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Does the Average Cost of Home Health Care Vary with Case Mix?

JOHN A. NYMAN, PhD
MARY ANNE SVETLIK, PhD

Dr. Nyman is an Assistant Professor with the Division of Health Services Research and Policy, University of Minnesota. Dr. Svetlik is a Lieutenant Colonel with the Medical Service Corps, U.S. Army.

Tearsheet requests to Dr. Nyman, University of Minnesota School of Public Health, 420 Delaware St., S.E., Box 729, Minneapolis, MN 55455-0392.

Synopsis

The relationship between the average cost of home health care and the case mix of patients served by the home health agency is investigated using 1983 data from Wisconsin's home health care agencies. In contrast to previous work, case mix is shown to have a significant effect on the home health agency's average costs. The methods used in the previous work are evaluated, and differences between the earlier study and the present study are discussed to explain the divergent results. Also, average costs are shown to decrease with output, to increase with the proportion of private patients served by the agency, and to be higher if the home health agency is located in an urban area or if it has a proprietary charter.

The implications of this research for the design of an appropriate home health reimbursement policy are discussed. Primarily, it is argued that, although future research might confirm the relationship between average costs and case mix for home health agencies, we cannot necessarily conclude that reimbursement rates must be adjusted to account for differences in case mix as many States are now doing for nursing home reimbursement. Policies must take into account the fundamental differences between home health agencies and nursing homes, and their respective markets, in order to be effective.

ALTHOUGH A LARGE NUMBER of articles have investigated the determinants of average costs of nursing homes, the health services literature has almost totally neglected similar "cost function" research with regard to home health agencies. This neglect is somewhat surprising since many of the

issues motivating such research in nursing homes apply to home health agencies as well. For example, the degree to which both nursing homes and home health agencies experience cost decreases as their output increases (that is, the degree to which they experience economies of scale) is important in determining the ability of competing firms to enter markets on the same cost footing as existing firms. Economies of scale also have implications for reimbursement policy: if average costs decrease as more output is produced, relatively low prospective reimbursement payments might favor large operations, driving smaller volume firms out of the markets.

Another area of interest is the relationship between average costs and the charter status of the firm. In the nursing home literature, proprietary homes have often been accused of scrimping on services in order to reduce costs and increase profits. The same might be expected of proprietary home health agencies.

Still another issue shared by these two types of health care firms is whether prospective reimbursement payments to home health agencies for Medicare and Medicaid patients should be adjusted for case mix. Because a number of States have adopted or are considering the adoption of prospective case-adjusted Medicaid reimbursement payments for nursing home care, interest is growing in case-adjusted reimbursement of home health care. However, in contrast to the nursing home cost function studies—many of which have shown evidence of a direct relationship between average nursing home costs and the dependency of the patient case mix—the sole existing study to estimate the relationship between home health agency costs per visit and case mix concluded that there was little evidence to suggest that costs were directly related to the degree of dependency of the patient (*1*). (Four other studies (*2–5*) have investigated this relationship, but none of these has used the firm as the unit of observation to estimate a "cost function" relationship as is conventionally found in the nursing home literature.) This counterintuitive finding would suggest that there is little need for proposals (*6*) to pay home health agencies higher reimbursements when they care for more dependent clients.

In a larger sense, the current interest in home health agencies as a potentially less costly or more beneficial alternative to nursing home care dictates that we learn as much as possible about these firms before policies are enacted. Nursing home policy has been accused of being made without a complete or accurate picture of how nursing homes behave when faced with various public policies. Policymakers have mistakenly assumed that nursing homes were simply miniature hospitals and that the same sorts of policies were applicable, often with unintended results (*7*). Similarly, it would be a mistake to assume that it is appropriate to apply nursing home policies to home health agencies, unless it is known that such policies fit the specific characteristics of these firms and their markets. Therefore, basic research into the general behavior of these firms is crucial.

The remainder of this paper is organized into three sections. In the first section, a model of the home health agency cost function is developed based on standard economic determinants of a firm's average costs. In the second section, this function is estimated using 1983 Wisconsin data and the results are reported. And in the final section, the policy implications are discussed.

