A RAND NOTE

Setting Medicare Capitation Rates for the Frail and Elderly

Joyce Mann, C. R. Neu

February 1987
This research was sponsored by On Lok Senior Health Services under Contract No. CA86-723.

The RAND Publication Series: The Report is the principal publication documenting and transmitting RAND's major research findings and final research results. The RAND Note reports other outputs of sponsored research for general distribution. Publications of The RAND Corporation do not necessarily reflect the opinions or policies of the sponsors of RAND research.
A RAND NOTE

N-2550-OLSHS

Setting Medicare Capitation Rates for the Frail and Elderly

Joyce Mann, C. R. Neu

February 1987

Prepared for
On Lok Senior Health Services
PREFACE

This Note was prepared for On Lok Senior Health Services of San Francisco. On Lok asked The RAND Corporation to review and comment on the methodology currently used to set Medicare capitation payments for at-risk health care providers. This methodology is based on the Adjusted Average per Capita Cost (AAPCC), an estimate of the Medicare cost of serving participants in risk-based programs if these participants were served instead by fee-for-service providers. RAND was also asked to review the available literature on possible refinements to the AAPCC methodology and to offer suggestions for future research.

The authors benefited greatly from consultations with the On Lok staff and with the staff of the Health Care Financing Administration (HCFA). The views expressed in this Note, however, are the authors' own and do not necessarily reflect the views of either On Lok or HCFA. The authors are grateful for comments and suggestions offered by their RAND colleague Emmett Keeler on an earlier draft. Any remaining errors are of course the authors' responsibility.
SUMMARY

As federal efforts intensify to promote capitated arrangements in the Medicare program, the methodology for calculating capitation rates has come under increased scrutiny. Under current rules, capitation rates for risk-based health maintenance organizations (HMOs) are based on costs for Medicare beneficiaries in the fee-for-service (FFS) sector. Capitation rates are set at 95 percent of the adjusted average per capita cost (AAPCC), an actuarial estimate of the Medicare cost of serving the HMO enrollees on a FFS basis in the same geographic area (defined as the county). The capitation rates paid to a provider reflect further adjustments to the AAPCC that take into account the demographic characteristics of the provider's enrolled population.

Concern centers on how well the AAPCC, as currently calculated, predicts the costs of care for populations of beneficiaries. Failure of capitation rates to reflect costs accurately may result in overpayments to risk-sharing plans with populations of unusually low-cost members and underpayments to plans with populations of unusually high-cost members. Potentially more problematic, capitation rates that do not adequately reflect expected costs of care may discourage providers from accepting potentially high-cost Medicare beneficiaries as members.

Separate capitation rates are calculated for the three Medicare populations—the aged, the disabled, and beneficiaries with end stage renal disease (ESRD)—for both Part A (Hospital Insurance) and Part B (Supplementary Medical Insurance). The capitation rate for a provider is calculated as the product of three components:

- The national per capita Medicare cost for the appropriate Medicare population (aged, disabled, or ESRD) for Parts A and B, projected to the current year;
- A geographic adjustment factor based on the ratio of the relevant county per capita cost to the national per capita cost;
- vi -

- Demographic adjustment factors reflecting the age, sex, institutional status, and the welfare status (Medicaid eligibility) of the provider's enrolled population.

Estimates of national per capita Medicare costs and geographical adjustment factors are updated annually on the basis of Medicare cost experience. Among the demographic adjustment factors, only those for age and sex are regularly updated. Adjustment factors for institutional and welfare status have been unchanged since they were first estimated on the basis of data from the period 1974 through 1976.

Data necessary for updating two of the demographic adjustment factors (welfare and institutional status) are no longer collected. Moreover, the original estimates of the effects of all four demographic variables have been criticized, primarily because they were based on beneficiary self-reports. Data collected in this manner may be susceptible to either underreporting (possibly because of forgetfulness) or overreporting (possibly because of not distinguishing between services that are covered by Medicare and those that are not) and may thus be unreliable.

Studies testing the capitation rate formula show that the four demographic factors explain very little of the variance (less than 1 percent) in medical care expenditures. Patients within the same demographic class can have widely varying costs of care, and providers may be over- or underpaid if costs of care for their particular populations vary greatly from average costs for each demographic class. Providers that specialize in caring for the frail elderly may bear a particular burden. Frail patients are likely to require more costly care than average, and payments based on the average rates for demographic classes are likely to be inadequate if a risk-sharing plan has a high proportion of the frail elderly.

In the actual implementation of the AAPCC, a substantial spread in the payment rates across geographic areas (counties) has been observed. Some analysts argue that this spread is probably greater than the variation in the true costs of serving enrollees. Even if the spread does reflect real cost differences, these differences may be due to
regional variations in practice style (elaborate versus conservative) that HCFA may not wish to see incorporated in capitation rates.

Several analysts have criticized the limitations of the "rate book" approach used to set rates for beneficiaries with different demographic characteristics. "Rate book" is an actuarial term that refers to the practice of calculating rates for a small number of demographic cells (in the case of the AAPCC, 30 cells). Critics note that this approach limits the number of factors that can be used to adjust payment rates. They suggest using regression analysis instead to calculate continuous adjustment factors.

Analysts have suggested various approaches to refining the AAPCC. For the most part, these involve introducing adjustments for additional factors. Some of these factors are as follows.

1. Prior Use. Adjusting the AAPCC on the basis of some indicator of prior health care utilization improves its power to predict medical expenditures. After the first year or two of enrollment in a risk-sharing plan, however, prior use reflects experience in the plan, and adjusting payment on this basis may introduce undesirable incentives for providers. At least two demonstration projects are or soon will be testing prior use adjustors.

2. Former Disability Status. Medicare beneficiaries who were "formerly disabled" (disabled before the age of 65) have higher costs than other Medicare beneficiaries. Only a small fraction of beneficiaries fall into this category, however, and an adjustor based on former disability status will not explain any variance in the large majority of beneficiaries not disabled before the age of 65.

3. Health Status. Measures of health status--perceived health status (excellent, good, fair, poor); functional measures (activities of daily living or instrumental activities of daily living); number of chronic conditions; and other diagnostic information--add predictive power to the AAPCC. In general, these measures do not perform as well as the measures of prior utilization and reimbursement, although the performance of these variables may have suffered in some studies because of poor model specification. Adjusting payments on the basis of health status can have the perverse effect of penalizing providers that improve the health and functional abilities of their enrollees.
4. *Health Risk Factors.* Risk factors, such as smoking and high blood pressure, are likely to affect future health status and to have an indirect effect on medical expenditures. Although no studies have examined whether health risk factors improve the ability of the AAPCC to predict medical expenditures, they do improve the ability to predict frequency of hospitalization. The use of risk factors to adjust the AAPCC poses both measurement and conceptual problems. The Medicare Program does not routinely collect such data. Additionally, the relationship between risk factors and future health status is not clearly understood for many health conditions, and choosing an appropriate set of risk factors may be problematic.

To date, no study has demonstrated a combination of adjustments to the AAPCC that permit explanation of more than about one-quarter of the variance in Medicare costs of care. This does not mean that adjustments to the AAPCC are not potentially useful. As a practical matter, it is neither possible nor necessary to adjust the AAPCC to account for all cost differences. Costs within a single risk group may be allowed to vary if two conditions are met:

1. The remaining variation is truly random and is not related to factors observable by the provider that the provider might use as a basis for selecting members.

2. The remaining variance is sufficiently small that gains and losses on particular enrollees will have a reasonable chance of offsetting each other, resulting in roughly fair reimbursement for particular providers.

An alternative to refining the AAPCC would be to choose another approach for setting a capitated rate. State Medicaid programs generally use one of three methods for setting capitated rates. The first is similar to Medicare's AAPCC in that the rate is set at some percentage of the per capita cost of serving Medicaid recipients in the FFS sector. The second method involves competitive bidding. In the third method rates are based on the provider's reported costs.
A recently proposed alternative to pure capitation rates is the use of a "blended" rate, incorporating both a capitated component and a FFS component. For example, one-fourth of the payment amount could be based on a refined AAPCC, while three-fourths could be based on FFS costs. This approach accommodates the imperfections of the adjustment methods that are currently available. As adjustors improve, the weight on the capitated portion could increase.

Another approach would be to retain the pure capitation payment but add a provision for outliers. Enrollees who exceed a threshold level of services over a defined time period could be classified as outliers and plans could receive an additional lump sum payment for such enrollees. Such an approach recognizes that the current AAPCC adjustors are inadequate and provides some protection to delivery systems, while preserving the basic structure of a capitated payment system.

There seems to be near universal agreement that the current AAPCC formula is inadequate. Analysts at HCFA have expressed their doubts concerning the adequacy of the AAPCC and have conducted preliminary studies to refine the AAPCC formula. The statutory language creating the AAPCC is flexible enough to permit the incorporation of additional adjustors. Given the ambiguities that remain with respect to the incentive effects of the various approaches and the uncertainty regarding the appropriate measures to choose as proxies for different adjustors, it seems prudent to test several approaches in demonstration projects.

Devising better methods for setting Medicare capitation rates will require progress on two tasks. The first is to identify more precisely which characteristics of patients and their circumstances explain differences in the costs of their care. The second is to determine that these characteristics are sufficiently objective, verifiable, and easily observed to form the basis of a payment system. This second task can be accomplished only by mounting demonstration efforts in which providers are paid on the basis of proposed capitation systems. Before these demonstrations can commence, however, further progress must be made on the first task.
Perhaps the most promising opportunity for further research into the health care costs of the frail elderly is provided by the Long-Term Care Surveys, which collected detailed information about the functional status, socioeconomic circumstances, living arrangements, and cognitive function of some 6000 impaired elderly Medicare beneficiaries in 1982 and again in 1984. Linking these survey data to Medicare records will provide the first opportunity since the Current Medicare Survey was discontinued in 1977 to use a representative national sample to examine the relationship between functional status and Medicare outlays. It will also offer an opportunity (never before available, as far as we know) to explore the effects of socioeconomic circumstances and living arrangements on Medicare outlays.

Other promising areas for research are the use of information on prior utilization and diagnoses to predict health care outlays and the use of objective physiologic measures for the same purposes. Work on the former topic is underway at University Health Policy Consortium at Brandeis University and on the latter at The RAND Corporation and at the University of Minnesota.

Finally, projects just beginning to test the feasibility of comprehensive, community-based, risk-based health services for the frail elderly provide an additional opportunity for research into the determinants of health care costs. We cannot expect that either the participants in these programs or the institutions providing care through these programs will be representative of the broader population of frail elderly or of the care they receive in HMOs serving more diverse populations. Careful observation of these programs may, however, provide insights that will guide subsequent demonstration projects or larger-scale data collection efforts.

Devising, testing, and implementing a truly satisfactory method for setting Medicare capitation rates will be difficult, expensive, and time-consuming—if it is possible at all. Consequently, no general overhaul of procedures for setting these rates can be expected in the next few years.
In the meantime, however, problems remain with current methods. The current adjustment for "frailty"—in practice, the adjustment for institutional status—is widely recognized as inadequate. It therefore seems sensible to seek an improved adjustor for interim use until there is a full-scale reform of the AARCC methodology.

For purposes of computing this interim adjustor, it will probably be necessary to define "frail" patients as those requiring institutional care. More comprehensive definitions based on functional status measures or diagnoses cannot be supported by existing databases. It is possible and perhaps desirable to extend the definition of frailty to include patients receiving home health care.

Calculating a new frailty adjustor requires two steps. First, a population of frail patients has to be identified. In the present context, this means identifying a population of Medicare beneficiaries receiving institutional care (or perhaps home health care). The second step is to tabulate the Medicare outlays on behalf of these patients and to compare these with outlays on behalf of nonfrail Medicare beneficiaries.

Medicare pays for little institutional care, and its records will not suffice for identifying patients receiving such care. Databases being compiled by Systemetrics, Inc. as a part of the so-called Tape-to-Tape project funded by HCFA will allow identification of elderly Medicaid patients receiving institutional care. These databases also provide a link to Medicare beneficiary numbers, so that outlays on behalf of these patients can be calculated from Medicare records. The Tape-to-Tape project has so far compiled the necessary databases for only a few states; among these, it is only for California and Michigan that data for the period after the implementation of the Medicare prospective payment system are available. Therefore, efforts will have to be concentrated on the frail elderly in these two states.

The necessary records of Medicare outlays are available only for samples of Medicare beneficiaries, rather than for all beneficiaries. Searching all Medicare records for outlays on behalf of identified frail patients would require computational resources beyond what would be available for calculating a new frailty adjustor. Analysis will
therefore almost certainly have to be restricted to Medicare beneficiaries represented in these samples.

