Using Statistics to Find A Reasonable Cost For Medicaid Payments

The statistical method is capable of determining reasonable cost of Medicaid service.

H. Tamura*
University of Washington

Acquiring information is a costly, time consuming part of complex decision making. Because of the favorable ratio of accuracy to cost, statistical methods are important tools for obtaining economical estimates of quantitative information. As a result, they are routinely used to estimate the parameters of a population without recourse to prohibitively expensive census procedures. One fruitful area of application demonstrated in this article, is the estimation of financial information at a lower cost than accounting, where greater accuracy may not justify greater expense.

Rates for nursing home care of welfare patients were developed for the State of Washington to comply with federal and state statutory requirements that became effective in January 1978. Rate setting utilized regression analysis, a commonly used statistical method, to determine the "reasonable cost" of caring for Medicaid patients. This avoided the time and expense of cost accounting of individual cases. The Washington experience suggests that regression analysis may be a useful tool in
NURSING HOMES AND MEDICAID

The nursing home industry has evolved from a collection of small, family-oriented businesses into a network of large firms including nationwide corporations. In addition to medical care and professional nursing services, nursing homes provide personal care such as assistance with dressing, eating, and bathing, as well as assistance in daily activities such as shopping and cleaning.

Medicaid (Title XIX) nursing home services are more homogeneous and inexpensive than Medicare services. These characteristics of Medicaid services make their cost determination more amenable to statistical procedures.

The State of Washington contracts with approximately 270 proprietary, non-profit, and governmental nursing homes to provide care for about 16,000 welfare patients eligible for Medicaid. Combined federal and state funding for this program for the 1978-1979 biennium amounted to $196 million. Contributions from patients, judging mainly from their social security checks, amounted to an additional $59 million, making the total biennium cost of the program approximately $255 million. Both total and per-patient-day contributions from federal and state governments have been rising rapidly. In 1968, total and per-patient-day government contributions were $23.8 million and $5.58, respectively. For 1978 these figures are expected to be $84 million and $15.24. This rate of increase far exceeded the Consumer Price Index, which rose in 1968 from 104.2 to 193.2 for all items and from 106.1 to 217.6 for medical care.

Reasonable Cost Requirements

In addition to licensing and certification of nursing homes, state regulations of the nursing home industry includes annual (or more frequent) formulation of daily rates to be paid by the state for Medicaid patients. In 1972, Congress amended Title XIX of the Social Security Act to require that, effective July 1, 1976, state Medicaid payments be "on a reasonable cost related basis." Regulations to implement the amendment were not published until July 1, 1976, however, and consequently the states were given an additional 18 months to develop complying rate setting systems. In 1977 Washington law mandated that patient characteristics and needs be "computerized" and incorporated into the determination of rates beginning January 1, 1978, based on the assumption that cost is related to level of care.
BASIC FRAMEWORK FOR A RATE-SETTING SYSTEM

Besides economy and ease of maintenance, the parameters for designing a rate setting system are (1) the choice between retrospective and prospective reimbursement, (2) the choice between a flat rate and a cost-related rate, and (3) selection of an appropriate unit of payment, such as patient, specific service, or patient day. A retrospective reimbursement system contains little incentive for cost containment. In the state's former system rates were set prospectively on a per-patient-day basis. Since a flat rate system would violate the new federal regulation that payments "be on a reasonable cost-related basis," it was decided early on that the new state system would be both prospective and cost-related.

Interpretation of Reasonable Cost

Much consideration was given to interpretation of the statutory phrase "reasonable cost." Federal regulations stress flexibility. For example, they state: "The fallacy . . . is the assumption that there is only one method to determine reasonable cost and only one cost figure which is reasonable . . . . A variety of cost-finding methods could be used to determine reasonable cost . . . . Rather than any one figure representing the reasonable cost, each figure within the acceptable range represents a reasonable cost."

COST ACCOUNTING VERSUS STATISTICS

Two approaches might be used to determine reasonable cost. Traditional cost accounting would begin with a detailed specification of services to be purchased by the state for each Medicaid patient. The specification would include per day nursing hours required for patient care, the amount of food to be consumed each day by the patient, and so on. The cost of each service for each home then could be determined, and the per day cost of caring for each patient (PDP cost) could be determined by aggregating their service costs. Traditional cost accounting procedures are currently used for determining Medicare payments, but are too time consuming and costly for Medicaid payments. The state could not feasibly undertake independent time studies for each of the 16,000 Medicaid nursing home patients to determine daily nursing hours required for proper care.

