services, and quality on costs remain unanswered, cost function research does not yet provide a solid basis for grouping facilities or adjusting their rates according to the needs of the patients they serve. The fact remains that providers do vary in their quality of care, the intensity of service they offer, and the needs of their patients. If rates are based on the cost experience of provider groups divided by level of care and location only, some nursing homes that provide necessary care to unusual patients will be penalized. This may act to contain total State expenditure on nursing home care but will work against the goals of improved quality and access to care for public patients, especially those with special needs. In a larger sense, rate methods that set rates for groups of facilities without regard to variation in their patients and services may actually work against cost containment by failing to encourage efficiency. Ideally, a rate-setting system should seek a screen for the production cost of the varying "products" of the nursing home industry, based on the concept of efficient provision of appropriate care. Such a screen would recognize that appropriate care for certain types of patients does cost more but would prevent reimbursement for excess or wasted resources. Providers serving less disabled patients or offering a less intensive service package may appropriately be held to a lower rate ceiling. Unfortunately, current cost function research cannot be used to distinguish high cost providers who are inefficient in producing a specific "product" from those whose costs are high because of a more needy patient mix or a more desirable (higher quality) service package.

Until more is known about the relationship between cost and such product characteristics as patient status, quality of care, and service availability and utilization, rate-setting authorities concerned with quality and access, as well as budget control, are choosing between two methods of adjusting for these factors, neither relying on cost analysis. First, ceilings for patient-related costs can be set at generous levels, in effect assuming that the care resources actually provided are appropriate and efficient. Under such a system, providers with higher patient care costs are reimbursed at higher rates. Second, an individualized budget review or an exceptions process may be established so that facilities serving especially difficult patients or providing very intensive services may request more generous ceilings. Eventually, however, rate-setters must decide how much bigger these exceptional ceilings will be and should also consider holding providers with less difficult patients and less intensive services to a more stringent cost standard. Future nursing home cost research will be valuable to rate-setting authorities if it can focus more effectively on the costs of efficient provision of nursing home care appropriate to patient needs.

CONCLUSIONS

Nursing home reimbursement policy can play a fundamental role in achieving long-term care goals, including access of patients to care, provision of high quality care, and containment of costs. It also affects the distribution of the nursing home industry by provider type, location, service offerings, and patient mix. Since by Federal statute, Medicaid reimbursement rates must be "reasonable cost related," econometric analyses of the determinants of nursing home costs can be useful to rate-setters by indicating characteristics of providers and services associated with cost differences. In addition, since cost studies show differences across States on the impacts of cost-related factors, assessment of cost determinants in particular States may require individual State analyses; these can be based on the foundation provided by the cost literature.

While the importance of some cost factors has been confirmed by cost function analysis, uncertainty remains about the costs of efficient, effective nursing home care. It is hoped that future cost research will use better data and develop more complete models, so that the production costs of various types of nursing home care can be better understood. Further, models that include the response of nursing homes to reimbursement policy may eventually allow States to simulate the cost and other outcomes of alternative rate policies. Nevertheless, the design of reimbursement systems must ultimately be founded not on technical information but on public policy goals for long-term care.

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