Despite limitations, it should be possible to identify and calculate all Medicare payments for a sample of some 3700 frail Medicare beneficiaries. For some classes of Medicare outlays, the sample can be much larger. These samples should be adequate to calculate a frailty adjustor that is superior to the one currently in use.
CONTENTS

PREFACE ................................................................. iii
SUMMARY ............................................................... v
TABLES ................................................................. xv

Section

I. INTRODUCTION ....................................................... 1

II. AAPCC: CURRENT METHODOLOGY AND DATA ..................... 5

III. LIMITATIONS OF THE AAPCC METHODOLOGY ............... 9
    Data Availability and Validity .................................. 9
    Homogeneity of Risk Groups .................................... 11
    Geographic Variation in Rates ................................ 15
    Rate Book Limitations .......................................... 16

IV. REFINING THE AAPCC ............................................ 18
    Prior Use ......................................................... 20
    Former Disability Status ........................................ 27
    Health Status .................................................... 28
    Health Risk Factors ............................................. 31
    Summary: Refining the AAPCC .................................. 33

V. ALTERNATIVE METHODS OF CAPITATION RATE SETTING ....... 36

VI. WHERE DO WE GO FROM HERE? .................................. 41
    Clinical vs. Policy Relevance .................................. 43
    The Long-Term Care Surveys ................................... 44
    Additional Work .................................................. 50

VII. AN INTERIM APPROACH ......................................... 53
    Defining Frailty .................................................. 53
    Identifying a Population of Frail Elderly ................. 56
TABLES

1. The Amount of Variance Explained by the AAPCC and Prior Use Models .............................................. 24
2. The Percentage of Variance Explained by Health Status and Functional Status Models .......................... 32
I. INTRODUCTION

As federal efforts to promote capitated delivery and financing arrangements in the Medicare program intensify, the methodology for calculating the capitation rate has come under increased scrutiny. Passage of a provision in the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA) encouraged enrollment of Medicare beneficiaries in health maintenance organizations (HMOs) on an at-risk basis by allowing risk-sharing plans to use any surpluses generated rather than having to return them to the Medicare program. The legislation also broadened the definition of plans eligible for risk-sharing contracts.\(^1\)

Before the TEFRA regulations were implemented in February 1985 only a single prepayment plan serving Medicare beneficiaries (and several demonstration projects) contracted with the Health Care Financing Administration (HCFA) on an at-risk basis. As of June 1, 1986, HCFA had signed 132 TEFRA risk contracts with HMOs and competitive medical plans (CMPs), covering approximately 630,000 Medicare enrollees (about 2 percent of total beneficiaries). In recent Congressional testimony HCFA administrators promoted capitation as the preferred long-term goal of the current administration's Medicare reimbursement policies.\(^2\) Over the short term the administration is promoting a voucher system for Medicare, which would involve the same problem of setting a base rate for beneficiaries and making adjustments to reflect the expected risks of different individuals.\(^3\)

---

\(^1\)Even though HMOs could enter into at-risk contracts before 1982, they had little incentive to do so because they had to absorb all losses but were not permitted to keep all surpluses. Any savings over costs had to be shared (50:50) with the Medicare program, and all savings over 10 percent of the payment rate reverted to Medicare. Under TEFRA, HMOs can use surpluses to reduce their premiums or increase benefits to Medicare enrollees.

\(^2\)Henry Desmarais, Acting Deputy Administrator, HCFA, accompanied by Carol Kelly, Acting Associate Administrator for Policy, and Allen Dobson, Director of Office of Research in testimony before the Subcommittee on Health, Senate Committee on Finance, Hearings on "Reform of Medicare Payments to Physicians," December 6, 1985.

\(^3\)The administration bill was introduced in the Senate in December 1985.
Under current rules, the capitation rate for risk-based HMOs is not
determined by the individual HMO's cost of serving its enrollees, but is
instead based on costs for Medicare beneficiaries in the fee-for-service
sector. The rate is set at 95 percent of the adjusted average per
capita cost, which is an actuarial estimate of the Medicare cost of
serving the HMO enrollees on a FFS basis in the same geographic service
area (defined as the county). Each plan must also compute its adjusted
community rate (ACR), the rate that the plan would have charged its non-Medicare enrollees for
Medicare covered services. This amount is adjusted for utilization
characteristics of the plan's Medicare enrollees and is reduced by the
value of Medicare coinsurance and deductibles. If the plan's ACR is
less than the average Medicare capitation payment, the plan may provide
additional benefits to Medicare enrollees, reduce premiums or other
charges, or request a reduction in its monthly capitation payment from
Medicare.

*To determine an actuarially equivalent rate, four factors are used to adjust the rates: age, sex, welfare
status, and institutional status of individual beneficiaries. This
capitation formula assumes that all beneficiaries in a given community
(county) having the same age, sex, welfare, and institutional
characteristics will have approximately the same expected level of
medical care expenditures. However, these actuarial factors have been
shown to be poor predictors of costs for the Medicare population; they
explain less than 1 percent of the variance in expenditures (Eggers,
1980; Eggers and Prihoda, 1982; Lubitz, Beebe, and Riley, 1985; Thomas
et al., 1983).

What are the potential implications of this problem? Failure of
the AAPCC to reflect enrollees' health care expenditures accurately
could result in overpayments to risk-sharing plans that experience a
favorable selection of low users and underpayments to other plans that
experience an adverse selection of high users. Favorable selection
could occur either because prepaid delivery systems market their

$The proxy for welfare status is Medicaid eligibility. It is
determined by whether a state Medicaid program purchases the Part B
premium for a Medicare beneficiary. An institutionalized individual is
a Medicare beneficiary who is in a nursing home, sanatorium, rest home,
convalescent home, long term care hospital, or domiciliary home, and has
resided there for at least 30 days.
services selectively to attract healthier enrollees or because less healthy beneficiaries are more likely to remain with their FFS physicians. In addition, HMOs may drive away patients needing more care, because they are more often subjected to queueing. Adverse selection could occur because less healthy beneficiaries are attracted by the comprehensiveness of HMO services and by the generally lower level of cost-sharing.

HCFA is concerned that risk-sharing plans may experience favorable selection, while the plans are concerned about potential losses associated with adverse selection. Beneficiaries are concerned about having adequate access to care, because less healthy beneficiaries may find it difficult to enroll or remain in a risk-sharing delivery system. As Thomas and Lichtenstein (1986b) note, at the heart of these concerns is the appropriateness of the AAPCC formula.

Because of the skewed distribution of medical expenditures among Medicare beneficiaries, risk-sharing plans could face large losses or reap substantial gains. Each year from 1977 to 1984, 5 percent of Medicare beneficiaries accounted for nearly 50 percent of Medicare's total expenditures. (The standard deviation of expenditures was nearly three times the mean.) A risk-sharing plan with even a small number of these expensive cases could be hurt financially. At the same time Medicare made no reimbursement for 36 percent of its beneficiaries in 1977 and 30 percent in 1984 (Waldo and Lazenby, 1984). Because the AAPCC does not adequately predict expected expenditures, it affords little protection to either the payer (Medicare) or the providers (risk-sharing plans) from possible selection effects.

In developing payment rates (whether capitation or DRG-based) the major problem is to define groups of patients that are homogeneous with respect to expected medical costs. Payment rates could then be varied across these groups. If patient groups are not homogeneous, a risk-sharing plan's success depends in part on the mix of enrollees attracted, providing them with an incentive to "cream skin" healthy beneficiaries. However, if the payment rate can be set to compensate for differences in expected expenditures, then biased selection need not be a problem.
Section II of this Note describes the methodology and data used to calculate and to update the AAPCC. Section III reviews some of the limitations of the AAPCC methodology. Section IV notes some of the proposals that have been advanced for refining the AAPCC. Section V discusses some alternative methods for setting capitation payment rates. This section also briefly reviews state experience in setting capitation rates for Medicaid programs. Section VI discusses promising avenues for further research. It notes some research that is currently underway and proposes the use of a newly available database, derived from the Long-Term Care Survey, to refine the AAPCC. Finally, Section VII describes an interim calculation--flawed, but feasible with existing data--of a revised adjustor to the AAPCC to reflect the higher costs of caring for the frail elderly. An appendix provides a detailed description of the computations necessary for this interim calculation.
II. AAPCC: CURRENT METHODOLOGY AND DATA

The AAPCC was first defined in late 1976 by regulations implementing the legislation that first permitted Medicare to enter into risk-based contracts with HMOs.\(^1\) Regulations implementing Medicare capitation provisions of TEFRA in 1985 and updating the rates in 1986 contain the most recent formula for calculating the AAPCC.\(^2\) The only factor that must be adjusted for in the AAPCC formula is location. The Congressional legislation required that other factors be incorporated if necessary to ensure the actuarial soundness of the formula, but it did not specify what these factors should be. The inclusion of these factors was left to the discretion of the Department of Health and Human Services. The regulations to implement the AAPCC formula were developed by HCFA. To satisfy the requirement for a locational adjusting factor, HCFA chose to make adjustments at the county level. The additional adjusting factors included in the AAPCC formula are age, sex, welfare status, and institutional status.

Separate rates are developed for the three Medicare populations aged, disabled, and beneficiaries with end stage renal disease (ESRD). Rates are calculated at the county level for aged and disabled beneficiaries and at the state level for ESRD beneficiaries (because of their limited numbers). HCFA develops separate rates for Medicare Part A (Hospital Insurance) and Part B (Supplementary Medical Insurance) services. The arithmetic mean Medicare reimbursement is calculated for each of 30 cells created by combinations of the demographic factors: five age groups, two sexes, and three statuses (institutionalized, not institutionalized with welfare, and not institutionalized without welfare).\(^3\) No demographic adjustments are made for ESRD recipients as

---

\(^1\)Social Security Amendments of 1972.


\(^3\)Age categories for aged beneficiaries are 65-69, 70-74, 75-79, 80-84, and 85 and over. The categories for disabled beneficiaries are under 35, 35-44, 45-54, 55-59, 60-64. Once a disabled beneficiary becomes age 65, he or she is classified as an aged beneficiary.
HCPA cannot "determine the significance of demographics in determining the cost" for this condition.\footnote{Federal Register, January 6, 1986, p. 508. In this rate book approach there are 122 cells with a different rate for each county (or state in the case of ESRD beneficiaries): 30 cells for aged beneficiaries for Part A; 30 cells for aged beneficiaries for Part B; 30 cells for disabled beneficiaries for Part A; 30 cells for disabled beneficiaries for Part B; 1 cell for ESRD beneficiaries for Part A; 1 cell for ESRD beneficiaries for Part B.}

The AAPCC formula is a product of three major components (Lubitz, Beebe, and Riley, 1985):

- The national per capita Medicare cost as projected to the current year (USPCC)
- Geographic adjustment factors based on the historical relationship between the county's and the nation's per capita cost (used to convert the national average per capita cost to the county level)
- An adjustment (based on the four demographic factors) for differences between beneficiaries who choose to enroll in an HMO and the population at large from which HMO enrollees are drawn.

\textit{Step 1.} The U.S. average per capita Medicare costs for each of Parts A and B are projected separately for the aged, disabled, and ESRD beneficiaries based on Medicare cost estimates prepared by HCPA's Office of the Actuary. The costs include loading factors for carrier and intermediary expenses.

\textit{Step 2.} Projected county per capita costs are not obtained directly. Instead, the historical ratio of county per capita cost to national per capita cost is computed separately for Parts A and B for each of the aged, disabled, and ESRD beneficiaries (actually state level averages are used for ESRD beneficiaries). Each ratio is calculated as an unweighted average of the ratio of county to national costs during the most recent five years available. The per capita costs are developed from the entire Medicare enrollment file and the aggregate amount of claims paid, which are tabulated by county. To estimate
projected county per capita costs from projected national per capita costs the six ratios are multiplied by the USPC.

At this point the county per capita cost estimates contain expenses associated with all beneficiaries in both FFS and prepayment systems. To obtain per capita cost estimates for the FFS sector only, the incurred Medicare costs and enrollment of prepayment delivery systems in the county are subtracted from the entire county (or state) cost and enrollment and the per capita cost is recomputed.

Step 3. The relative cost effects of the demographic factors (age, sex, welfare, and institutional status) are calculated for aged and disabled beneficiaries. For each of the aged and disabled groups there are 30 demographic cells for each of Parts A and B. The factor in each cell is the ratio of the average cost for a beneficiary with the particular demographic profile to the average per capita cost for all beneficiaries. The average costs are calculated using national Medicare data (a 100 percent sample). In other words, the demographic factors for each of the 30 cells are not calculated based on the average Medicare costs for each county.

The demographic factors are based on national data and were developed using three years (1974-76) of the Current Medicare Survey (CMS), which contained 20,000 beneficiary years of observations.

HCFA periodically updates only the relative cost effects of age and sex based on Medicare cost experience. No update has been made for the relative cost effects of welfare and institutional status as HCFA does not routinely collect data on institutional status (the definition of institutional status is considerably broader than the definition of care in skilled nursing facilities, which is reimbursed by Medicare and for which HCFA has data).