The Department of Health, Education and Welfare apparently appreciated this problem. Its regulations explain that:

the tremendously detailed cost finding requirements under Medicare might be unnecessarily cumbersome and expensive . . . . Instead] States [should] be allowed the maximum possible flexibility in developing cost-related payment methods [as re-
A different approach to determining reasonable cost is based on statistical methods. The underlying principle is that reasonable cost is a relative concept and can be determined from comparisons of costs of different homes. An interval of reasonable cost of daily care is established, therefore, based on truncating both sides of the frequency distribution of PPD cost observed in the past for all nursing homes in the Medicaid program. This approach assumes, however, that on the average, patient care during the sample period complied adequately with federal standards, and that, on the average, nursing homes operated efficiently. The interval of reasonable cost must be adjusted for cost variations attributable to justifiable factors such as individual patient characteristics and needs, and regional price differentials. Cost differences from these sources cannot be controlled by nursing home administrators. At least in the short run.

The statistical approach is simple and inexpensive compared to the traditional cost accounting approach because most needed data are routinely collected by the state. Officials of the Washington State Department of Social and Health Services chose the statistical approach.

**Determination of Cost Centers for Rate Setting**

When applying the statistical approach, an important first step is to determine major categories of cost of nursing home operations. There are two reasons for breaking down the total cost into cost by type of different categories are likely to be influenced by different factors. Greater precision therefore is achieved if a different reasonable cost interval is established for each cost category. Second, if nursing home operators are compensated on the basis of cost categories, rather than a single PPD rate, the state can influence how nursing home operators allocate their resources among categories. When the unit of payment is a patient day, the quality of care may be sacrificed for efficiency.

Differences in the management structures of nursing homes must be taken into account in determining cost categories. Some homes in the Medicaid program operating in rural areas are small—the smallest in Washington operates only ten beds—and retain much of the family-oriented management structure. Each employee’s responsibilities and activities are diverse and loosely defined. There also are large homes with several hundred beds—the largest in Washington has 268 beds—with a systematized management structure in which the responsibilities and activities of employees are narrower and more defined. Cost categories

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<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>Major Cost Components</th>
<th>Proportion of Total Industry Wide Cost</th>
<th>Industry Wide Per Patient Day Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Care (PC)</td>
<td>Salaries, wages, payroll taxes and benefits of nursing staff, nursing supplies</td>
<td>43.75</td>
<td>$ 8.79</td>
</tr>
<tr>
<td></td>
<td>Food</td>
<td>8.50</td>
<td>$ 1.72</td>
</tr>
<tr>
<td>Food (FO)</td>
<td></td>
<td>36.75</td>
<td>$ 7.39</td>
</tr>
<tr>
<td>Administration and Operation (AO)</td>
<td>Salaries, wages, payroll taxes, and benefits of the personal other than nursing staff, all supplies other than nursing supplies, utilities</td>
<td>11.15</td>
<td>$ 2.24</td>
</tr>
</tbody>
</table>

| Property (PR)        | Depreciation, lease expenses, mortgage interest, insurance, property and real estate taxes | 11.15 | $ 2.24 |

**TOTAL** | 100.00 | $ 20.14 |

should be selected which are applicable to all nursing homes, regardless of management structure.

Broadly, total cost may be divided into operating cost and property cost, since it is likely that these two types of cost are influenced by different variables. Operating costs in turn may be broken down into several other major cost categories. The categories that were identified by Washington State are given in Table 1. Food costs do not include the wages and salaries of kitchen staff, because in small homes the same employees may engage in operation of the kitchen as well as in the general administration of the home.

Table 2 is the correlation matrix of the four cost categories based on data from 257 homes. The correlation coefficients between PPD cost of property, and each of the three PPD costs of operation are uniformly small compared to the correlation coefficients among the PPD costs of operation. This supports the hypothesis that the PPD cost of operation and that of property have few cost-influencing factors in common.

Operating costs account for approximately 90 percent of total cost and are measured readily. It is questionable whether property costs can be reasonably measured, however. Federal regulations mandate adherence to generally accepted accounting principles for property cost determination. That is, the acquisition cost and an estimate of the "use-
Table 2
Correlation matrix of PPD costs for four expenditure categories

<table>
<thead>
<tr>
<th></th>
<th>PC</th>
<th>FD</th>
<th>AO</th>
<th>PR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC</td>
<td>1.000</td>
<td>.4736</td>
<td>.6682</td>
<td>.1843</td>
</tr>
<tr>
<td>FD</td>
<td>1.000</td>
<td>.4864</td>
<td>.0553</td>
<td></td>
</tr>
<tr>
<td>AO</td>
<td>1.000</td>
<td></td>
<td>.1396</td>
<td></td>
</tr>
<tr>
<td>PR</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PC: PPD Cost of Patient Care
FD: PPD Cost of Food
AO: PPD Cost of Administration and Operation
PR: PPD Cost of Property

ful" life are the basis for determining the cost of capital consumption. Under present inflationary conditions it is questionable whether the cost of capital consumption calculated in this way is a reasonable measure of the current cost of occupancy. The following discussion therefore concentrates on rate setting procedures for operating costs.