Model

Regression analysis was used to identify the significant determinants of average home health agency costs. Average costs, the dependent variable, was represented by the cost per home health care visit. This variable was constructed by dividing each home health agency's total 1983 expenditures—both payroll and nonpayroll (Wisconsin's distinction)—by the total number of visits during 1983. Because some agencies kept hourly data on the amount of homemaker services delivered, this information was converted to the number of visits by arbitrarily assuming that 1 hour of homemaker services equalled one visit. This specification of the dependent variable seemed the most appropriate for our purposes since it is consistent with the unit of service by which home health agencies are currently being paid. That is, both private and public patients pay on a per visit basis, rather than per case. Furthermore, existing prospective case-adjusted reimbursement systems for nursing home pay on a per diem, rather than per case, basis. If the case-adjusted reimbursement systems for nursing homes serve as a model, prospective home health reimbursement rates are also likely to be set on a per visit basis. Therefore, the dependent variable was specified as average costs per visit.

The choice of independent variables to include in the regression was dictated by the issues to be investigated. The first of these issues is whether economies of scale are present for home health agencies. To test whether economies of scale exist,

the number of visits and the number of visits squared were included in the regression. If economies are present, average costs of production should decrease as more visits are made. The squared visits term was included to test for an upward sloping section of the average cost curve. A positive coefficient would indicate that, beyond some point, average costs increase with the number of vists; that is, diseconomies of scale occur. Together, both variables permit the calculation of the minimum point on this cost function, if evidence suggests that one exists.

In the sole existing study to investigate the relationship between agency costs and case mix, Hay and Mandes (*1*) concluded that there was little evidence that such a relationship exists. To try to replicate these counterintuitive results, a case-mix variable was included in the regression.

Case mix was represented by a variable constructed from activities of daily living (ADL) scores for patients served by the agency on a certain date. Specifically, the number of ADLs (bathing, continence of bowels, continence of bladder, mobility, dressing, feeding, toileting, transferring from bed to chair) with which patients needed help was assumed for all patients served by the agency on a certain day. This number was then divided by the number of patients served on that day to derive a variable that represented the average ADL score of the agency's clientele. ADL scores were used instead of other measures (such as instrumental activities of daily living scores) because ADLs seem to be a more widely accepted measures of case mix. For example, they are the basis for patient classification under New York's experimental reimbursement system for nursing homes—resource utilization groups. ADLs also seem more consistent with the skilled nursing case-mix concept that Hay and Mandes' attempt to capture since they are more related to the relative medical dependencies of patients. It was hypothesized that higher ADL scores would be associated with higher average costs.

Home health agencies provide a number of different services. Because the costs of producing these various services may differ, it is necessary to control for different outputs in some way. One way is simply to focus on one type of output. For example, the average cost of skilled nursing care might be regressed on the number of skilled nursing visits and visits squared, the case mix of the skilled nursing patients, and so forth. One problem with this approach is that it does not allow for the possibility that, if the volume of visits is sufficiently large, workers can specialize in delivering one or two types of services. Simply regressing the average costs of skilled care on the number of skilled nursing visits may not capture the effect that more visits of all types might have on the costs of a skilled nursing visit through specialization. Similarly, this approach also does not capture how fixed costs are spread over all types of visits. Both the specialization of labor and spreading of fixed costs are important in determining whether prospective reimbursement payments should be set lower for larger agencies.

An alternative approach to controlling for the type of output is to include variables that represent the percentage of visits devoted to providing different services in the regression equation. Following this approach, the percentage of the agency's visits that were devoted to homemaker services and the percentage devoted to skilled nursing care were included in the regression as separate variables. Although these were only two of seven categories of therapeutic care for which Wisconsin collected information (the other five categories were physical therapy, speech pathology, occupational therapy, medical social service, and other service), they accounted for 88 percent of all visits (*8*). The other categories of services accounted for uniformly small proportions of visits, and were added together and viewed as a residual percentage for that reason. With this approach, the regression statistics will reflect a more accurate picture of the relationship between average costs and output, and therefore a more accurate picture of whether economies of scale exist.

Average costs also depend on the prices of the inputs used. It is assumed that prices of inputs are higher in large metropolitan areas. Consequently, a dummy variable was constructed representing whether the agency served one of the five most populous counties in the State, namely, Milwaukee, Dane, Waukesha, Brown, and Racine Counties. These counties represent the Milwaukee, Madison, and Green Bay urban areas. Costs are expected to increase with this variable.