The final step in the computation of capitation payment rates for particular HMOs is not spelled out in detail in the regulations. HCFA analysts (Lubitz, Beebe, and Riley, 1985) explain, however, that capitation payments to a particular HMO are equal to the USPC times the

\[ \text{USPC} \times \text{Factor} \]

\[ \text{Factor} = \frac{\text{Average Cost of Benefit Group}}{\text{Average Cost of All Beneficiaries}} \]

The CMS was a beneficiary survey conducted by the Social Security Administration from 1973 to 1977 that measured functional impairment, institutionalization, out-of-pocket expenses, and other beneficiary attributes.
ratio of the county to the national PCC times a factor reflecting the average demographic profile of the HMO’s capitated Medicare enrollees, compared with the average demographic profile of the total Medicare-eligible population in the county. More specifically, this demographic adjustment factor has the following form:

\[
\frac{\sum (DF_i \times n_{HMO_i})}{N_{HMO}} \over \frac{\sum (DF_i \times n_{COUNTY_i})}{N_{COUNTY}}
\]

where \(DF_i\) is the demographic factor in cell \(i\), \(n_{HMO_i}\) is the number of HMO enrollees in cell \(i\), \(N_{HMO}\) is the total number of HMO enrollees, \(n_{COUNTY_i}\) is the number of Medicare beneficiaries in cell \(i\) in the county, and \(N_{COUNTY}\) is the total number of Medicare beneficiaries in the county.\(^6\) The numerator reflects the average demographic characteristics of the HMO enrollees, and the denominator reflects the average characteristics of the population from which the HMO enrollees are drawn. A value of the ratio greater than one indicates that the HMO enrolled a group expected to have higher than average utilization. Conversely, if the ratio is less than one, the HMO enrolled a group expected to have lower than average utilization, based on its demographic profile. The accuracy of this interpretation of the ratio hinges on the assumption that the four demographic factors accurately predict differences in expected medical utilization and cost.

\(^6\)The formula is drawn from an explanation of the AAPCC given by Trieger, Galblum, and Riley (1981).
III. LIMITATIONS OF THE AAPCC METHODOLOGY

The AAPCC methodology was first adopted ten years ago. At the time, data on the relative effects of all four demographic variables on medical expenditures were available through the Current Medicare Survey. Since that time, collection of a database with all four variables has been discontinued, precluding the ability to update two of the four factors (welfare and institutional status). Moreover, the validity of the original data has been subject to criticism (Trieger, Galblum, and Riley, 1981; Greenlick, 1985; OTA, 1986).

During the intervening years the AAPCC formula has been subject to empirical testing with various datasets by analysts within HCFA as well as independent health services researchers (Anderson, Resnick, and Gertman, 1982; Hornbrook, 1984; Beebe, Lubitz, and Eggers, 1985; Thomas and Lichtenstein, 1986a). All of the studies indicate that the four demographic factors explain less than 1 percent of the variance in medical care expenditures. In the actual implementation of the AAPCC a substantial spread in the payment rates across geographic areas (counties) has been observed. Some analysts argue that this spread is probably greater than the variation in the costs of serving enrollees (Greenlick, 1985; Newhouse, 1986). Finally, several analysts have criticized the limitations of the rate book approach used to set rates for beneficiaries with different demographic characteristics. This section discusses each of the four points of contention: data problems, poor predictive value, geographic spread, and rate book limitations.

DATA AVAILABILITY AND VALIDITY

Because data on all four factors are not routinely collected either in Medicare administrative records or in a continuing survey, the relative effects of welfare and institutional status can no longer be verified or updated. By not updating these factors, HCFA must assume that the relative effects of these two variables on medical expenditures have not changed over the past ten years.
However, the health care delivery system has undergone considerable restructuring, which may indeed affect the size and distribution of both the elderly cross-over population (the elderly eligible for both Medicare and Medicaid) and the institutional population. For example, provisions of the Omnibus Reconciliation Act of 1981 (OBRA) led to important changes in state Medicaid programs. Of particular relevance is a provision that permits states to apply for home and community-based care waivers in an effort to promote alternatives to long term care institutionalization. Over 30 states have taken advantage of this provision. Moreover, fiscal pressures on state budgets have caused many states to limit eligibility and benefits in their Medicaid programs and to implement case management programs. Within the Medicare program, the Prospective Payment System for hospital care may be altering utilization of post-acute care services, namely home health and skilled nursing facility care. Overall, the home health and hospice industries have grown a great deal over the past ten years, possibly altering the mix of patients entering institutional care facilities.

Even aside from the problem of old data, the method used to measure the initial effects of the four demographic variables has been criticized. Greenlick (1985) and analysts from the Office of Technology Assessment (OTA, 1986) note that data from the Current Medicare Survey used to collect information on reimbursable Medicare expenses and welfare and institutional status were based on beneficiary self-reports with all the limitations thus imposed. The validity of the data rests on the ability and willingness of respondents to correctly identify their status (e.g. with respect to the Medicaid program), to accurately recall their use of medical services, to know which services were covered by Medicare, and to know the dollar amount reimbursed by Medicare. Such data are susceptible to considerable underreporting (possibly because of forgetfulness) or overreporting (possibly because of not distinguishing between Medicare and non-Medicare covered services) and may thus be unreliable. Greenlick suggests that a better approach would have been to use Medicare claims data (for estimating expenditures and for verifying Medicaid status).
HOMOGENEITY OF RISK GROUPS

Drawing from a sample of Medicare data covering aged beneficiaries (sample size of 20,773), Beebe, Lubitz, and Eggers (1985) obtained independent variables from 1975 data to explain medical expenditures in 1976. Three AAPCC variables (age, sex, and welfare status) explained only 0.6 percent of the variation in medical care expenditures.\(^1\) Thomas and Lichtenstein (1986a) performed a similar analysis using all four demographic factors, using a dataset from Michigan (with a sample size of 1,934 Medicare beneficiaries). Independent variables obtained from 1982 data were used to explain expenditures in the first six months of 1983. In this case, the AAPCC factors explained only 0.3 percent of the variation. Two other studies provided similar findings (Anderson, Resnick, and Gertman, 1982; Hornbrook, 1984).\(^2\)

The poor performance of the AAPCC factors in explaining medical care expenditures creates the potential for biased selection and its attendant problems. At issue is the comparability of the FFS population used to develop the rate and the prepayment population to which the rate is applied. Risk groups defined by the AAPCC contain very unhomogeneous risks within a given group. Because of the wide within-group variations in expected expenditure, it is possible for the two populations to have entirely different expected expenditures even when the demographic profiles are the same, thus leading to the problems of underpayment or overpayment or possible discrimination against high risk beneficiaries.

\(^1\)Data on institutional status were not available from Medicare records because the definition of institution in the AAPCC is considerably broader than the Medicare benefit covering skilled nursing facilities.

\(^2\)These results are hardly surprising because studies that model determinants of medical care utilization never rely solely on demographic factors. For example, Andersen's behavioral model of health services utilization proposes three sets of factors: predisposing (age, sex, education); enabling (income, insurance--private Medi-gap supplementary health insurance--and area resource factors); and medical need (perceived health status, disability days). Nevertheless, the empirical studies described above laid the groundwork for establishing the inadequacy of the present AAPCC factors.
Two studies of the Medicare population comparing the pre-enrollment history of beneficiaries in HMOs with beneficiaries remaining in the FFS sector showed that HMO enrollees used fewer services than FFS beneficiaries when both were still in the FFS sector (Eggers, 1980; Eggers and Prihoda, 1982). These differences persisted even after adjustment for age, sex, welfare, and institutional status. Eggers reported that HMO enrollees' hospital inpatient utilization was 52-62 percent lower and their per capita costs were 40-50 percent lower than in the comparison group. These studies also provide evidence of large variation in expenditures within AAPCC classes. Apparently, selection factors for which the AAPCC does not control can affect enrollment, utilization, and cost in HMOs.

Welch indicates that biased selection may be less of a problem over the long term than it is in the short term, because of regression to the mean: Individuals who are very healthy when enrolling in HMOs become less healthy and require more services over time. Hence, the value of selecting healthy enrollees decreases over time. Newhouse, however, argues that because of the large differences in prior utilization between HMO enrollees and beneficiaries remaining in the FFS sector, selection could be a considerable problem. He is not convinced that regression to the mean significantly reduces the problem of selection because many factors that predict future medical expenditures are observable to a delivery system. In a study of selection behavior in the Twin Cities (an area with a large HMO enrollment) Dowd and Feldman (1985) did not support the hypothesis that biased selection is a short term problem. They found significant differences in enrollee characteristics that affect expected medical expenditures (e.g., long-standing medical conditions such as arthritis or diabetes) between different HMOs.

As a report by the Office of Technology Assessment (OTA, 1986) notes, if great differences exist in the profit that can be made from enrolling low risk beneficiaries, plans will find it in their interest to emphasize marketing strategies rather than (or perhaps in addition to) efficient delivery of care. This could cause access problems for high risk beneficiaries. The 30-day open enrollment period is intended
to mitigate such problems, but the OTA analysts report that biased selection may still have occurred. A recent General Accounting Office (GAO) report provides some supporting evidence for biased selection favoring risk-sharing plans (Cantwell, 1986). GAO analysts examined mortality rates of HMO enrollees and found that they were "significantly lower" than actuarially projected. In its report to Congress the GAO charges that Medicare payments to many HMOs are "probably too high."

If favorable selection is occurring and capitated systems acquire a nonrepresentative group of enrollees, overpayments to HMOs arise from two sources. In the short term, HMOs are overpaid because they attract healthier than average enrollees within the actuarial classes but are paid on the basis of average costs. In the long term the AAPCC will be inflated in subsequent years by the less healthy enrollees remaining in the FFS sector, so HMOs will receive even higher payments. The increasing divergence in the distribution of beneficiaries will lead to an increasing divergence between FFS costs and HMO costs, with HMOs reaping the benefits.

As evidence mounts that favorable selection may be occurring resulting in overpayments to some HMOs, it is also possible that HMOs with a greater distribution of less healthy enrollees (within the AAPCC actuarial classes) are being underpaid. In particular, at least two risk-sharing capitation systems serve the frail elderly (On Lok Senior Health Services in San Francisco exclusively serves a population certified for institutionalization at least at the intermediate care level, and Senior Health Plan in Minneapolis attempts to attract the frail elderly).

The AAPCC is likely to result in underpayment because within the actuarial classes the frail elderly probably have the highest expected expenditures. A payment based on the average rate within these demographic cells is likely to be inadequate. Risk-sharing plans with an even distribution of patients are able to balance the higher than average needs of frail patients with the lower than average needs of healthier patients. Delivery systems serving the frail elderly exclusively or almost exclusively are unable to strike this balance.
Moreover, because the enrolled population of these two plans consists of persons at high risk of needing services, there will be less variation in costs than is reflected in the adjustment for the four AAPCC factors (Winn and McCaffree, 1979). All of the beneficiaries are likely to have similar resource requirements regardless of their actuarial class. The primary determinant of service utilization and expenditures will probably be the poor health status of these enrollees, and it is likely to override the demographic effects.

HCFA compensates for the higher needs of these patients by paying a frailty adjustment, which is set at the institutional rate. However, a study funded by HCFA showed that Medicare per capita costs tended to be higher for frail individuals receiving community-based care. HCFA discounted the findings of the study because it was generally assumed that costs are higher in institutional settings. Although this assumption is plausible with regard to total costs (Medicare cost plus Medicaid cost plus out of pocket cost), it may not be correct for Medicare costs only, because the Medicaid program picks up a large share of institutional costs. Acknowledging the limitations of the AAPCC as currently formulated, HCFA is testing a payment scheme that incorporates prior utilization in its payments to Senior Health Plan (discussed in the next section).

Although the issues just discussed are problems for primarily two HMOs, the growth of specialized delivery systems may extend the effect of these problems. Although most HMOs currently serve employed populations, HMOs in the future may start to specialize by selecting certain types of enrollees or by delivering certain types of services. Much interest has already been expressed in the development of social HMOs, prepaid delivery systems combining medical and social services to serve the acute care and long term care needs of their elderly enrollees. Moreover, On Lok Senior Health Services has been awarded funds from a private foundation to work with organizations nationwide to test the feasibility of developing a similar range of services to serve the impaired elderly. Although these organizations include hospitals, community health programs, and a nursing home, all will adopt the HMO-like financing model developed by On Lok. The development of these
risk-based long term care programs may have some attractive features (reducing fragmentation of services, providing an efficient mix of services). However, the inadequacy of the AAPCC as currently formulated may impede the growth of such programs by failing to adjust for the higher risks of the target population of enrollees.

The AAPCC as currently constructed fails to protect the government from overpayments associated with favorable selection, it fails to protect HMOs from the risks of potential losses due to adverse selection, and it fails to adequately protect the interests of high-risk beneficiaries who may have difficulties in enrolling or remaining in risk-sharing plans.

GEOGRAPHIC VARIATION IN RATES

The wide geographic variation in payment rates has come under scrutiny (Trask, 1986; Greenlick, 1985). For example, Greenlick reports that the five AAPCC rates in the five counties of the Portland metropolitan area vary by a factor of two. He argues that annual costs of caring for Medicare beneficiaries are unlikely to vary that much among contiguous counties. An HMO that operates in both Miami and Tampa, Florida reports that its AAPCC rate differs by about $100 per enrollee between the two areas, even though its costs are not that different (it dropped its Tampa risk-sharing contract). In comparing rates for selected Florida counties, the GAO reported that 95 percent of the AAPCC ranged from $193 to $372 (for a male, aged 75-79, noninstitutionalized, and non-Medicaid, combining Parts A and B).

Freund (1985) argues that there is tremendous regional variation in practice style that HCFA may not wish to reimburse for. For example, if an area's high AAPCC reflects an elaborate style of practice, HCFA may not want to build that into the rate paid to risk-sharing plans. Ideally, HCFA should reimburse for differences in practice and living costs across regions, but not for variations in practice patterns.