Factors in Rate Differentials
In the short run, three categories of factors justifiably contribute to the variation of PPD cost of operation among homes, and hence should be considered in setting rates:

- Input prices, such as wages and salaries of employees, and prices of supplies

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• Characteristics of the outputs, such as the types of services required for the proper care of the patients in the home
• Physical characteristics of facilities that determine the technology employed in the delivery of services.

These variables cannot be manipulated by nursing home administrators, at least in the short-run. They are exogeneous to management of each home.

For practical reasons the selection of variables in rate setting also is governed by the measurability and the availability of data for each variable. The Office of Nursing Home Affairs collects two major sets of data on an ongoing basis. State law requires each contractor to submit annually a detailed cost report containing the costs of detailed items and the number of patient days. By aggregating costs allocated to each expenditure category and dividing the aggregate by patient days, the PPD cost of each expenditure category can be determined. In addition, federal Medicaid regulations require the state staff of registered nurses to collect data on the medical and functional status of all Medicaid patients. Based on this data, a measure of patient mix can be calculated, which in turn serves as a surrogate measure of the patient care services provided by each home.

Data on the location, number of licensed beds, and certification of each home are maintained by the Office of Nursing Home Affairs. Data on certain physical characteristics of each facility, such as construction date, type of construction, number of stories, and fire detection and protection devices, are maintained by the State Fire Marshall’s Office. Based on these facility characteristics, construction of proxy variables for the technology employed by each home is difficult and admittedly crude. Since federal price and wage indices are not broken down by counties, the location of each home is used as a surrogate measure of input price differentials.

RESULTS OF REGRESSION ANALYSIS ON WASHINGTON DATA

Regression analysis was used to explain the variation of PPD costs with justifiable cost factors. The variables in each regression equation were selected partly on the basis of observations of nursing home operation made during field trips to different homes in Washington State.

Before applying regression analysis, costs were adjusted for inflation to eliminate variations due to homes’ use of different accounting periods, and to project all costs forward to the next fiscal year. Homes with a utilization rate of licensed beds below 85 percent (a policy decision) were deleted from the analysis, since their costs did not reflect normal
A statistical significance level of .20 was used as the criterion to include variables in each equation. Regression equations developed for determination of reasonable cost for rate setting in July, 1978 were:

Patient Care (PPDPC) = 13.5757
- 1.4679 \times KATZADL
+ .4808 \times STORIES
+ 3.0931 \times HOSDUM (R^2 = .471, SE = 1.80),

where PPDPC is PPD cost (in dollars) of patient care predicted by the regression equation. KATZADL is the home's patient mix. A sample of 10 percent of the patients or 10 patients (whichever was greater) was selected from each home, and for each patient the Index of Activities of Daily Living (ADL) was computed. The mean ADL for each home was used as a measure of patient mix of the home. A higher score indicates patients are capable of more daily living functions requiring less care. STORIES are the number of patient floors in the facility (more floors require more nursing stations). HOSDUM is a binary variable identifying hospitals with a certified nursing home component.

Food (PPDFD) = 1.8057
+ .2701 \times SMSAD1
+ .1710 \times SMSAD2
+ .6637 \times HOSDUM (R^2 = .091, SE = .39),

where PPDFD is PPD cost (in dollars) of food predicted by the regression equation. SMSAD1 and SMSAD2 are binary variables identifying counties in Standard Metropolitan Statistical Areas (SMSA).

Administration and operation (PPDAO) = 6.9035
+ .5910 \times STORIES
+ 9.7689 \times HOSDUM
- 1.2643 \times ICFDUM (R^2 = .325, SE = 1.54),

where PPDAO is PPD cost (in dollars) of administration and operation. ICFDUM is a binary variable identifying homes licensed to care for ICF (intermediate as contrasted to skilled care) patients only.

All independent variables were significant at the .01 level except SMSAD2 in the equation for PPDFD; its significance level was .12. The value of R^2 in each regression equation might have been lower had outliers been deleted. Deletion of outliers was not permitted by state regulations.
Use of Reasonable Cost in Washington Rate Setting

A "reasonable cost interval" for each expenditure category was defined as a band of one standard deviation on either side of the residual from the regression analysis. This allows for variation due to factors not included in the regression analysis at the same time as it provides control over excessive PPD cost variation among homes. Costs falling outside the reasonable cost interval are not likely to be the result of justifiable cost factors. An unusually high cost may be due to inefficiency or to luxury care, neither of which is a justifiable basis for compensation by the state under existing regulations. On the other hand, an unusually low cost may reflect poor quality care in need of improvement.

