

Capitation pricing: Adjusting for prior utilization and physician discretion

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As the number of Medicare beneficiaries receiving care under at-risk capitation arrangements increases, the method for setting payment rates will come under increasing scrutiny. A number of modifications to the current adjusted average per capita cost (AAPCC) methodology have been proposed, including an adjustment for prior utilization. In this article, we

propose use of a utilization adjustment that includes only hospitalizations involving low or moderate physician discretion in the decision to hospitalize. This modification avoids discrimination against capitated systems that prevent certain discretionary admissions. The model also explains more of the variance in per capita expenditures than does the current AAPCC.

Introduction

In 1982, Congress passed the Tax Equity and Fiscal Responsibility Act, which permitted health maintenance organizations (HMO's) and competitive medical plans to enter into risk contracts for Medicare patients. The Health Care Financing Administration (HCFA) published regulations in 1985 that specified the methodology for calculating payment rates to organizations that accept risk contracts. Organizations reimbursed under a risk contract are paid 95 percent of the adjusted average per capita cost (AAPCC), an estimate of the expected cost of treating Medicare beneficiaries in the fee-for-service sector in each local area.

To minimize problems that could result from adverse and favorable selection, careful attention must be given to the methodology HCFA uses to establish payment rates for risk contracts. Pricing policies that pay an equivalent amount for both sick and healthy enrollees could lead to increased Medicare outlays, windfall profits for certain providers, and difficulty in obtaining comprehensive prepaid coverage for certain risk categories of Medicare beneficiaries (Anderson et al., 1986).

In this article, we propose a modification to HCFA's current AAPCC payment methodology that we believe would not only improve the predictive accuracy of the AAPCC but also discourage providers from hospitalizing patients unnecessarily. In our proposed approach, we employ a prior-utilization model in which only conditions involving low or moderate physician discretion in the decision to hospitalize are considered. Our purpose is to develop a payment methodology in which payment rates are based on the instances of prior utilization that are most likely to have been medically necessary and that would have occurred regardless of the setting or delivery system in which care was provided.

Our proposed approach thus has an important advantage over several prior-utilization models that have been suggested as alternatives to the current AAPCC (Anderson and Knickman, 1984b; Beebe,

Lubitz, and Eggers, 1985). Each of these models would pay providers a capitation premium directly proportional to the prior utilization of enrolling beneficiaries without regard to the appropriateness of that utilization. Previously proposed prior-utilization models may thus discriminate against HMO's that control discretionary admissions.

The body of the article is organized into five sections. In the first section, we describe the current methodology for calculating the AAPCC and review specific criticisms of it. In the second section, we present the rationale for including in a prior-utilization model only those conditions that involve little or moderate physician discretion in hospitalization decisions. The third section contains a description of the methodology used in the construction and analysis of our data set. We also describe how we classified hospitalizations into categories of low, medium, and high physician discretion. In the fourth section, our empirical results are presented and compared with those resulting from use of the AAPCC alone and the AAPCC adjusted for all prior hospitalizations. In the final section, we summarize the reasons that a modified prior-utilization model in which only conditions involving low or moderate physician discretion in hospitalization decisions are considered a significant improvement over both the current AAPCC and existing prior-utilization models.

Current AAPCC methodology

Currently, three steps are used in calculating the AAPCC, which is used to determine the payments made by HCFA to HMO's operating under risk contracts. The calculation begins with the expected national average per capita cost for Medicare beneficiaries in the fee-for-service sector. This rate is then adjusted for any historical difference between the per-beneficiary costs in the county in which the HMO is located and the national average. This county-adjusted level of payment is then adjusted for the age, sex, welfare status, and institutional status of beneficiaries who actually enroll in the HMO.

The extent to which the AAPCC is predictive of actual expenditures is quite important because adverse and favorable selection could occur if prices are not

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established properly. According to Luft (1982): "The major difficulty with any competitive approach is that the effective premiums of the sick must be above those for the healthy; otherwise plans will develop strategies to avoid enrolling people whose expected costs exceed the premium."

Adverse and favorable selection, in turn, could lead to increases in Medicare outlays if good risks tend to enter capitation systems and poor risks tend to remain in the fee-for-service sector (Anderson et al., 1986). Such a situation could increase Medicare outlays because the HMO's would be paid 95 percent of the AAPCC for providing care to beneficiaries who may not require medical services, but beneficiaries requiring services would continue to incur expenses in the traditional fee-for-service system. Moreover, the AAPCC is related to actual Medicare expenditures in the fee-for-service sector, so it would increase over time if the poor risks remained in the fee-for-service system.