Newhouse (1986) notes that the variation in geographic rates may be due to using individual county means to estimate per capita cost at a county level. He suggests a statistical technique that provides a better estimate of the true mean per capita cost for many counties.
RATE BOOK LIMITATIONS

The current use of the AAPCC requires the application of a "rate book" to specify a payment rate based on the individual's characteristics. "Rate book" is an actuarial term that refers to the process HCFA uses to calculate the AAPCC. The average Medicare cost is calculated for each of the 30 demographic cells, representing different demographic profiles; it is compared with the Medicare average cost for all beneficiaries. Greenlick (1985) notes that this approach limits the number of factors that can be used to adjust the AAPCC rate. If additional factors are included, the number of cells would rapidly expand beyond 30 (depending on the number of values each factor could take) and individual table look-up would become administratively infeasible. He suggests using regression analysis or other population estimation techniques to determine risk adjustment factors. For example, different measures of health status could be gathered from interviews, surveys, or medical charts. Regressions could be run on patient-level data to determine the effect of health status and the other adjustment factors on Medicare costs. It would not be necessary to look up the factor for each type of beneficiary in a table, the regression coefficients could be used to make the appropriate adjustment, determining the payment level.\(^3\) Therefore, by eliminating the rate book approach, more factors could be incorporated as adjustors; and they could be estimated from samples of Medicare beneficiaries.

This regression approach will be administratively attractive only if the adjustment factors included lend themselves to payment adjustment in accordance with a fairly simple functional form, such as the additive form noted here. This may not be the case, however. Sex, for example, may be a useful predictor of health care expenditures for a healthy population; but for an impaired population, sex differences may disappear. Thus, the adjustment for sex (d in the example given here)

\(^3\)The following is an example of such an equation:

\[
\text{payment} = a + b(\text{HEALTH STATUS}) + c(\text{AGE}) + d(\text{SEX}) + e(\text{WELFARE STATUS}) + f(\text{INSTITUTIONAL STATUS})
\]

The coefficients (a, b, c, d, e, f) could be estimated from a sample of beneficiaries and then used to set the payments for all beneficiaries.
may vary as health status varies. A formula incorporating this variation in coefficients might have become quite complex, and a rate book--however cumbersome--might be preferable.
IV. REFINING THE AAPCC

Analysts have suggested various approaches to refine the AAPCC (Anderson and Knickman, 1984; Beebe, Lubitz, and Eggers, 1985; Luft, Trauner and Maerki, 1985; Lubitz, Beebe, and Riley, 1985; Newhouse, 1986; Thomas et al., 1983; Thomas and Lichtenstein, 1986a,b). Many advocate the incorporation of additional adjustors, such as prior utilization, disability, health status, and health risk factors. The purpose of the additional adjustors is to improve the predictive ability of the AAPCC formula in predicting expected medical expenditures, thus facilitating the creation of more homogeneous patient risk groups.

By paying risk-sharing plans in proportion to the expected cost of enrollees, the reimbursement scheme can diminish the incentive to cream skim and can increase access for high risk beneficiaries. The adoption of additional adjustors will not require legislative changes. The TEFRA legislation permits the modification of the AAPCC factors to ensure actuarial soundness. It did not specify the current factors, but only required that an adjustment for location be incorporated. If the rate book approach is retained, introducing new underwriting factors is a problem unless the adjustment for institutional status is dropped.

This section reviews the adjustors that have been proposed, presents empirical information on their ability to predict medical expenditures, and discusses their benefits and limitations. The adjustors considered include:¹

¹Although some analysts have advocated the inclusion of other demographic variables in the AAPCC formula, a study by Thomas and Lichtenstein (1986a) showed that adding income, education, and marital status to the AAPCC factors increases the percentage of variance explained to only 0.8 percent (rather than 0.3 percent for the AAPCC factors alone). Welch (1985) points out that some variables may predict expenditures in conventional insurance plans but not prepayment plans. For example, income may be more important in conventional insurance because cost sharing requirements are typically larger in such plans. Excluding such variables from the AAPCC may not be a problem.
Prior reimbursement and prior utilization (with and without diagnostic information)

Former disability status of aged enrollees in the Medicare program

Health status: perceived health status and functional status

Health risk factors

Determining the feasibility and desirability of each of these alternatives requires consideration of both conceptual and practical issues. The factors should improve the AAPCC in that they increase its predictive ability with respect to medical expenditures, but they should also be feasible in that reliable measures of the adjustors exist and HCFA or the delivery system can readily acquire the requisite data. The criteria for desirable adjustors include:

1. The set of adjustors should result in reasonably homogeneous risk groups with respect to expected medical expenditures. In other words, all patients within a risk group should have roughly the same level of expected Medicare expenditures. The payment level would therefore adequately reflect the expected costs.

2. Adjustors should be fairly easy to collect and should not have excessive costs associated with the collection effort. For example, such adjustors as prior utilization, age, and sex appear in Medicare administrative files for each beneficiary. Such adjustors as functional status are not currently collected by HCFA and would require the development of new efforts to collect the data.

3. Adjustors should be reasonably cheap to verify or audit so fraud can be minimized. For example, if adjustors are currently part of Medicare data files, they will be cheap to audit and verify. Such subjective measures as perceived health status would be difficult to verify because new data would have to be collected and they are not based on objective criteria.
4. An adjustor should reflect patient characteristics indicating health status and the expected need for services. It should exclude measures that depend on the practice style and subjective judgments of individual providers, so that it is not subject to manipulation techniques that classify patients in higher reimbursement categories. For example, prior use reflects both the patient's health status and the provider's decisions regarding treatment. If payment were based on prior use, providers could increase their payment by providing more services.

5. Adjustors should reflect chronic risk for the year and not acute short term risk. This criterion is particularly important if conditions or expenditures in the previous year are used to set payments for the current year. Acute conditions, such as self-limiting illnesses or a nondebilitating injuries, are not good predictors of future expenses. However, chronic conditions can be expected to influence medical expenditures over a long period of time.

In considering additional adjustors for capitation payment rates, it is important to keep "Campbell's Law" in mind (Campbell, 1975)--any measure on which payments are based is thereby corrupted. This suggests that only easily verifiable, nonsubjective measures should be considered as potential adjustors for capitation rates.

PRIOR USE

Prior use of medical services can be viewed as an indirect measure of health status as well as a reflection of a patient's proclivity to seek care (which may remain fairly constant over a period of time). It can therefore be used to predict future expenditures. The assumption is that those with poorer health status will use more services and incur more expenses than those with better health. Measures proposed to incorporate a factor for prior use can be categorized into three groups:
• Prior payments
• Prior utilization of inpatient care and/or outpatient care with no diagnostic information
• Prior utilization of inpatient care and/or outpatient care with diagnostic information.

Thomas and Lichtenstein (1986a) empirically tested the predictive ability of prior payments on future medical expenditures, using a sample of 1,934 Medicare beneficiaries in Michigan.² As the sole independent variable, prior year payment explained 5.7 percent of the variation in future expenditures, a substantial improvement over the 0.3 percent that the AAPCC factors were able to explain when used alone in the same dataset. Incorporating the AAPCC factors with the prior payment variable added little to the predictive ability, explaining 5.9 percent of the variation.

Beebe, Lubitz, and Eggers (1985) developed an AAPCC formula incorporating prior utilization variables available from Medicare administrative records. They restricted themselves to variables already being collected, so the formula could be easily implemented. Three measures were used to indicate prior utilization: (1) whether the enrollee was hospitalized in the previous year, (2) number of hospital days in the previous two years, (3) whether the Medicare Part B deductible was met in the previous two years. Three of the four AAPCC demographic variables were incorporated in the formula (age, sex, and welfare status). The analysts omitted institutional status because it cannot be determined from Medicare data files.

Data from 1974 and 1975 were used to predict 1976 Medicare expenditures for a sample of 20,773 Medicare beneficiaries. The dataset contained only the aged beneficiary population (not disabled and ESRD beneficiaries). Using the three measures, the analysts developed two

²Total Medicare payments made in 1982 were used to predict expenditures in the first six months of 1983. For Part A hospital inpatient services, each discharge was assigned to a DRG. A standardized average Medicare payment was calculated for each DRG to eliminate the effect of hospital rate and cost differences.
models. The first model incorporated the three demographic factors and the binary variable indicating whether a beneficiary had been hospitalized in the previous two years. It explained 2.2 percent of the variation in expenditures. The second model used the demographic variables, days in the hospital during the previous two years, and two binary variables indicating whether the Part B deductible was met in each of the two previous years. It performed slightly better, explaining 4.3 percent of the variation in expenditures.

The second model performs better possibly because it incorporates two years of previous utilization rather than one year as in the first model. Moreover, its hospital use measure, number of days in the hospital, provides some indication of whether a person was hospitalized for a short time, possibly indicating an acute condition unlikely to affect future expenditures, or a long time, possibly indicating a more serious or chronic condition likely to affect future expenditures. It also partly indicates the number of times a person was hospitalized, whereas the first measure equates all hospital stays regardless of duration and does not distinguish between one stay or many stays. In the first model a person who had a hospital stay of one day is not distinguished from a person who may have had several long hospital stays because it indicates only whether a hospital stay occurred and is not weighted by the number of hospitalizations.

Applying similar models to the Michigan dataset, Thomas and Lichtenstein (1986a) explained slightly more of the variation. The first model, indicating whether the beneficiary was hospitalized, explained 4.6 percent of the variation; the second model explained 5.0 percent of the variation.\(^3\) This study used all four AAPCC factors. Moreover, only six months of future expenditure were being predicted, whereas Beebe, Lubitz, and Eggers included 12 months of future expenditure. This might help to explain the higher percentages of variance. Thomas and Lichtenstein found a smaller difference between

---

\(^3\)Thomas and Lichtenstein's second model was slightly different from that of Beebe, Lubitz, and Eggers. It included number of hospital days over a one year period instead of two, and it had only one binary variable for whether the Part B deductible was met in the previous year instead of two binary variables.
the two models than did Beebe and colleagues. Part of the difference in
the two studies was that Thomas and Lichtenstein incorporated only one
year of prior utilization in both models, whereas Beebe, Lubitz, and
Eggers used two years of utilization in their second model rather than
one year in the first.

Thomas and Lichtenstein (1986b) refined the first model by
distinguishing between the number of hospitalizations. The prior use
measures were reimbursement but no hospitalization, one hospitalization,
and more than one hospitalization. These measures plus the AAPCC
factors explained 7.1 percent of the variance in expenditures,
exhibiting a better performance than the one that included number of
hospital days. Another prior use model tested by these analysts,
incorporating number of hospital admissions, number of part B claims,
and number of emergency room visits, explained the same amount of
variance (7.2 percent). In any event, the prior utilization models
performed much better than the AAPCC alone, and this latter group
performed even better than the prior payments model. Moreover, the
prior utilization models performed almost as well without the AAPCC
demographic factors as they did with them. Table 1 shows the
improvement achieved by adding the AAPCC factors to the models; it lists
some of the prior use measures and the amount of variance each explains
in predicting Medicare expenditures. To determine the incremental
effect of adding the AAPCC factors to the prior use models, compare the
amount of variance explained for the same models with and without the
AAPCC.

Another refinement would add information about diagnoses associated
with hospitalization, particularly for chronic conditions. A
shortcoming of the approaches described above is that they do not
distinguish high users who had self-limiting acute conditions from those
with chronic conditions that will continue to generate higher medical
expenditures over time. The University Health Policy Consortium (UHPC)
at Brandeis University is conducting research for HCFA on models that
incorporate both prior use and prior diagnosis information (Anderson and

^Thomas and Lichtenstein applied the prior payments and prior
utilization models to the same dataset.
<table>
<thead>
<tr>
<th>Model</th>
<th>Percentage of Variance Explained</th>
<th>Analysts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, sex, welfare status</td>
<td>0.6</td>
<td>Beebe, Lubitz, and Eggers</td>
</tr>
<tr>
<td>AAPCC</td>
<td>0.3</td>
<td>Thomas and Lichtenstein</td>
</tr>
<tr>
<td>Prior year payments</td>
<td>5.7</td>
<td>Thomas and Lichtenstein</td>
</tr>
<tr>
<td>Prior year payments + AAPCC</td>
<td>5.9</td>
<td>Thomas and Lichtenstein</td>
</tr>
<tr>
<td>Hospitalized in past year + age, sex, welfare</td>
<td>2.2</td>
<td>Beebe, Lubitz, and Eggers</td>
</tr>
<tr>
<td>Hospitalized in past year + AAPCC</td>
<td>4.6</td>
<td>Thomas and Lichtenstein</td>
</tr>
<tr>
<td>Hospital days in past 2 years, Part B</td>
<td>4.3</td>
<td>Beebe, Lubitz, and Eggers</td>
</tr>
<tr>
<td>deductible met in past year, Part B ded.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>met in 2 years past, and age, sex, welfare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital days in past year, Part B ded.</td>
<td>5.0</td>
<td>Thomas and Lichtenstein</td>
</tr>
<tr>
<td>met in past year, and AAPCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reimbursement but no hospitalization, 1 hosp, More than 1 hosp, and AAPCC</td>
<td>7.1</td>
<td>Thomas and Lichtenstein</td>
</tr>
<tr>
<td># admissions, # Part B claims, # ER visits</td>
<td>7.0</td>
<td>Thomas and Lichtenstein</td>
</tr>
<tr>
<td># admissions, # Part B claims, # ER visits, and AAPCC</td>
<td>7.2</td>
<td>Thomas and Lichtenstein</td>
</tr>
<tr>
<td>Reimbursement but no hospitalization, non-high cost diagnosis (dx), secondary dx, high cost dx with 20 day stay or less, high cost dx with greater than 20 day stay.</td>
<td>6.3</td>
<td>Thomas and Lichtenstein</td>
</tr>
<tr>
<td>No prior use, Part B use only, non-chronic hosp, chronic hosp, repeated hosp for cardiac and musculoskeletal conditions and cancer, AAPCC</td>
<td>9.0</td>
<td>Gruenberg et al.</td>
</tr>
</tbody>
</table>
Gruenberg, 1983). The models use information on hospital diagnosis that has been collected in Medicare files for all beneficiaries since 1984 (before that it was collected for a 20 percent sample).