Finally, two variables were included because the average amounts reimbursed for patients in these categories were so great. The total bill for each patient served during the 1983 fiscal year averaged $794 (*8*). If the patient was paid for by Medicare, the average total bill was $753; by Medicaid, $831; and by private sources, $1,062. When broken down by agency ownership, government agencies averaged $512 per patient in revenues; nonprofit agencies, $674; and proprietary agencies, $2,095. Con-

Table 1. Costs and patient statistics for 83 home health agencies, Wisconsin 1983

Variable	Mean	Standard deviation
Average costs	$35.086	16.683
Total visits	7890.800	13568.406
Average ADL score	2.303	0.965
Home health aide visits (as percent of all visits)	44.050	19.659
Skilled nursing visits (as percent of all visits)	45.934	20.098
Urban	0.188	0.393
Proprietary	0.213	0.412
Private pay patients (as percent of all patients)	19.404	21.039

Table 2. Results of regression with average costs (total costs per visit) as dependent variable for 83 home health agencies, Wisconsin 1983 [1]

Independent variable	Coefficient	Standard error	Significance level
Intercept	17.218	14.532	.2399
Total visits	-0.0013	0.0006	.0390
Total visits squared	5.12E-09	6.90E-09	.4605
Average ADL score	5.733	2.839	.0471
Percent home health aide visits	-19.961	17.684	.2626
Percent skilled nursing visits	30.331	18.409	.1037
Urban	17.818	7.293	.0169
Proprietary	15.437	8.351	.0685
Percent private pay patients	29.139	14.341	.0458

[1] R^2 = .38, F value = 5.797.

sidering only private source revenues, government agencies received $317 per patient; nonprofits, $546; and proprietaries averaged $3,531.

In view of these great differences in revenues for patients served by proprietary firms and for patients paying from private sources, it would be interesting to see whether higher costs could be attributed to firms with these characteristics. Accordingly, two variables, one representing whether the firm is proprietary and the other measuring the percentage of private patients served during the 1983 fiscal year, were included in the regression. Positive signs here would indicate that these higher revenues were to some extent explained by higher average costs.

Results

The data for this study come from Wisconsin's first Annual Survey of Home Health Agencies. This survey, like a similar one for nursing homes, must be completed by all agencies as part of the annual requirements for licensure in Wisconsin. Although 121 agencies provided sufficient information to be included in the data file, missing data constrained the sample to 83 agencies.

Three different periods are represented in the data. Some variables, such as the total number of visits, were collected for calendar year 1983. Financial data, such as total revenues and total expenses, were collected for the firms' 1983 fiscal year, and data on client characteristics, such as activities of daily living, were collected for patients served on May 1, 1984. Relating the characteristics of patients served on a certain day to firm characteristics collected over an entire year is a common problem in health research. One test of its acceptability will be the degree to which the regression results reflect expectations.

Descriptive statistics are reported in table 1 and the results for the following regression equation appear in table 2:

$$\begin{aligned} \textit{average costs} = {} & \alpha + \beta_1 \textit{ visits} + \beta_2 \textit{ (total visits)}^2 \\ & + \beta_3 \textit{ average ADL score} \\ & + \beta_4 \textit{ percent home health aide visits} \\ & + \beta_5 \textit{ percent skilled nursing visits} \\ & + \beta_6 \textit{ urban dummy} + \beta_7 \textit{ proprietary dummy} \\ & + \beta_8 \textit{ percent private patients} + \textit{error.} \end{aligned}$$

Both total visits and visits squared have coefficients with signs indicating the conventional u-shape, although only the negative sign on visits is significant. If we take these numbers literally, the average cost function would reach a minimum at about 126,000 visits. This is much greater than the 7,000 skilled visits reported by Jay and Mandes (*1*). The strength of the negative portion and the statistical weakness of the positive portion, however, suggest that there is no significantly increasing portion of the average cost function. In other words, there may be no diseconomies of scale and no optimal number of visits.

Average costs increase as the average ADL score increases showing greater costs for those agencies serving a more dependent mix of patients. The coefficient is significant at the 5 percent level. This is rather strong evidence that a relationship between average costs and case mix exists, especially considering that some error must have been introduced by the fact that the total expenditure data were collected for fiscal year 1983, total visits were

collected for calendar year 1983, and the ADL score for those people served on May 1, 1984.

The percentage of visits categorized as home health aide visits was negatively, but not significantly, related to costs. The percentage of visits classified as skilled nursing was positively, but again not significantly, associated with costs. These results occurred despite the absence of any evidence that multicollinearity had affected the estimates.

As expected, agencies located in high-wage urban areas also experienced significantly higher average costs. The final two variables had positive, significant coefficients revealing that proprietary agencies and agencies serving a large percentage of private patients did have significantly greater costs.