At the same time, HMO's could earn large profits if they are able preferentially to enroll good risks. Because they are paid 95 percent of the AAPCC for providing care to individuals under current risk contracts, the enrollment of individuals whose anticipated costs are less than that would be profitable.

Capitation systems are generally believed to benefit from favorable selection for several reasons (Wilensky and Rossiter, 1986). First, seriously ill patients are more likely than others to have a usual source of care. They tend to be unwilling to forgo their usual source of care to join a system, such as an HMO, that has a closed physician panel (Galbaum and Trieger, 1982; Pauly, 1974; Thomas et al; 1983). Second, providers in a capitation system are able to engage in selective marketing techniques that attract healthy individuals and encourage disenrollment by less healthy individuals. Such techniques include designing benefits packages with an emphasis on preventive services and making access to specialists difficult. Additionally, they can make it difficult for poor risks to enroll—for example, by locating the enrollment office in a site that requires physical effort to reach (Luft, 1982). Third, sick patients may be encouraged to disenroll from the HMO (DesHarnais, 1985).

In addition to the financial problems that may arise when premiums are not based on the expected costs of enrollees, there is the added problem that a capitation market for some risk groups might not develop when premiums are not based on expected costs (Rothschild and Stiglitz, 1976). Under the current AAPCC formula, HMO's have no economic incentive to enroll high-risk or chronically ill beneficiaries.

Without some medical-status adjustment in the AAPCC payment for the expected cost of beneficiaries, it is unlikely that any capitation system will be interested in enrolling the chronically ill. This is unfortunate because the chronically ill might receive more efficient and appropriate care in such settings.

For several years, researchers have recognized the problems inherent in the AAPCC and have suggested

alternatives to it. Several researchers have demonstrated that the AAPCC is a poor predictor of future expenditures (Hornbrook, 1984; Beebe, 1984). Others have suggested that, given the specific factors used to calculate the AAPCC, payment may be made for treatments that are not necessarily medically appropriate (McClure, 1984).

Most of the suggested modifications to the AAPCC have incorporated into the payment formula adjustments for individuals' health status (Thomas et al., 1983). An alternative but related approach uses prior utilization. Anderson and Knickman (1984b) used data from a 1-percent sample of the Medicare History File to create groups of patients with similar expected future costs. These cost-related groups were developed using a statistical methodology similar to that used to create diagnosis-related groups. It was found that the traditional variables used to calculate the AAPCC—age, sex, and welfare status—were poor predictors of future expenditures. Rather, the variable that explained the greatest variance in per capita expenditures was prior Medicare expenditures on behalf of the individuals.

Other researchers have used different statistical techniques and obtained similar results (Beebe, Lubitz, and Eggers, 1985). In addition, some researchers have moved away from using prior expenditures as a measure of prior utilization and instead have suggested a diagnostic category approach based on an individual's disease history. Certain diagnostic categories have been shown to be good predictors of high expenditures in future years (Ash et al., 1986).

New disease-specific approach

Most prior utilization models do not differentiate necessary from unnecessary admissions. As a result, HMO's which carefully monitor admissions may be at an economic disadvantage if the payment formula is based on prior utilization. In response to this deficiency, we propose a new approach in which attention is given only to prior hospitalizations that occurred for reasons involving little or moderate physician discretion in the decision to hospitalize.

Our rationale for classifying conditions into categories of low, medium, and high discretion is that hospitalizations for conditions involving high discretion are the most likely to be influenced by supply variables, such as number of physicians, or by what Wennberg (1984) calls "practice style factors." Hospitalization decisions that involve little or moderate discretion are more likely to be based on patients' needs. They are less likely to vary as a function of type of provider or the number of facilities or physicians in an area than are admissions involving substantial discretion.

We recognize in proposing this approach that many admissions that we have classified as high discretion may be medically necessary. Nonetheless, our approach has the virtue that it avoids paying for all utilization regardless of necessity. Moreover, it could

be modified to minimize the frequency of inappropriately low payments to providers.

Data and methods

We began with a 1-percent national random sample of Medicare beneficiaries from the Medicare History File. All beneficiaries who were alive from 1974 through at least part of 1978 were included in the file. The sample was then limited to beneficiaries with both Part A and Part B coverage during this period. The final data set contained 189,088 beneficiaries.