Chronic diagnoses were defined by whether they were expected to result in substantial further medical costs following the hospitalization. Such chronic diagnoses were further classified according to whether the patient had more than one hospitalization for cardiac or musculoskeletal conditions or cancer. This final group consisted of about 1 percent of all Medicare beneficiaries with very high current and expected future use. Subsequent expenditures for this group were about 3.5 times the average (Gruenberg et al., 1985).

The measure of prior use with diagnostic information consisted of five items: no prior use, Part B use only, hospitalization for a nonchronic condition, hospitalization for a chronic condition, and repeated hospitalizations for cardiac or musculoskeletal conditions or cancer. This model, consisting of the five items and the AAPCC factors, predicted about 9 percent of the variance in expenditures, indicating that it is important to distinguish between acute and chronic conditions when using prior use variables to predict future expenditures.

Thomas and Lichtenstein (1986b) tested another model developed by Anderson, Resnick, and Gertman (1982), which incorporated diagnostic information. The model included the current AAPCC factors; Part B use but no hospitalization; if hospitalized whether the primary diagnosis was on a high cost diagnosis list; if so, whether hospital days for the high cost episode exceeded 20 days; and whether a secondary diagnosis was present. This model explained 6.3 percent of the variance, which is close to the performance of the prior utilization measures without diagnostic information in the Thomas and Lichtenstein dataset.

All of the prior use measures reviewed improve the ability to predict medical expenditures over the four AAPCC variables. In terms of practical considerations, incorporation of an adjustor based on prior use would seem to be an easy way to improve the AAPCC formula. The data
already exist in Medicare claims files for fee-for-service beneficiaries, minimizing collection and auditing costs.\(^5\)

A problem exists when newly entitled Medicare beneficiaries join a risk-sharing plan. The Medicare program has no data on the utilization of these beneficiaries in the FFS sector because they were not enrolled in Medicare while they were using services on a FFS basis. Another problem exists in terms of updating rates after the enrollee has been in prepayment plans for several years. Once a beneficiary joins a prepayment plan, current regulations require that the plan report only hospital stays. It would therefore be difficult to calculate or update a rate based on prior utilization measures (other than the variable indicating hospitalization) for beneficiaries who have been enrolled in risk-sharing plans for several years. In addition, the prior payment measure is not appropriate for enrollees of capitated plans because it merely reflects the previous year's capitated rate. One alternative would be to use the plan's accounting costs. The UHPC is developing a model that uses diagnostic information available after HMO enrollment to update payment levels set at the time of enrollment (Lubitz, Beebe, and Riley, 1985).

Even though prior utilization improves the ability to predict medical expenditures and is administratively feasible in terms of data collection, other aspects of this measure may diminish its attractiveness as an adjustor for the AAPCC. McClure (1984) discusses the incentive effects of this measure. He states that after the first year or two of enrollment in a risk-sharing plan, prior use reflects experience in the plan. It is a result, therefore, not just of the patient's condition but also of the provider's style of practice, and so is vulnerable to provider manipulation. If used as the sole basis for setting capitation levels, the adjustors would resemble an experience rating approach, leading to incentives similar to those in retrospective, cost-based reimbursement. Providers can increase their capitation rate in following years by increasing the quantity of services provided in the current year.

\(^5\)As with any other adjustor considered, institutional status would have to be dropped as an adjustor unless new efforts were made to collect this variable again so that the relative risks of institutionalization on medical expenditures can be measured.
Lubitz, Beebe, and Riley (1985) argue that the incremental increase in the payment rate received as a result of increasing "unnecessary" hospital utilization would not fully compensate for the increase in costs, thus diminishing incentives to adopt more "elaborate" practice styles. However, Newhouse (1986) is not convinced by this argument because "decisions are made at the margin." His counterargument is that a not very sick person may be kept out of the hospital if no adjustment is made for prior utilization, but may be hospitalized if such an adjustment is made.

At least two demonstration projects are or will be testing prior use adjustors. Under a federal demonstration waiver, Maryland plans to retroactively adjust the capitation rates paid to two HMOs, based on the utilization history of enrollees (Lubitz, Beebe, and Riley, 1985). The prior utilization model (consisting of hospital days in previous two years, whether Part B deductible was met, age, sex, and Medicaid status) developed by Beebe, Lubitz, and Eggers (1985) is being tested by Senior Health Plan, a Medicare demonstration project in Minneapolis. The payment rate is set at 95 percent of this new AAPCC for enrollees with two years of utilization history. For enrollees with less than two years of utilization experience, Medicare uses the regular AAPCC formula based solely on demographic factors.

Senior Health Plan attempts to serve primarily "frail" elderly, a group for which the usual AAPCC formula is unlikely to provide adequate payment. The HMO provides Medicare Part A and B services with no limit on hospital or nursing facility days. Some community-based social services are also provided. Lubitz, Beebe, and Riley (1985) report that in the first month of testing the new formula the HMO received about 20 percent more than it would have under the usual AAPCC.

FORMER DISABILITY STATUS

Lubitz, Beebe, and Riley (1985) compared the average Medicare reimbursement for formerly disabled (before turning 65 and becoming reclassified as "aged" beneficiaries rather than "disabled" beneficiaries) and nonformerly disabled beneficiaries. The sample consisted of 1 percent of the aged Medicare population (250,000
beneficiaries) of whom 6 percent were formerly disabled. The average Medicare reimbursement for the formerly disabled group was 56 percent higher than for nonformerly disabled beneficiaries ($1704 and $1091, respectively). However, the analysts did not report testing this adjustor using regression analysis to determine its effect on predicting medical expenditures.

Adding former disability status to the AAPCC is administratively feasible. It already exists in Medicare data files, so collection and auditing costs are minimized. It also seems unlikely to be susceptible to provider or patient manipulation (e.g., by having individuals unduly certified as disabled). However, there is a problem for enrollees who develop chronic disabling conditions after age 65. Medicare administrative records do not contain information on their disability status, because their entitlement is based on being aged.

Only about 11 percent of Medicare beneficiaries are disabled (some 3 million individuals). Newhouse (1986) notes that this adjustor will not explain any variance in the large majority of beneficiaries not disabled. Moreover, this adjustor could be applied to only one population of Medicare beneficiaries, the aged. It cannot be used for beneficiaries entitled solely on the basis of disability. Therefore, this measure alone will not solve the problems of the current AAPCC. If further testing of this measure proves that it would be beneficial to add it to the AAPCC formula, it could be incorporated with other refinements as well.

HEALTH STATUS

As expected, health status is an important determinant of medical expenditures (Manning, Newhouse, and Ware, 1982). It can be represented by self-reports of perceived health status (excellent, good, fair, poor); functional measures (activities of daily living or instrumental activities of daily living); number of chronic conditions; and other diagnostic information.

Thomas and Lichtenstein (1986a,b) empirically tested the predictive values of similar measures, alone and in combination with the AAPCC factors. In particular, they tested two measures of self-reported perceived health status: a single item measure asking, "Compared with
others your age, would you say your health is excellent, good, fair, or poor?" and a multiple-item measure, consisting of nine questions with Likert-scaled responses ranging from very satisfied (assigned a value of 1) to very dissatisfied (assigned a value of 4). The responses to each question were summed to get a single score.

Perceived health status may not necessarily reflect changes in objective health status. For example, a person's health may deteriorate, but his perception of his health may not change if he believes others the same age have the same or greater levels of deterioration. Recognizing these limitations, Thomas and Lichtenstein also incorporated more objective measures of health status into their analysis. They tested two widely accepted functional health status scales: the activities of daily living (ADL) and the instrumental activities of daily living (IADL). A final measure, also employed by Thomas and Lichtenstein, was simply a count of the number of reported chronic conditions (from a list of 23 adapted from the National Health Interview Survey). It included such conditions as hypertension, arthritis, heart disease, stroke, and cancer. Such a measure provides an indication of the number of chronic comorbidities, but it counts all types of chronic illnesses equally, which is a very crude approximation.

All of the measures achieved better predictive ability than the AAPCC factors alone. Of the models using a single health status measure, the best performance was achieved by the IADL (explaining 3.2 percent of the variance in expenditures). The poorest models were the ADL alone (1.0 percent) and the count of chronic conditions (1.1 percent). Perceived health status was an intermediate performer (2.3 to 2.4 percent). Adding the AAPCC demographic variables to each health status measure only slightly improved on the proportion of variance explained.

---

6 The ADL scale counts the number of a defined set of activities (such as eating, dressing, bathing, going to the toilet) that an individual can perform without assistance. The IADL scale consists of a more difficult set of activities, designed to provide a measure of functional status that can more clearly differentiate between individuals with different levels of impairment.
One of the difficulties with including health status as an adjustor to the AAPCC is the lack of availability of this type of information to the Medicare program. New data collection efforts would have to be mounted. McClure (1984) suggests putting the onus on the risk-sharing plan. HCFA could assume that the health of all enrollees was good, unless the plan provided evidence otherwise. However, even this type of system would require the development of a standard set of criteria or measures to be used as evidence of poor health status.

Using health status measures retrospectively to explain past variations in health care costs is quite a different matter from using these same measures prospectively to determine payment levels. No matter how carefully health status measures are constructed, and no matter how detailed the descriptions of different health states become, some degree of subjectivity will almost certainly remain. That some health status measures have proved reliable and meaningful in a research context is no guarantee that similar measures will prove equally reliable and meaningful when patients' and providers' interests are at stake. Indeed, one might expect that they will not. At the very least, then, increased reliance on health status measures for reimbursement purposes will have to be accompanied by increased auditing and verification efforts. Whether this auditing and verification can be made effective and whether its costs—in financial and administrative terms—can be kept low enough to allow some net benefit from the use of health status measures are both far from clear.

Because health and functional status can change, measurements would have to be made repeatedly, posing the problem of how to avoid penalizing plans that improve the health and functional abilities of their enrollees. If the HMO improves the health status of an individual, it may receive a lower payment later. Conversely, HMOs that allow their enrollees' health status to deteriorate would be paid a higher capitation rate. Perhaps ethical considerations and fears of malpractice litigation would be sufficient to prevent "strategic" reductions in enrollees' health status. However, there is understandable concern about instituting incentives that reward undesirable behavior.
In general, measures of health status have not performed as well as the measures of prior utilization and reimbursement as predictors of care costs. Part of the reason for this finding is that utilization of medical services reflects not just health status, but other variables as well (income, availability of a regular source of care, etc.). Measures based on prior utilization incorporate—at least to a degree—the effects of these other variables.

Considering predictive ability and availability of data, models based on prior utilization appear superior. However, other criteria are relevant. Health and functional status may reflect longstanding conditions requiring future medical care better than do measures of prior utilization, which incorporate the use of services for both acute and chronic conditions. A more important problem is that prior use is determined not just by patient risk characteristics, but also by provider styles of practice. Health and functional status measures may more closely reflect patient risk characteristics. Another concern is that functional status can be observed by providers and used for skimming if no adjustments are made. Clearly, the choice of which adjustor to use will involve tradeoffs among these criteria.

In a later study, Thomas and Lichtenstein (1986b) added the IADL measure to models having prior use measures, increasing the amount of variance in expenditures that was explained. Table 2 shows the results and compares the amount of variance explained with and without the addition of the IADL measure.