A prospective rate for each provider was established by comparing the provider's inflation-adjusted reported PPD cost to the reasonable cost interval for each expenditure category. If the inflation-adjusted reported cost fell within the reasonable cost interval, the rate was set at the inflation-adjusted reported cost. If the inflation-adjusted reported cost fell below the lower limit of the reasonable cost interval, the rate was raised to the lower limit of the reasonable cost interval, encouraging the provider to spend more on service delivery. If the inflation-adjusted reported cost fell above the upper limit of the reasonable cost interval, the rate was set at the upper limit to provide an incentive to reduce costs. Homes not included in the regression analysis, either because their utilization rate had been below 85 percent or because they had failed to meet standards, were treated in the same manner. For a variety of reasons cost data was not available for some homes. Their rates were set at a level equal to the reasonable cost estimated by the regression equation for each expenditure category.

Table 3 compares the rates for operation set by this method with providers' own reported PPD operation cost. Note that only 16.5 percent of the homes that operate at 85 percent or more of capacity were assigned rates below reported costs, but that 55.6 percent of the homes that operated at less than 85 percent of capacity were assigned rates below reported costs. The second group of homes would have to make a fuller use of their capacities to operate at lower PPD costs.

Table 4 compares profit and non-profit providers. In principle, non-profit homes have less incentive to minimize costs than profit homes. In fact, a significantly higher proportion of non-profit homes (47.7 percent compared to 15 percent for homes operated for profit) were assigned rates below their reported PPD costs.

CONCLUSION

The purpose of legislatively relating Medicaid payments to reasonable cost is the efficient utilization of available resources for Medicaid pa-
Tables 3 and 4, although by no means conclusive, indicate that the statistical method of determining reasonable cost is capable of performing this function.

Any new reimbursement standard stimulates controversy and this was no exception. However, in time it will be possible to evaluate the effectiveness of the procedure and discover unexpected problems.

### Table 3

Rate for operation relative to reported cost of operation, by utilization rate of licensed beds

<table>
<thead>
<tr>
<th>Rate</th>
<th>Below 85 Percent</th>
<th>Above 85 Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Than Cost</td>
<td>.556</td>
<td>.165</td>
</tr>
<tr>
<td>Equal to Cost</td>
<td>.407</td>
<td>.604</td>
</tr>
<tr>
<td>Higher Than Cost</td>
<td>.037</td>
<td>.230</td>
</tr>
<tr>
<td><strong>Column Sum</strong></td>
<td><strong>1.00</strong></td>
<td><strong>1.00</strong></td>
</tr>
<tr>
<td><strong>Total Number of Homes</strong></td>
<td><strong>27</strong></td>
<td><strong>230</strong></td>
</tr>
</tbody>
</table>

\( \chi^2 = 23.76, \text{ descriptive significance level } = .0000 \)

### Table 4

Rate for operation relative to reported cost of operation, by ownership

<table>
<thead>
<tr>
<th>Rate</th>
<th>For Profit</th>
<th>Non-Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Than Cost</td>
<td>.150</td>
<td>.477</td>
</tr>
<tr>
<td>Equal to Cost</td>
<td>.629</td>
<td>.364</td>
</tr>
<tr>
<td>Higher than Cost</td>
<td>.221</td>
<td>.159</td>
</tr>
<tr>
<td><strong>Column Sum</strong></td>
<td><strong>1.000</strong></td>
<td><strong>1.000</strong></td>
</tr>
<tr>
<td><strong>Total Number of Homes</strong></td>
<td><strong>213</strong></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>

\( \chi^2 = 23.97, \text{ descriptive level of significance } = .0000 \)
FOOTNOTES

1. Medicare and Medicaid are two national health insurance programs established in 1965 with passage of the Social Security Amendments. Medicare covers most persons 65 or older, among other benefits, against major hospital expenses. Medicaid, on the other hand, provides necessary health care, including nursing home services, for low-income persons.

2. Estimates were obtained from the Office of Budget Services, Department of Social and Health Services, State of Washington.


5. See R.C.W. 18.1.310.


7. 42 C.F.R. 450.30, 27300. It is interesting to point out the similarity between the concept of reasonable cost as defined in the federal regulation and the concept of controlled quality described by W. A. Shewhart in his classic Economic Control of Quality of Manufactured Product (New York: D. Van Nostrand Company, Inc., 1931) p. 6, where he stated, "we must also accept as axiomatic: a controlled quality will not be a constant quality. Instead a controlled quality must be a variable quality within limits."

8. 42 C.F.R.450.30, 27300, 27303.


13. The application of multiple regression to long-term care reimbursement systems is not new. See, for example, the theoretical formulations of H.S. Ruchlin, S. Levey, and C.


16. "Robust" procedures, currently being developed, might be very useful for this type of application. See Frederick Mosteller and Gale Mosteller. "New Statistical Methods in Public Policy: Experimentation and Exploratory Data Analysis" in this issue.