Our classification of conditions was based on the *Eighth Revision International Classification of Diseases, Adapted for Use in the United States*, or ICDA (National Center for Health Statistics, 1967). We classified all three-digit ICDA codes into one of three categories (low, medium, or high physician discretion) based on the extent to which we believed there was room for physician discretion in the decision to hospitalize. These classifications were based on the clinical judgments of the physician coauthors and were completed before any data analysis was begun. For example, we classified acute myocardial infarction (heart attack) as a low-discretion event, angina pectoris as a medium-discretion event, and varicose veins as a high-discretion event. A list of the most common conditions classified in the categories of low, medium, and high discretion is presented in Table 1. Our classification of all ICDA codes is available on request.¹

Given data collection and processing constraints, there would most likely be a 1-year lag between a hospitalization and the year for which payment was being calculated. For this reason, we used a 1-year lag in constructing our prior utilization variables. In addition, in order to employ a sufficient number of prior hospitalizations in the independent variable, we combined 3 years of data in the construction of the prior utilization variable. Earlier studies suggest that, despite some regression toward the mean, utilization rates remain elevated for several years after a hospitalization (Anderson and Knickman, 1984a; Welch, 1986). We thus used utilization data for the period 1974-76 to predict expenditures for the same beneficiaries in 1978.

Data from the Area Resources File regarding a number of characteristics of the counties in which the beneficiaries resided in 1978 were merged with the Medicare file. Specifically, we merged county data on per capita income, physician density, hospital beds per capita, and Medicare Part A and Part B expenditures per beneficiary as well as an indicator of whether the county was classified as being medically underserved. Whenever possible, we transformed continuous variables into categorical variables by dividing them

into equal-sized groups. For example, Medicare Part A and Part B expenditures per beneficiary in the county (not including beneficiary deductibles or coinsurance) were divided into four approximately equal groups. We did not test whether slightly different classifications would improve the overall model.

The final list of variables employed in our model is shown in Table 2. Because of constraints in the statistical computer package, we classified all of the variables into discrete values. The variables and percent distributions of beneficiaries by the breakdown for each variable are presented in Table 2.

In order to define which variables explain the most variance in expenditures, we used the Automatic Interaction Detector (AID) computer program (Sonquist, Baker, and Morgan, 1971), the same statistical method used to create diagnosis-related groups. The AID program splits the sample into binary groups in an iterative fashion, always splitting the data into two categories that explain the maximum variance of expenditures between the groups. The advantage of using AID instead of multiple regression is that AID does not require continuous functions. The major disadvantage is that the variable must be discrete, and transforming continuous variables into discrete variables is always somewhat arbitrary. The final result of AID analysis is a set of homogeneous expenditure-related groups of individuals based on a specific set of variables.

We constrained the program so that groups stopped being formed when no additional splits of the data would explain an additional 0.05 percent of the variance or when 30 groups had been formed. The computer would otherwise have continued to subdivide the population until there were as many groups as observations. We also required that groups include at least 500 beneficiaries, approximately 0.25 percent of our 1-percent sample of the Medicare population, because smaller samples would lead to statistically unstable estimates. In order to further prevent statistically unreliable results, any observations that were more than 10 standard deviations from the group mean were deleted from consideration in any given split. This final restriction resulted in the elimination of 165 individuals whose mean expenditures exceeded \$26,124 during the first split. The cost of these beneficiaries would generally be covered by a reinsurance program purchased by the HMO.

Results

We restricted the set of independent variables to age, sex, welfare status, and Medicare expenditures per beneficiary in the county, four of the five variables that the Medicare program currently uses to establish AAPCC payment rates. We did not include the other AAPCC variables, institutional status, which is based on data from a survey of institutionalized persons in counties. These data were not available to us. Moreover, they have been

¹The classification is available from Gerard Anderson, Room 307, Hampton House, Johns Hopkins University, 624 North Broadway, Baltimore, Maryland 21205.