HEALTH RISK FACTORS

Because of the incentive problems associated with prior use measures, Howland (1986) recommends using health risk factors to improve the AAPCC. He defined risk factors as measures that affect or help to predict future health status. He tested a model incorporating both behavioral and physiological risk factors, such as smoking, blood pressure, inspiratory capacity, blood glucose levels (for women), subscapular skinfold (for men), and cholesterol levels. Unlike the other researchers, Howland chose the frequency of hospitalization (rather than medical expenditures) as the dependent variable to be
Table 2
THE PERCENTAGE OF VARIANCE EXPLAINED BY HEALTH STATUS AND FUNCTIONAL STATUS MODELS

<table>
<thead>
<tr>
<th>Model</th>
<th>Percentage of Variance Explained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No IADL</td>
</tr>
<tr>
<td>Hospitalized in previous year, AAPCC</td>
<td>4.6</td>
</tr>
<tr>
<td># hosp days, AAPCC</td>
<td>3.9</td>
</tr>
<tr>
<td># Hosp Days, Part B Deductible met, AAPCC</td>
<td>5.0</td>
</tr>
<tr>
<td>Reimbursed but no hosp in previous year, 1 hosp, more than 1 Hosp, AAPCC</td>
<td>7.1</td>
</tr>
<tr>
<td>Reimbursement but no hospitalization, non-high cost diagnosis, secondary diagnosis, high cost diagnosis with 20 prior year payments, AAPCC</td>
<td>6.3</td>
</tr>
<tr>
<td>Past year reimbursement, age, sex</td>
<td>5.8</td>
</tr>
<tr>
<td>Reimbursed but no hosp, 1 hosp, more than 1 hosp, # Part B claims, # ER visits, age, sex</td>
<td>9.6</td>
</tr>
<tr>
<td>1 hosp, more than 1 hosp, # Part B claims, age, sex</td>
<td>9.2</td>
</tr>
</tbody>
</table>

Source: Thomas and Lichtenstein (1986b).
predicted. Adjustors in the model included demographic factors (age, marital status, education), prior utilization (frequency of hospitalization during a previous two year period), and health risk factors. This model explained 10 percent of the variation in hospitalization among men, but only 3.6 percent of the variation among women.

Howland argues that many risk factors (at least the physiological ones) cannot be manipulated as easily as previous utilization and functional health status, thus mitigating some of the undesirable incentive effects of these other adjustors. Although the measurement of many risk factors is fairly straightforward, the use of such chart-based data would pose new collection requirements on the Medicare program. There are few risk factors for which much is known. The Framingham study was able to develop risk factors for only 44 percent of hospital discharges.

It is difficult to compare this model with the other models reviewed given that the dependent variables are different. Inclusion of health risk factors may be a promising avenue of research in efforts to improve the AAPCC, but ethical considerations may influence the feasibility of this approach. Newhouse (1986) discusses the problems of setting payments based on such risk factors as blood pressure. If payment is based on the observed (treated) blood pressure, the payment may be too low because treatment has probably reduced the blood pressure from its originally higher level. To accurately reflect the risk, payment should be based on the untreated blood pressure level, but this value is unobserved. Howland's study is the first attempt to explore the feasibility of a risk factor approach. Perhaps with a more careful selection of risk factors the performance of the model can be improved.

SUMMARY: REFINING THE AAPCC

McClure (1984) suggests that the ideal capitation risk adjustment system should eliminate all cost variations caused by patient risk but not those caused by provider inefficiencies. He emphasizes that it is acceptable for per capita costs of patients in a given risk group to vary considerably as long as all variations can be explained by differences in provider efficiency rather than patient risk.
McClure's formulation of the ideal capitation rate may perhaps be too narrow. Ideally, the method for calculating the capitation rate should create homogeneous patient risk groups. Such a method accomplishes several goals: It protects ill beneficiaries from being discriminated against; it mitigates the adverse effects of cream skimming because providers with a healthy enrollee population will be paid a lower rate, reflecting the reduced risk; and it protects small providers who face increased risks because of the "small numbers" problem (wherein a high-cost beneficiary cannot be averaged out over a large number of low-cost beneficiaries). McClure argues that to create homogeneous risk groups, all variations in costs due to patient characteristics must be eliminated. A more practical approach might tolerate variation within a risk group, as long as this variation is truly random and cannot be observed by providers. This would remove provider incentives (or at least opportunities) for cream skimming.\(^7\)

To create homogeneous patient risk groups the set of adjustment factors must be able to predict medical expenditures. This can be judged by the amount of variance explained by the factors. How well the factors perform depends on the amount of variance in medical expenditures one believes can be explained. Drawing on previous empirical work of other analysts, Welch (1985) believes that approximately 80 percent of the variance cannot be explained because it is due to variations across time in individuals. These variations represent specific events in a given year that cause an individual to have high or low expenditures in that year relative to his or her mean expenditure.\(^8\) Many of the proposed adjustors to the AAPCC explain only a small fraction of the variance. If Welch's arguments are accepted,\(^7\)

\(^7\)Even this goal is not likely to be achieved because providers will always know more about beneficiaries than the payor (either through observing patient characteristics before enrollment or monitoring utilization after enrollment). Moreover, various tactics are available to providers to persuade selected beneficiaries to enroll or disenroll.\(^8\)The remaining 20 percent of the variance that can be predicted is due to variations across individuals that are stable with time and that can be observed by a delivery system (each individual has a mean level of expenditure that can be observed more or less).
the performance of the adjustors may not seem as poor as at first
glance. For example, a set of adjustors that explains only 10 percent
of the variance actually explains 50 percent of what is possible to
predict.

Newhouse (1986) challenges the assumption that variations in
individuals across time cannot be predicted. He asserts that plans can
observe some of the factors that vary with time and that therefore
considerably more than 20 percent of the variance in expenditures can be
predicted. As an example he cites patients who become at high risk of
death. 9

The set of adjustors may perform better than indicated if one
examines the $R^2$ values, which represent the percentage of variation
explained. The prediction of expenditures for groups of beneficiaries
is the important result because Medicare pays risk-sharing plans for
groups of enrollees. $R^2$ values reflect the accuracy of predictions for
individual enrollees, not for group averages. Because the random errors
of predictions for individuals tend to cancel out for large groups,
predictions of group averages can be more accurate. Beebe, Lubitz, and
Eggers (1985) report that the prior utilization model they developed
(demographic variables plus prior hospital days and whether the Part B
deductible was met) reduced the prediction errors for groups of
enrollees by one-half to one-third of the average error obtained with
the current AAPCC. Proposed methods for refining the AAPCC may
therefore offer some improvements over the current formula by reducing
the likelihood that at-risk providers will be substantially over or
underpaid for services provided to their entire enrolled populations.
We can be less confident that these refinements will remove incentives
for dumping or cream skimming. If potential enrollees in an at-risk
health care plan are selected or rejected by the plan one by one, the
ease of predicting group means will do nothing to discourage the plan
from rejecting someone whose care it believes will be unusually
expensive and brings no extra reimbursement.

9The 5 percent of Medicare enrollees who die in any year account
for 28 percent of Medicare expenditures (Lubitz and Prihoda, 1984).
Although many give no warning, providers in a capitated system may be
able to identify a substantial portion. Even though all high risk
patients do not die, those who do not are almost as expensive as those
who do (Detsky et al., 1981).
V. ALTERNATIVE METHODS OF CAPITATION RATE SETTING

An alternative to refining the AAPCC would be to choose another approach for setting a capitated rate. This section briefly reviews the approaches used in state Medicaid programs and describes two additional approaches not now in use. As of June 30, 1985, 113 HMO plans served 744,000 Medicaid recipients (about 5 percent of the Medicaid population) in 25 states. State Medicaid programs generally use one of three methods for setting capitated rates. The first is similar to Medicare's AAPCC in that the capitated rate is set at some percentage of the per capita cost of serving Medicaid recipients in the FFS sector. The second method involves competitive bidding. In the third method rates are set based on the costs of the prepayment plan.

The most prevalent method for setting rates is similar to the AAPCC approach used by the Medicare program. Per capita costs are determined for Medicaid beneficiaries in the FFS sector and capitation rates are set at some percentage of these costs. Adjustors used are similar to those used by Medicare and typically include age, sex, category of welfare eligibility and county of residence. Some states calculate separate rates for different types of services (inpatient, outpatient, emergency room).

Examples of this approach are seen in Florida and Minnesota. In Florida's Alternative Health Plan for the Frail Elderly the capitated rate is set at 95 percent of the historical FFS cost and is then updated by the lesser of the medical component of the Consumer Price Index or 10 percent. In Minnesota's Prepaid Medicaid Competition Demonstrations the rate is set at 90 percent of the FFS cost for the AFDC population and 95 percent for the aged, blind, and disabled. Adjustments are made for age, sex, institutional setting, welfare category, and Medicare status. Even though state Medicaid programs have been engaged in prepayment contracts longer than the Medicare program, they have not adopted any of the adjustors proposed for refining Medicare's AAPCC.
An alternative to the AAPCC approach is competitive bidding arrangements in which plans submit bids of rates they are willing to accept and limits on the numbers of recipients they are willing to serve. This approach has been tried in Florida and Arizona. However, because of the low rates found acceptable to the Medicaid programs, provider interest has been very low. In some areas of Arizona, the state could not find plans that were willing to submit bids. In Florida the state abandoned the competitive bidding approach and returned to negotiated rates based on FFS per capita costs.

In terms of the Medicare program a competitive bidding approach would be more feasible with carrier capitation plans than with numerous smaller risk-sharing plans. In carrier capitation plans, a carrier submits a per capita bid for all beneficiaries in an area and in return agrees to arrange their medical care. Maryland Blue Cross has submitted a proposal to create such a system. The Texas Medicaid program has had this type of arrangement since its inception in 1967. The state pays the carrier a capitated amount, while the carrier pays the providers on a FFS basis. Rates are set separately for the two categories of recipients (AFDC and SSI).

California and Washington set rates based on the costs of the capitated plan. California determines the cost for each prepayment plan and compares it with the FFS per capita cost for Medicaid recipients, adjusted for category of eligibility, type of service, county of residence, age, and sex. If the plan's costs are less than the FFS cost, the state pays the plan based on its costs. If the plan's costs are higher, the state pays 100 percent of the FFS cost. If the state cannot determine the costs of the prepayment plan, it pays the plan 95 percent of the FFS cost.

In general the methods used to set rates in state Medicaid programs do not offer any improvement over the current method used by the Medicare program. If anything, research on finding adequate adjustors to vary rates based on beneficiary characteristics is proceeding even more slowly in the Medicaid programs.
A novel approach for setting capitated rates has been proposed by Newhouse (1986). He argues for the use of a blended rate, incorporating both a capitated component and a FFS component. For example, one-fourth of the payment amount could be based on the AAPCC, and three-fourths could be based on FFS costs. Moreover, the weight on the capitated portion need not be the same for each individual. Newhouse suggests assigning a lower weight to the capitated portion for beneficiaries with higher variances in expenditures, such as the very old. Such a method accommodates the imperfections of the current or proposed adjustors to the AAPCC. Either the current AAPCC formula or a refined formula could be incorporated into the blended rate. Part of the rationale rests on the conflicting incentives inherent in the two payment methods: The incentives of FFS systems are to over treat, while those of capitated systems are to under treat. Perhaps by combining the two incentives, treatment patterns will reflect a more appropriate level of utilization. As adjustors improve, the weight on the capitated portion could increase.

Rather than incorporating past utilization, which has previously been proposed as an adjustor to the AAPCC, the Newhouse approach uses current utilization. He sees two advantages: It recognizes changes in health status as they occur rather than with a delay; it avoids the problem that past utilization data are unavailable for new Medicare beneficiaries who enroll in HMOs. Newhouse argues that the incentive effects associated with payments based on current utilization are the same (or can be made so) as those associated with payments based on past utilization.

Even so, capitation payments based either on past or current utilization lead to similar incentive problems inherent in FFS payment: providers who overtreat may be rewarded while more conservative providers may be penalized. Any adjustment based on utilization weakens the incentives of a capitated payment system. In addition, the FFS/capitation blend method imposes administrative burdens on HMOs, which would have to keep service level records enabling them to bill on an FFS basis.
A simpler modification of the capitation payment is to make some provision for outlier patients. A plan would receive a capitated payment for every enrollee, but if an enrollee exceeded a threshold level of services within a defined time period, the plan would receive an adjustable lump sum payment. The amount of payment for outliers could be based on the extent to which the outlier exceeds the threshold level of services or costs, specific medical conditions, and other patient or provider characteristics.

The capitation with outliers approach would be less a departure from current capitation payment methods than the Newhouse blended approach and would more closely preserve the incentives of a capitated system. At the same time, it would afford some protection to plans with heavy users for which the current AAPCC adjustors are inadequate. Similarly, it may help to improve access to HMOs for heavy care patients.

As long as the outlier classification scheme is not based on costs of care, this approach would impose less of an administrative burden on HMOs than the blended approach, because FFS billing records need not be kept. It only requires the collection of records pertaining to the service units used to define outliers (number of outpatient visits, hospital days, etc.).

The purpose of an outlier payment scheme would not be to compensate providers for all losses incurred in treating unusually expensive cases. Outlier payments this generous would provide no disincentive to overtreatment. Instead, the aim would be to reduce providers' losses in these cases. Because providers would not be fully compensated for the care of high-cost enrollees, outlier payments would not completely eliminate incentives for biased enrollment. They could, however, reduce the incentives to manageable levels.