Conclusions

The evidence suggests that diseconomies of scale may not be associated with this industry. This is inconsistent with Hay and Mandes' (*1*) finding of substantial diseconomies of scale, but consistent with Kass' (*9*) finding that the cost function is virtually flat for firms producing near the mean. On the other hand, it seems likely from all the evidence that there is some initial range of output where average costs are decreasing. Both these effects taken together suggest that, if payments for publicly supported users of home health services are the same for all firms, profits are likely to be greater for larger agencies than smaller ones.

The significance of the proprietary and percent private pay patients variables in the equation helps to explain why patients served by proprietary homes and private patients pay so much for care. This, of course, does not rule out other explanations.

This paper presents evidence that a home health agency's case mix, measured by the number of dependencies per patient, is related to average costs. As mentioned, this finding is contrary to the conclusions of Hay and Mandes (*1*), the only other cost function study to address the question of whether agency costs vary with case mix. Differences in the methods of the two studies, however, may account for the different results.

Hay and Mandes (*1*) postulate a total cost function where the dependent variable is the total skilled nursing costs for an agency during a year. They regress this variable on output (measured by the number of skilled nursing visits in that year) and output squared to determine the shape of the firm's average cost curve. To test whether costs vary with the case mix, they include variables representing the shares of all costs that are devoted to various cost categories. They hypothesize that agencies serving more severely incapacitated patients will have a larger percentage of expenses devoted to indirect inputs (administration, clerical staff, office space, transportation, and office expenses) than to direct inputs (nursing inputs and medical supplies). Therefore, if the total costs increase with the percentage of costs devoted to indirect input categories and decrease with the percentage of costs in direct input categories, these relationships would indicate that costs are increasing with the severity of the agency's case mix.

'If future research shows more conclusively that home health agency costs do increase with the dependency of the patient, this finding would suggest that a prospective payment system based on the case mix would be "fairer" and perhaps a more efficient use of government funds than a flat rate per visit.'

Hay and Mandes base their conclusion that case mix probably is not related to costs on two results: the general insignificance of the cost share variables and the high R^2. Both pieces of evidence may, however, be influenced by the specification of their model.

Regarding the insignificance of the cost share variables, the assumed relationship between severity of case mix and the share of costs devoted to *indirect* costs is not intuitively obvious. Severity of case mix could reasonably be associated with a larger share of *direct* nursing and medical supply costs instead. For example, it seems just as likely that severely incapacitated patients would be long-term patients; therefore, the initial administrative and processing portion of their costs would be relatively small compared with the direct care portion.

Furthermore, even if it were true that the percentage of indirect costs was a good proxy for the case mix of the agency's clientele as hypothesized, their specification of this case-mix proxy variable might account for the lack of significance. The authors include five variables to represent the relative amount of indirect costs in their regression equation. Indeed, since indirect cost is a dichotomous variable, the sole direct cost variable—the

share of costs going toward medical supplies—also measures (negatively) indirect costs. As a result, the authors are measuring the same underlying theoretical construct with six variables. If these are all related to case mix (as is their contention), they are all theoretically correlated with each other, and multicollinearity may have been introduced into the equation. If the degree of multicollinearity is sufficiently large, it may render otherwise significant coefficients insignificant. If the case-mix variable is intended to be whether the home health agency's costs are indirect or not, then the most appropriate specification would be to include only one case-mix variable: the portion of all costs in the agency that are indirect.

Regarding the high R^2, Hay and Mandes argue that an R^2 of 96 percent implies that patient case-mix characteristics can at most account for only 4 percent of agency cost variation. Clearly, this conclusion does not permit the possibility that case mix is correlated with one of the included independent variables and is indirectly accounting for a portion of the explained variation. Moreover, their R^2 may also have been influenced by the total cost specification of their regression equation. That is, total costs must increase with output since an additional unit of output requires more resources, and these resources are not free. On the other hand, it is not clear whether average cost will increase or decrease with output. On the basis of specification alone, one might expect that a total cost function might have a higher R^2 than an average cost function. Therefore, their conclusion that at most only 4 percent of cost variation could be attributable to any omitted case-mix variables may be sensitive to their choice of dimension for the cost variable.