Table 1

Most common Medicare conditions, by amount of physician discretion involved in hospitalization

Discretion category	ICDA code ¹
Low discretion	
Malignant neoplasm of buccal cavity and pharynx	140-149
Malignant neoplasm of digestive organs and peritoneum	150-159
Malignant neoplasm of trachea, bronchus, and lung	162
Malignant neoplasm of bone	170
Malignant melanoma of skin	172
Malignant neoplasm of breast	174
Malignant neoplasm of ovary, fallopian tube, and broad ligament	183
Malignant neoplasm of brain	191
Lymphosarcoma and reticulum cell sarcoma	200
Leukemias	204-207
Aplastic anemia	284
Acute myocardial infarction	410
Acute and subacute endocarditis	421
Subarachnoid hemorrhage, cerebral hemorrhage	430-431
Aortic aneurysm	441
Arterial embolism and thrombosis	444
Gangrene	445
Pulmonary embolism and infarction	450
Spontaneous pneumothorax	512
Acute appendicitis	540
Hernia with obstruction	552-553
Peritonitis	567
Suppurative hepatitis and liver abscess	572
Nephritis and nephrosis	580-584
Infections of kidney	590
Acute arthritis due to pyogenic organisms	710
Uremia	792
Various fractures of skull, spine, and trunk	800-806, 808-809
Fracture of femur	820-821
Traumatic pneumothorax and hemothorax	860
Burn involving face, head, neck, trunk, and limb(s)	948
Medium discretion	
Thyrotoxicosis	242
Myxedema	242
Thyroiditis	245
Plasma protein abnormalities	275
Amyloidosis	276
Hereditary hemolytic anemias	282
Coagulations defects	286
Purpura	287
Agranulocytosis	288
Meningitis	320
Multiple sclerosis	340
Epilepsy	345
Meniere's disease	385
Otosclerosis	386
Chronic rheumatic heart disease	393-398
Hypertensive renal disease	403
Chronic ischemic heart disease	412
Angina pectoris	413
Bronchitis, emphysema, and asthma	490-493
Diseases of esophagus, stomach, and duodenum	530-537
Cirrhosis of liver	571
Uterovaginal prolapse	623
Concussion	850
High discretion	
Senile dementia	290
Neuroses, personality disorders, and other nonpsychotic mental disorders	300-309
Migraine	346
Refractive errors	370
Corneal opacity	371
Cataract	374
Otitis media or mastoiditis	382-383
Essential benign hypertension	401
Hypertensive heart disease	402
Arteriosclerosis	440
Varicose veins	454
Hemorrhoids	455

Table 1—Continued

Most common Medicare conditions, by amount of physician discretion involved in hospitalization

Discretion category	ICDA code ¹
High discretion	
Acute respiratory infections	460-466
Influenza, unqualified	470
Viral pneumonia	480
Hyperplasia of prostate	600
Disorders of menstruation	626
Rheumatoid arthritis and allied conditions	712
Sprains and sprains of joints and adjacent muscles	840-848
Contusion and crushing with intact skin surface	920-929

¹ Eighth Revision International Classification of Diseases, Adapted for Use in the United States (National Center for Health Statistics, 1967).

criticized as unreliable and are thought to have little predictive value (Trapnell, McKusick, and Genuardi, 1982).

Using this limited set of variables, the expenditure-related groups shown in Table 3 were formed. Mean expenditures in the groups varied from \$708 to \$1,889. This four-variable model explained only 1-percent of the variation in per capita expenditures. Statistically, the most important variable in the model

was Medicare expenditures per beneficiary in the county. Welfare status and age were somewhat less important, and sex had no predictive value, given our model constraints.

To explore the marginal improvement in predictive accuracy related to the addition of a prior-utilization variable, we added to the first model a variable describing the total number of times a beneficiary was hospitalized during 1975 and 1976. This particular

Table 2
Percent distribution of Medicare beneficiaries, by variables used in analysis

Variable	Percent distribution of beneficiaries	Variable	Percent distribution of beneficiaries
Number of low-discretion hospitalizations, 1975-76		Welfare status (Medicaid buy-in)	
0	89.2	Yes	9.8
1	8.8	No	90.2
2	1.5	Number of low-, medium-, or high-discretion hospitalizations, 1975-76	
3-5	0.5	0	62.0
6-9	(¹)	1	21.1
10 or more	(¹)	2	8.8
Number of moderate-discretion hospitalization, 1975-76		3-5	6.7
0	87.9	6-9	2.2
1	9.3	10 or more	0.2
2	1.9	Medically underserved county	
3-5	0.8	None of county	15.8
6-9	0.1	Part of county	69.5
10 or more	(¹)	All of county	14.7
Total Parts A and B expenditures per beneficiary, 1978 (MEPBC)²		Number of hospital beds per 1,000 population	
Less than \$750	36.2	3 or less	54.0
\$751-\$850	17.7	More than 3	46.0
\$851-\$1,000	20.0	Income per capita	
\$1,000 or more	26.1	Less than \$6,000	14.3
Sex		\$6,001-\$7,500	32.4
Male	40.4	\$7,501-\$9,000	34.9
Female	59.6	\$9,000 or more	18.4
Age		Physicians per capita	
Under 65 years	6.2	0-2	2.5
65-69 years	9.8	3-5	10.2
70-74 years	32.8	6-7	7.6
75-79 years	23.7	8-10	12.8
80-84 years	15.7	11-15	18.4
85 years or over	11.8	16 or more	48.5