Capitation with outliers could serve as an interim method until workable adjustors to the AAPCC are developed. The precedent for such an approach lies with the current Medicare Prospective Payment System, which pays hospitals predetermined rates based on DRGs and includes a provision for outliers.
There seems to be near universal agreement that the current AAPCC formula is inadequate. The first generation of empirical studies suggests that other adjustors show some promise in improving the homogeneity of patient risk groups. Analysts at HCFA have expressed their doubts concerning the adequacy of the AAPCC and have conducted preliminary studies to refine the AAPCC formula. The statutory language creating the AAPCC is flexible enough to permit the incorporation of additional adjustors without having to seek Congressional approval. Given the GAO findings of the failure of the AAPCC to protect the government from overpaying some risk-sharing plans, and HMO contentions that they are at risk for losses from potential adverse selection, the climate seems to favor modification of the AAPCC formula in the near future. Given the ambiguities that still exist with respect to the incentive effects of the various approaches and the uncertainty regarding the appropriate measures to choose as proxies for different adjustors, it seems prudent to test several approaches in demonstration projects.
VI. WHERE DO WE GO FROM HERE?

The AAPCC is a poor predictor of costs of care, and providers may therefore be exposed to considerable financial risks. Perhaps more troubling, the AAPCC explains only a fraction of the variance in costs of care that could be explained by other factors. These factors (prior utilization, health status, and health risk factors, for example) can be observed by providers, and providers can sometimes identify particular patients or classes of patients whose care is unlikely to be adequately reimbursed. The current AAPCC provides both incentives and opportunities for cream skimming and dumping by at-risk health care providers. The evidence on whether these are actually going on is inconclusive, but few would feel comfortable placing increased reliance on a payment mechanism that provides systematic incentives to deny care to particular classes of Medicare beneficiaries. In its announcement of research priorities for the most recent grant application cycle (applications were due December 15, 1986), HCFA noted a special interest "in projects that refine or expand [previous] efforts or develop new adjustors, and projects that test such adjustors in capitated systems" (Federal Register, October 16, 1986).

In addition to the general shortcomings of the AAPCC, there are particular problems in using it to set capitation rates for the frail elderly. Few would dispute that "frail" or "impaired" enrollees are likely to require more expensive care than are other enrollees in risk-based programs. The current approach to setting Medicare capitation rates makes no effort at identifying truly frail or impaired patients. Instead, institutional status is used as an identifier of patients likely to incur higher than usual costs.

Even when efforts to specify frailty or impairment more precisely have been successful, problems still arise. Alternative definitions of frailty and impairment can lead, it seems, to quite different conclusions about what constitutes an adequate capitation rate.\(^1\) Also, there is evidence that, at least for the population of frail elderly

\(^1\)For example, using data from the 1977 Current Medicare Survey,
served by the On Lok program, age and sex--currently used to adjust capitation payments--do not explain differences in care costs. It may be that age and sex affect the probability that a given patient will become frail or need unusually intensive care. Within a population of already frail patients, however, these factors seem to be of little importance. For this population, adjustment for age and sex may serve only to make some patients more attractive than others to at-risk health care providers.

The shortcomings of current methods for setting capitation rates may be discouraging risk-based care for the frail elderly. They may also result in an unfair financial burden on those programs that have chosen, despite what may be seen as inadequate reimbursement, to serve primarily a frail population. The most serious consequences of a flawed methodology for setting capitation rates, however, may lie in the future. Current interest in capitated reimbursement for health care is such that the important issue for the future may not be whether Medicare and other third-party payors will rely increasingly on capitation. Instead, the issue may be how well capitation schemes--which will inevitably become more important--will work. Recent experience with Medicare reimbursement policies may be instructive in this regard. Prospective payment for Medicare hospital care was not delayed until an ideal system for such payment was devised. Neither does it seem likely that flaws in the current system of setting capitation payments will prove a serious obstacle in a political environment where capitation is seen as the next important step in restraining medical costs.

_____

Gruenberg and Stuart (1982) calculated annual Medicare outlays for a sample of "impaired" elderly Medicare beneficiaries living in the community. These impaired beneficiaries fell into three categories: must stay in bed all or most of the time; must stay in the house all or most of the time; need the help of another person in getting around. Their Medicare costs were about twice the average for the general aged population and were not significantly different from the Medicare costs of institutionalized beneficiaries, as reflected in the current institutional status adjustor to the AAPCC. For a narrower sample of "impaired" patients, however--those who must remain in the house all or most of the time--average Medicare costs were 2.8 times the average for the general aged population. Which of these figures can be interpreted as the "correct" adjustment for "frailty" or "impairment?"
CLINICAL VS. POLICY RELEVANCE

Devising more satisfactory ways of setting capitation rates will require progress on two related but nonetheless distinct tasks. The first task is to identify more precisely which characteristics of patients and their circumstances explain differences in the costs of their care. As the preceding sections of this note illustrate, considerable work has already been undertaken in this connection. Clearly, though, much remains to be done. If it is true that some 20 percent of the variance in annual care costs can be explained by observable patient characteristics, then efforts to date have succeeded in explaining less than half of the "explainable" variance.

The principal obstacle to further progress in this regard has been and continues to be the cost of collecting detailed clinical and social information for samples of potential enrollees in risk-based plans and of subsequently tabulating Medicare outlays on behalf of these patients. Some potentially relevant patient characteristics are not routinely recorded or reported, and when information on potential explanatory variables is available, limitations of the HCFA data reporting system make it difficult to calculate associated Medicare outlays.

It is not sufficient simply to identify patient characteristics that seem to be associated with higher or lower than average health care costs. It is necessary in addition to verify that these characteristics can provide a basis for an operational system of capitated payments. At issue here is whether these characteristics are sufficiently objective, verifiable, and easy to observe that they cannot be manipulated by patients or by health care providers in order to "game" the payment system. We must also verify that the costs of collecting the information necessary to calculate improved capitation payments will not overwhelm whatever benefits might result.

Some of the patient characteristics studied in previous research are clearly suspect on these grounds. Some functional status measures, for example, are inherently subjective and cannot be easily verified by someone who is not familiar with a patient's history and circumstances. Thus, characteristics that are "clinically" relevant in explaining variations in care costs may not be "policy" relevant; they could not be
used to calculate payments. In these situations, other questions arise. If payment calculations ignore these characteristics, will providers (who may still observe these characteristics for their own purposes) use their information advantage to skim or to dump patients? If so, can some reasonable proxy for the unusable characteristic be identified?

These questions cannot be addressed simply by observing Medicare spending in the current payment regime. How easy it is to collect and to audit patient-specific information and how at-risk providers behave in the face of particular payment arrangements can be tested only through demonstration efforts: Providers must actually be paid on the basis of the patient characteristics. Demonstrations, though, are time-consuming and expensive, and demonstrations intended to observe changes in behavior by at-risk health care providers are likely to be particularly difficult. Debate continues, for example, over whether HMO patient selection is currently biased. If we cannot settle even this question, will we be able to observe a change in HMO enrollment behavior that comes about as a result of a change in payment methods?

Pointing out the difficulties inherent in demonstrations is not to suggest that they not be undertaken. If we are to devise improved methods for calculating capitation rates, demonstrations are essential. There are two points to be made here. First, major improvements in capitation rate setting procedures will probably not come soon; there is just too much to do. Second, because demonstrations will take a long time, it is important to get started on them as soon as possible.

We are not ready yet to mount major demonstrations of new capitation systems, however. Additional work on identifying potential rate adjustment factors must be completed first. Fortunately, a recent data collection effort by the Bureau of the Census has created some new possibilities for such research.

THE LONG-TERM CARE SURVEYS

On behalf of HCFA and the National Center for Health Services Research and Health Care Technology Assessment, the Bureau of the Census has recently undertaken to identify and survey a sample of impaired elderly subjects. In 1982, the Census Bureau selected a sample of 36,000 Medicare beneficiaries from Medicare enrollment records. The
sample was stratified on the basis of geographic region, age, race, and original reason for Medicare entitlement. These 36,000 persons were then contacted by telephone and asked about their functional status. Those who were over 65 and reported problems or expected problems performing any of the activities regularly included among the activities of daily living (ADL)\(^2\) or the instrumental activities of daily living (IADL)\(^3\) were asked to respond to a more detailed questionnaire, which provided information on socioeconomic status, living, arrangements, living quarters, and possible cognitive impairment. Some 6,000 of these more detailed questionnaires were completed.

One of the principal objectives of the 1982 survey was to learn more about Medicare beneficiaries who might one day need institutional care. For this reason, the 1982 sample included only those beneficiaries who were living in the community. Patients in nursing homes were excluded.

In 1984, a follow-up was conducted of the respondents to the 1982 survey. The information gathered was similar to the earlier survey, and the sample was the same with two exceptions. First, beneficiaries from the original sample who had subsequently entered nursing homes were retained in the 1984 sample. Second, beneficiaries from the original list of 36,000 who had "aged into" the sample--had reached the age of 65 in the last two years--were also included. This latter group of additional respondents were included whether they were living in the community or in nursing homes.

Some results of the 1982 survey have been published (Macken, 1986) and a public use file created of the data. The 1984 survey data are still being processed, and only a raw version of the data file is available at HCFA. Access to these data could presumably be arranged for the purpose of calculating new adjustments to the AAPCC.

\(^2\)Bathing, dressing, getting to the bathroom or using the toilet, getting in or out of bed, getting around outside, eating, and continence.

\(^3\)Heavy housework, light housework, laundry, preparing meals, shopping for groceries, getting around outside, going places outside of walking distance, managing money, making telephone calls, and taking medicine.
The Long-Term Care Survey data offer an opportunity (unavailable since the last Current Medicare Survey in 1977) to examine the effect of functional status on Medicare expenditures. The 1984 survey came during the transition to prospective payment for Medicare hospital services, and analysis of Medicare outlays on behalf of patients classified as impaired during that year might reflect at least some of the changes in care patterns brought about by prospective payment. The survey samples include Medicare beneficiaries who were eligible for Medicaid and beneficiaries who were not, allowing a further analysis of the appropriateness of the welfare status adjustment in the case of frail patients. Finally, these surveys provide an opportunity (never available before, as far as we know) to explore the relationship between socioeconomic circumstances and living arrangements, and Medicare outlays.

This last attribute of the Long-Term Care Surveys may be particularly important in studying the costs of care for the frail elderly who cannot care fully for themselves. The presence or absence of a healthy spouse, child, neighbor, or some other person to offer informal assistance may influence the amount of formal care required and thus Medicare outlays. Because living arrangements can be defined objectively and observed fairly easily—they are used to calculate some kinds of welfare payments, for example—they may be suitable for inclusion in a capitation rate-setting mechanism. The danger inherent in using such factors for setting payment rates is that it may in some cases provide an incentive for family members to desert a frail elderly patient (or at least appear to do so) in an attempt to make the patient more attractive to an at-risk provider. Since the financial consequences of changes of social status would probably be felt primarily by the provider and not by the family of the enrollee, however, these perverse incentives might not be very strong. More to

"Similarly, the availability in the community of various kinds of nonmedical support services or perhaps of certain kinds of lower-priced medical services may also influence Medicare outlays. A better understanding of these influences might allow not only improved calculation of capitation rates but also insights into how to structure local health care services more efficiently."
the point, providers can certainly collect information on a potential enrollee's social situation. If there is a correlation between social situation and expected costs, and if this correlation is not reflected in the payment mechanism, providers will have an opportunity and an incentive to discriminate against potential enrollees without family support in the immediate area. It seems advisable, then, to attempt at least to incorporate social situation into the calculation of capitation rates.

Because the samples for both Long-Term Care Surveys were drawn from Medicare enrollment files, all respondents are identified by Medicare beneficiary number. Thus, it is at least conceptually possible to link data from these surveys with HCFA billing and payment records, simplifying the task of tabulating Medicare outlays on behalf of beneficiaries represented in the Long-Term Care Surveys. This linkage will also allow other information reflected in HCFA records (prior utilization and prior diagnostic information, for example) to be included in the analysis.⁵

The data gathered in the Long-Term Care Surveys have some shortcomings, however. First, nursing home residents are underrepresented in the 1984 survey and excluded entirely from the 1982 survey. If the Medicare costs of nursing home residents are considerably different from the costs of Medicare beneficiaries living in the community, the surveys may not provide an accurate estimate of Medicare costs for a population of frail elderly that includes both both nursing home and community residents. Careful modeling of the costs of care (as opposed to simple averaging of costs for beneficiaries in particular demographic or health status cells) might allow estimates of how care costs for nursing home residents differ from those of beneficiaries living in the community. This in turn would allow correction of estimates of care costs for mixed populations. Whether the 1984 sample contains sufficient nursing home residents for such modeling to be successful cannot be determined at this stage, however.

⁵Linking information on prior or current diagnosis with information on functional status might be particularly useful. Restricted mobility in a patient with a broken hip, for example, might have very different implications for future care costs than would the same restriction in a patient who has suffered a stroke.
A more serious problem arises from the difficulty of extracting from Medicare billing and payment records information about Medicare outlays on behalf of the beneficiaries included in the Long-Term Survey samples. Unfortunately, HCFA maintains no unified file listing all Medicare payments by beneficiary. Instead, it maintains separate files for payments for different types of services. For some kinds of services (physician services, for example) these files are extremely large--hundreds of reels of computer tape for each year of data. Moreover, many of these files are maintained not on the IBM equipment at the HCFA data center but at the Social Security Administration data center on Univac equipment. Searching all of the Medicare files would require extensive operations at two data centers, accessing files coded for different systems--a task that is probably impossible for analysts outside HCFA. HCFA analysts have managed this task on a few occasions. Conversations with HCFA staff suggest that a special effort to extract records relevant to the 1984 Long-Term Care Survey is being contemplated. As yet, though, it has not been carried out, and there is apparently no firm plan yet for undertaking this task.