In addition, there are other studies that do not employ a cost function analysis, but nevertheless present evidence suggesting that costs increase with the dependency of the patient. For example, Manton and Hausner (*5*) show that patient dependency indices can be constructed that are significantly related to the reimbursement payments to home health agencies. Since these reimbursements reflect costs to some degree, we can reasonably conclude that this study also indicates that a firm's expenditures increase with case mix as measured by these indices.

If future research shows more conclusively that home health agency costs do increase with the dependency of the patient, this finding would suggest that a prospective payment system based on the case mix would be "fairer" and perhaps a more efficient use of government funds than a flat rate per visit. It does not, however, necessarily indicate that a case-mix reimbursement system is required to counter possible "cream skimming" on the part of home health agencies, such as occurs in the nursing home care markets. It is important to remember that, while care given by home health agencies may be regarded by some as a substitute for nursing home care, there are many differences between these two institutions and the markets in which they exist. Therefore, although nursing homes may choose among prospective patients on the basis of patient characteristics, it is not necessarily true that home health agencies will do the same.

The crucial difference is that many nursing homes face an excess demand for their care. This means that the number of patients they can serve is constrained by the number of beds they have in the short run, and certificate of need laws or construction moratoria in the long run. If there are more patients than beds available, prospectively paid homes with profit-maximizing objectives would naturally opt to serve patients with lower costs. Heavy-care patients would be excluded, even though the prevailing reimbursement rate is sufficient to cover the costs of their care, because nursing homes can make more money caring for the lighter-care patients (*10*, *11*). With home health care, excess demand is less of an issue. If the demand becomes great enough, more care-giving personnel can be hired. Therefore, rather than turn down a customer, home health agencies will serve anyone that requests home health services, regardless of the severity of their incapacity, as long as revenues cover marginal costs. Consequently, cream skimming is not a reason to adopt case-mix reimbursement of home health agencies.

Research into the behavior of home health agencies is in its infancy. Most of the problems with research efforts to date (including those of this paper) can be traced to a lack of good measures for theoretically important variables. If the appropriate measures are not available, then researchers have been forced to use either distant proxies or omit the variable altogether. Clearly, all existing efforts would have benefited from having a more reliable and more comprehensive data set available. Given this lack of data, we can only hope for relatively crude approximations of the real underlying behavior. When these pioneering studies occasionally produce counterintuitive results, they force us to question our assumptions about reality and make further inquiries into the issue. To their

credit, they force us to root our knowledge and policy prescriptions in scientifically supportable evidence. As a result, we are less likely to make major policy errors, and the policies we do make are more likely to be effective.

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Runners' Health Habits, 1985– "The Alameda 7" Revisited

C. A. MACERA, PhD
R. R. PATE, PhD
D. R. DAVIS, BA

Dr. Macera is an Associate Professor and Chairman, and Ms. Davis is a research assistant, Department of Epidemiology and Biostatistics, University of South Carolina School of Public Health; Dr. Pate is a Professor in the Department of Physical Education at the University of South Carolina College of Health.

Tearsheet requests to Dr. Macera, School of Public Health, University of South Carolina, Columbia, SC 29208.

Synopsis

Seven health habits were shown to be associated with longevity in a longitudinal study initiated in Alameda County, CA, in 1965. These habits (drinking moderately, exercising regularly, maintaining desirable weight for height, eating breakfast, not eating snacks, sleeping 7 or 8 hours per day, and never having smoked) were recently examined in a sample of the U.S. population. Subgroups with low income and little education were found to have low frequency of these health habits. In this report, findings on the frequency of these habits in 966 habitual runners in South Carolina are presented separately for men and women and according to age, education, income, and weekly mileage.

Subgroups of the runners are surprisingly similar to subgroups of the national sample for several health habits. In addition, among the runners, low-income groups and those with little education have a lower frequency of good health habits relative to the other groups, although these differences are not statistically significant. Overall, about half of the runners practice five or more good health habits. These results indicate that even among healthy runners there is need for improvement in the adoption of health habits thought to be associated with reduced morbidity and mortality.

IN A 9-YEAR FOLLOWUP to a longitudinal study initiated in 1965 in Alameda County, CA, seven health habits were identified that were associated with physical health status and low mortality (*1,2*). These habits were drinking moderately or not at all, exercising regularly, maintaining desirable weight for height, eating breakfast, not eating snacks, sleeping 7 or 8 hours per day, and never having smoked cigarettes. Researchers in several studies have attempted to describe the frequency of these habits in other populations and to relate these habits to health status. In a recent report on the frequency of the health habits in a sample of United States adults, important differences were