¹Quantity more than 0.0 but less than 0.1.

²MEPBC is Medicare expenditures per beneficiary in county.

Table 3
Selected statistics using current adjusted average per capita cost model,¹ by expenditure-related group: United States, 1974-78

Expenditure-related group	Mean ²	Standard deviation	Percent of beneficiaries in group
MEPBC less than \$750	\$708	\$1,859	36.2
MEPBC \$750-\$850	900	2,354	17.8
Age under 75 years:			
No Medicaid buy-in	977	2,764	20.2
Medicaid buy-in	1,430	3,540	1.9
Age 75 years or over:			
MEPBC \$851-\$1,000	1,123	2,689	10.1
MEPBC more than \$1,000	—	—	—
No Medicaid buy-in	1,343	3,220	12.4
Medicaid buy-in	1,889	4,013	1.5

¹Does not include an adjustment for institutionalization.
²Because data are from a sample, there may be some variance around the true mean.
 NOTES: MEPBC is Medicare expenditures per beneficiary in county. Overall level of explanation is 1.0 percent. Sex was included in the model but was not statistically significant.

Table 4
Selected statistics using traditional prior-utilization model, by expenditure-related group: United States, 1974-78

Expenditure-related group	Mean	Standard deviation	Percent of beneficiaries in group
No prior hospitalizations			
MEPBC less than \$850	\$540	\$1,648	33.0
MEPBC \$850 or more:			
Age under 75 years	698	2,268	14.6
Age 75 years or over	940	2,648	14.4
1 prior hospitalization			
MEPBC less than \$850	871	2,099	11.5
MEPBC \$850 or more	1,341	3,144	9.7
2 or 3 prior hospitalizations			
MEPBC less than \$850	1,219	2,500	7.2
MEPBC \$850 or more	1,920	3,702	5.6
4 or more prior hospitalizations			
MEPBC less than \$750	1,915	3,047	1.6
MEPBC \$750-\$850	2,703	4,639	0.7
MEPBC more than \$850	3,299	4,920	1.7

NOTES: MEPBC is Medicare expenditures per beneficiary in county. Overall level of explanation is 4.3 percent. Sex and welfare status were included in the model but were not statistically significant.

prior-utilization variable has been suggested by several authors (Anderson and Knickman, 1984b; Beebe, Lubitz, and Eggers, 1985). The results derived from this expanded model, shown in Table 4, are generally similar to those reported in the earlier studies. This model, which created 10 groups with mean expenditures that varied from \$540 to \$3,299, explained 4.3 percent of the variance in expenditures. Number of prior hospitalizations was the variable

with the most predictive value, followed by Medicare expenditures per beneficiary in the county and age. Neither welfare status nor sex were significant predictors in this model.

We then replaced the variable regarding number of prior hospitalizations with two new variables. One included only prior hospitalizations for conditions that involved little physician discretion in the decision to hospitalize; the other, those that involved moderate discretion. The results are shown in Table 5. The 11 groups that emerged from this analysis explained 3.1 percent of the variance in expenditures. Mean expenditures in the 11 groups varied from \$634 to \$4,064. The most important predictor in this model was whether the beneficiary had any moderate-discretion admissions. Variables defining hospitalizations involving low physician discretion and the number of times a person was hospitalized with a condition classified as involving moderate physician discretion were the next most important predictors. Medicare expenditures per beneficiary in the county and age were also significant predictors.

Finally, variables describing the characteristics of the county, including the supply of physicians and

Table 5
Selected statistics using physician discretion prior-utilization model, by expenditure-related group: United States, 1974-78

Expenditure-related group	Mean	Standard deviation	Percent of beneficiaries in group
No moderate-discretion admissions			
No low-discretion admissions:			
MEPBC less than \$850	\$634	\$1,798	42.7
MEPBC \$850 or more:			
Age under 75 years	815	2,437	18.2
Age 75 years or over	1,108	2,803	18.7
1 or more low-discretion admissions:			
MEPBC less than \$1,000	1,246	2,744	6.2
MEPBC \$1,000 or more	1,941	4,132	2.2
1 or 2 moderate discretion admissions			
MEPBC less than \$750	1,147	2,690	4.3
MEPBC \$750 or more:			
No low-discretion admissions:			
MEPBC less than \$1,000	1,531	3,266	3.4
MEPBC \$1,000 or more	2,088	4,041	2.2
1 or more low-discretion admissions:			
	2,494	4,260	1.4
3 or more moderate discretion admissions			
MEPBC less than \$850	2,468	3,521	0.5
MEPBC \$850 or more	4,064	5,703	0.5

NOTES: MEPBC is Medicare expenditures per beneficiary in county. Overall level of explanation is 3.1 percent. Sex and welfare status were included in the model but were not statistically significant.

hospital beds, the per capita income, and whether the county is classified as being medically underserved, were added to the third model. None of these variables added to the predictive power of the model.

Discussion

The overall level of explanation in each of the four models we examined is very small, varying from 1.0 to 4.3 percent. This low level of explanatory power demonstrates that many factors other than the ones we have considered explain future health care expenditures for a Medicare beneficiary. A significant proportion of the variation will probably never be explained because it involves random variation, which cannot be predicted in advance. A payment formula does not have to explain all of the variation in future health care expenditures in order to be useful, however. In fact, if a model explained 100 percent of the variance, it would cease to be insurance because all events could be predicted with certainty.

As shown in Table 3, some of the variables included in the current methodology for creating the AAPCC are not significant predictors of future expenditures. As shown in Tables 3 and 4, the inclusion of a prior-utilization variable improved the overall predictive power of the model. The overall level of explanation increased from 1.0 to 4.3 percent, creating substantially different cost-related groups.

When traditional prior-utilization models and our prior-utilization model including physician discretion are compared, it can be seen that the overall level of explanation is marginally better in traditional prior utilization models. Again, this result is not surprising. Patients and providers who have a tendency to use discretionary services will tend to continue to do so. Additionally, some high-discretion hospitalizations are medically appropriate and may also predict subsequent hospitalizations. Therefore, one would expect that the inclusion of hospitalizations involving high physician discretion would predict subsequent utilization.

Thus, either of two different types of prior-utilization models, each of which has advantages and disadvantages, could be used to pay capitated providers. Both approaches are better predictors of subsequent utilization than is the AAPCC. From an HMO's perspective, either of these approaches would be more equitable than the current AAPCC.

Previously proposed prior-utilization models have the disadvantage of paying for utilization without regard to its medical necessity. The approach we propose takes a step toward overcoming this disadvantage, but at a cost of eliminating payment for high-discretion hospitalizations, some of which are undoubtedly medically appropriate. One potential partial solution to the latter problem would be to include some payment for high-discretion hospitalization in a capitation premium, albeit at a reduced rate compared with that for low- or moderate-discretion admissions.

Clearly, more work is necessary in classifying reasons for hospitalization into categories of low, moderate, and high discretion. Work is also necessary in identifying high-discretion admissions that are medically necessary and low- or moderate-discretion admissions that tend not to be medically necessary. Our own classification system may require refinement as our model is tested on other data sets and reviewed by clinicians. The results suggest, however, that basing a payment system only on conditions involving low or medium physician discretion can have advantages. HMO's can be rewarded for preventing unnecessary admissions but still be paid an adequate amount for care of individuals who require hospitalization.

We believe that our results are robust because other studies, for which the same data set but different samples were used, have yielded similar results (Anderson and Knickman, 1984b; Beebe, Lubitz, and Eggers, 1985). However, it would be worth while to validate our methodology on a more recent Medicare data set and to examine its predictive value in a non-Medicare population.

Additional research directions could also be pursued. One possibility is to separate conditions into chronic versus self-limited categories and to adjust the AAPCC for chronic conditions only. A second possible research direction is to review ambulatory utilization and nursing home utilization to see whether they predict future expenditures. Additionally, utilization trends could be examined over a longer time period than has been studied previously to determine which diseases best predict future utilization.

Much more research is necessary. However, we believe that a model that incorporates hospitalizations of low and medium physician discretion into the AAPCC should be pursued. It represents a significant improvement in the overall predictive accuracy of the AAPCC without the liability of penalizing capitation systems that are able to prevent unnecessary admissions.

References

- Anderson, G., and Knickman, J.: Patterns of expenditure among high utilizers of medical care services: The experience of Medicare beneficiaries from 1974 to 1977. *Med Care* 22(2):143-149, Feb. 1984a.
- Anderson, G., and Knickman, J.: Adverse selection under a voucher system: Grouping of Medicare recipients by level of expenditure. *Inquiry* 21(2):135-143, 1984b.
- Anderson, G., Steinberg, E. P., Holloway, J., and Cantor, J.: Establishing payment rates for capitated systems. *Milbank Mem Fund Q* 64(4), Winter 1986.
- Ash, A., Porell, F., Gruenberg, L., et al.: *An Analysis of Alternative AAPCC Models Using Data from the Continuous Medicare History Sample*. Prepared under contract for Health Care Financing Administration, Boston. Boston University, Aug. 1986.

- Beebe, J.: Chronic disease in the workplace and the environment: Record linkage methodologies and legal issues. *Arch Environ Health* 39(3):169-172, May-June 1984.
- Beebe, J., Lubitz, J., and Eggers, P.: Using prior utilization to determine payments for Medicare enrollees in health maintenance organizations. *Health Care Financing Review*. Vol. 6, No. 3. HCFA Pub. No. 03198. Office of Research and Demonstrations, Health Care Financing Administration. Washington. U.S. Government Printing Office, Spring 1985.
- DesHarnais, S.I.: Enrollment in and disenrollment from health maintenance organizations by Medicaid recipients. *Health Care Financing Review*. Vol. 6, No. 3. HCFA Pub. No. 03198. Office of Research and Demonstrations, Health Care Financing Administration. Washington. U.S. Government Printing Office, Spring 1985.
- Galbaum, T. W., and Trieger, S.: Demonstrations of alternative delivery systems under Medicare and Medicaid. *Health Care Financing Review*. Vol. 3, No. 3. HCFA Pub. No. 03141. Office of Research, Demonstrations, and Statistics, Health Care Financing Administration. Washington. U.S. Government Printing Office, Mar. 1982
- Hornbrook, M. C.: Examination of the AAPCC methodology in an HMO prospective payment demographic project. *Group Health Journal* 5(1):13-21, Spring 1984.
- Luft, H. S.: Health maintenance organizations and the rationing of medical care. *Milbank Mem Fund Q* 62(2):237-250, Spring 1982.
- McClure, W.: On the research status and risk-adjusted capitation rates. *Inquiry* 21(3):205-213, Fall 1984.
- National Center for Health Statistics: *Eighth Revision International Classification of Diseases, Adapted for Use in the United States*. PHS Pub. No. 1693. Public Health Service. Washington. U.S. Government Printing Office, 1967.
- Pauly, M.: Overinsurance and public provision of insurance: The roles of moral hazard and adverse selection. *Quarterly Journal of Economics* 81(1):44-62, Feb. 1974.
- Rothschild, M., and Stiglitz, J.: Equilibrium in competitive insurance markets: An essay on the economics of imperfect competition. *Quarterly Journal of Economics* 90(4):629-649, 1976.
- Sonquist, J., Baker, E., and Morgan, J.: *Searching for Structure*. Ann Arbor. Institute for Social Research, 1971.
- Thomas, J. W., Lichtenstein, R., Wyszewianski, L., et al.: Increasing Medicare enrollment in HMO's: The need for capitation rates adjusted for health status. *Inquiry* 20(3):227-239, Fall 1983.
- Trapnell, G. R., McKusick, D. R., and Genuardi, J. S.: An Evaluation of the Adjusted Average Per Capita Cost (AAPCC) Used in Reimbursing Risk-Basis HMO's under Medicare. Unpublished document. Washington, D.C. Actuarial Research Corporation, 1982.
- Welch, W. P.: Medicare capitation payments to HMO's in light of regression towards the mean. In Scheffler, R. M., and Rossiter, L. F., eds. *Health Economics and Health Services Research*, 6. Greenwich, Conn. JAI Press, 1986.
- Wennberg, J. E.: Dealing with medical practice variations: A proposal for action. *Health Affairs* 3(2):6-32, Summer 1984.
- Wilensky, G. R., and Rossiter, L. F.: Patient self selection in HMO's. *Health Affairs*, Spring 1986.