Without a special extraction effort, analysts must rely on Medicare files that record payments on behalf of only samples of beneficiaries. Three such files are relevant:

The Inpatient Stay File (INP). This file provides a record of covered charges for a 20 percent sample of Medicare-reimbursed inpatient hospital stays. The file also contains information on diagnosis, length

---

6HCFA has plans to construct such a file, to be called the Medicare Automated Data Retrieval System (MADRS). MADRS is to provide a complete record of Medicare-related bills and payments, organized by year, state/county, and beneficiary number. The MADRS project has been seriously delayed, however, and there seems little prospect that it will be completed any time in the next couple of years.

7In late 1985, HCFA produced a one-time "pseudo-MADRS" covering 1980 through 1983. Users with a need for the MADRS type of information submitted beneficiary numbers to HCFA, and HCFA searched its Medicare records for transactions on behalf of these beneficiaries. A similar pass through all HCFA records would provide information on the respondents in the Long-Term Care Surveys, but we know of no plans to repeat the 1985 exercise.
of stay, services provided, deductible and copayment status, and outlier status. Also included is similar information about Medicare-reimbursed care in skilled nursing facilities. The file includes charges for hospital and SNF services covered by Part A of Medicare. It does not contain records of physician services; these are reimbursed under Part B.

The Home Health Billing File (HHB). This file provides a record of covered charges for a 40 percent sample of Medicare-reimbursed home health care. Like the INP file, the HHB file contains information only on payments to home health agencies reimbursed under Part A of Medicare. No physician services are included in this file.

The Part B Medicare Annual Data File (BMAD). This file provides a record of all Medicare Part B payments during a year for a 5 percent sample of Medicare beneficiaries. Included here are payments for all physician services and various other services reimbursed under Part B of Medicare. Similar data are also available in a 5 percent sample of the Part B Medicare Payment Record File.

The samples for these files are drawn on the basis of beneficiary number. The INP file, for example, includes records for all Medicare beneficiaries with beneficiary numbers ending in 0 or 5. The BMAD file contains information on all beneficiaries with beneficiary numbers ending in 05, 20, 45, 70, or 95. The samples are nested. The beneficiaries in the 5 percent Part B sample will also appear in the 20 percent INP sample and in the 40 percent HHB sample.

Unfortunately, the samples of Medicare beneficiaries for the Long-Term Care Surveys were not chosen so that respondents would be among the beneficiaries represented in these files of HCFA payments. Thus, it will be practical to calculate Medicare Part B outlays for only about 5 percent (300) of the 6,000 respondents to the Long-Term Care Survey. Records of hospital and SNF payments will be available for 20 percent (1,200), and home health care payments will be available for 40 percent (2,400).

It is disappointing that the available sample sizes are so small, but these still may be adequate to do some useful analysis, particularly if efforts are made to model the contributions of different factors to costs of care. This modeling will allow pooling of the limited data.
available. Given the difficulty of collecting data relevant to the costs of care for the frail elderly, though, it seems foolish not to exploit the data available from the Long-Term Care Surveys, even if the sample sizes are smaller than we might wish. Analysis of these data (aided if at all possible by a special HCFA effort to extract information on Medicare outlays for the entire sample) should have a high priority in efforts to improve the calculation of capitation rates for the frail elderly.

**ADDITIONAL WORK**

Although the Long-Term Care Surveys appear to offer the most promising opportunities for further research into the determinants of Medicare outlays, other avenues should continue to be explored as well. Some of this work is already under way. The University Health Policy Consortium at Brandeis University is currently engaged in efforts to incorporate both prior utilization and prior diagnosis into models of expected Medicare outlays.

Another promising area (and one where little work has been done to date) is the use of physiologic measures to predict future costs. Such measures might be most effective in combination with information about previous diagnoses, and one might imagine using physiologic measures to refine rate-setting calculations based principally on prior diagnoses and prior utilization. Because physiologic measures can be objective, they lend themselves to observation and to audit. Because we know the frequency with which certain physiologic characteristics occur in certain populations, it may be possible to monitor health care providers' performance on the basis of aggregate statistics, singling out a particular provider for audit only when its enrolled population shows a higher than expected frequency of high-cost marker conditions.

---

*Analysis of all components of Medicare costs will not have to be based on the same sample. We may be restricted to investigating Part B outlays on the basis of a 5 percent sample. We would be able, however, to analyze outlays for inpatient hospital and SNF care on the basis of a 20 percent sample and average home health costs on the basis of a 40 percent sample. Average total Medicare outlays can be estimated simply by adding together average outlays for each component of care. Estimates for confidence intervals around these averages will, however, require some linking of records from each of the files and thus a restriction to a 5 percent sample of outlays for each type of service.*
If payments are based on physiologic measures that can change as a result of care provided, it may be necessary to ensure that a provider would not face a financial disincentive to improving a patient's condition. This might be achieved by establishing a "ratchet" for payment purposes. Payments would be based on the least favorable value of the physiologic measure reliably observed. Subsequent improvements in the measure would not lower the payment rate for that patient. Even this kind of arrangement does not remove all perverse incentives, because a provider could conceivably gain by allowing a patient's condition, as indicated by a particular physiologic measure, to deteriorate. It would be best to seek measures that are fairly independent of care.

The major obstacle to further research into physiologic measures is the difficulty of collecting the necessary data. Physiologic measures are seldom reported to third-party payors. Collecting such data requires, at best, expensive medical record abstractions and, at worst, actual examination of patients. Occasionally, physiologic measures for a sample of patients are available. Joseph Newhouse at The RAND Corporation is embarking on a further examination of the physiologic data generated during the RAND Health Insurance Experiment, seeking physiologic predictors of health care costs. These data are for a sample of the nonaged population and therefore more immediately relevant to Medicaid than to Medicare policies. This research may, however, provide additional suggestions for physiologic measures that might be adapted to Medicare use.

Another project, a joint effort by the School of Public Health at the University of Minnesota and The RAND Corporation and funded by HCFA, may offer some additional insights into possible physiologic predictors of care costs. This study will focus specifically on Medicare patients and will seek through medical record abstractions and patient interviews to identify characteristics in stroke and hip fracture patients that are associated with the need for long-term post-acute care in a variety of

---

A similar "ratchet" might prove useful if functional status measures are incorporated into a rate-setting mechanism.
settings. The aim will be to explain why some patients receive extensive and expensive post-acute care while others do not. Because this study will be restricted to only two conditions and because it will examine mainly Part A Medicare outlays, the results will not have immediate wide applicability to the general problem of setting Medicare capitation rates. The study will, however, provide a careful examination of two conditions that account for a large fraction of Medicare outlays, and in the process it may produce candidate markers for unusually high-cost cases and methods for observing these markers that can be incorporated into future demonstrations of capitated payment systems.

The projects just getting under way to test the feasibility of programs for the impaired elderly similar to the program currently operated by On Lok Senior Health Services may provide additional opportunities for correlating a variety of patient characteristics with health care costs. We probably cannot expect either that the populations enrolled in newly established risk-based care programs will be representative of the broader population of all of the frail elderly or that the care provided will be representative of what might be available in HMOs serving more diverse populations, much less in the fee-for-service sector. These programs should, however, provide an opportunity for observing patient characteristics that make care in this special setting more or less costly. Insights gained in this way may guide subsequent larger-scale data collection efforts. The key will be making sure that the experience gained in these newly established programs can be exploited fully. This will require establishing methods for monitoring the care required (and if possible the costs of this care) by individual patients. It will also require early identification of candidate predictors of unusually extensive care needs and methods for observing and recording the presence or absence of these markers.
VII. AN INTERIM APPROACH

In this section, we discuss how—purely as an interim measure, until some of the research described in the preceding section can be completed—existing large-scale databases could be used to calculate a revised "frailty" adjustor for the AAPCC. This recalcultated adjustor would be far from ideal. Indeed, it would share many of the flaws of the current adjustor. However, it would be based on recent data. (The current adjustor is based on data from the mid-1970s.) Given the changes in health care patterns that have marked the past few years, this could be an important advantage. The proposed recalculation has a further advantage in that it will allow some variation in the definition of who is "frail." In particular, it will allow calculation of a frailty adjustor for a population that is broader than just the institutionalized elderly. At the very least, this recalcuated adjustor would serve as a useful check on the current adjustor, providing a warning if the current adjustor appears to be far off the mark.

Calculating an interim frailty adjustment factor for Medicare reimbursement will require accomplishing two basic tasks. The first task will be to identify a population of Medicare patients who might appropriately be termed "frail." The second task will be to collect information on total Medicare expenditures on behalf of these patients and to calculate their average annual costs of care. In the remainder of this section, we will consider each of these tasks in turn and describe how an interim frailty adjustment factor might be computed.

DEFINING FRAILTY

In current practice, the "frail" elderly are those who require long-term institutional care. The frailty adjustor used with the current AAPCC is really an adjustor for institutional status: an estimate of the additional costs to Medicare of care for beneficiaries receiving long-term care in institutional settings above the costs of care for other beneficiaries. This interpretation of "frailty" is supported by
the practice of at least one of the currently operating risk-based health care programs that specializes in caring for the frail elderly. Participants in the On Lok program must be certified by the California state Medicaid program (Medical) as eligible for long-term institutional care.

Equating frailty and the need for institutional care has obvious drawbacks, and one would prefer a more clinically, functionally, or socially relevant definition of frailty. But these better definitions have not yet been specified, and the data to support them are not generally available. When you have lemons, it is a good idea to make lemonade. All we have at this stage are indications of institutional status, and the only practical approach for an interim calculation is to continue the current practice of defining frailty on the basis of institutional status.

Unfortunately, even this pragmatic approach does not avoid serious difficulty. No large-scale database identifies patients requiring long-term institutional care. (Indeed, it is hard to imagine how any large database could, inasmuch as such identification would have to reflect physician assessments of individual patients--assessments in which all physicians might not agree.) Existing databases identify only patients who actually received long-term institutional care. If this care were paid for by a third-party payer (Medicare, Medicaid, or private insurance), presumably some review organization concurred in the physician's judgment that institutional care was necessary for the patient.

Our inability to identify patients who require (or could benefit greatly from) long-term care, but who for some reason do not receive such care may bias estimates of care costs for the frail. Little is known about the characteristics of patients who do not receive institutional care. They may, for example, be "less sick"--in the sense that Medicare outlays on behalf of these patients may be lower--than patients who actually receive institutional care. In a world where institutional care is not available to all who need it or might benefit from it, these patients may be excluded because they need institutional care less than do other patients. If this is the case, their absence from a sample of the frail elderly will result in an overestimate of the
actual costs of care in programs that succeed in serving all those who need institutional care.

Alternatively, patients may not get the institutional care they require because they are unable to seek it—perhaps because they are mentally ill, drug dependent, economically or socially disadvantaged, or for some other reason out of touch with the usual channels through which medical care is provided. Or they may simply be unaware that they are eligible for benefits. If these patients are unable to seek institutional care, they may be unable to seek other forms of care as well, and Medicare outlays for such patients may be minimal. If these patients do find their way into the health care system, their medical needs may greater than those of other patients receiving institutional care, perhaps because previous failure to receive care damaged their health. A capitation rate based on a sample excluding such patients may underestimate the costs of care for a program that is successful at finding and providing treatment for patients who might otherwise have had none.

Finally, these patients may be just as "sick" as institutionalized patients but have the luxury of remaining at home with the care of family members and (perhaps more expensive) outpatient medical care. Costs of care for these patients could be higher than for institutionalized patients, and undersampling them could lead to an underestimate of the cost of caring for the frail elderly.

There is little evidence about what sorts of biases may be introduced by undersampling of patients who might qualify for institutional care but do not receive it. Neither do we have any reliable estimates of how many such patients there may be. Conversations with On Lok staff suggest that at least some of the participants in the program would probably not be receiving institutional care elsewhere.

All that can be done about potential biases arising from less-than-perfect identification of frail patients is to test alternative identification methods whenever possible. One might perhaps first identify as frail all patients who actually receive institutional care. One might then broaden the definition of frail to include, for example, patients who received home health services. If the resulting capitation rates are similar, then one might conclude that potential biases introduced by faulty identification are minor.
IDENTIFYING A POPULATION OF FRAIL ELDERLY

Unfortunately, Medicare data cannot be used to identify patients who have used long-term institutional care. Medicare is intended to reimburse short-term acute care; it pays for very little long-term institutional care. Medicare will reimburse only skilled nursing care, not intermediate care. Further, Medicare will reimburse a maximum of 100 days of nursing home care, and this only after a three-day "qualifying stay" in an acute-care hospital for treatment of the same condition. Medicare reimbursement accounts for only about 2 percent of all nursing home revenues in the United States (Levit et al., 1985). Thus, Medicare records are likely to indicate only a small fraction of the patients receiving long-term institutional care.

This is not to imply that total Medicare outlays for patients who receive long-term institutional care are minimal. Although Medicare typically does not pay for the nursing care these patients receive, it does pay for physician services, inpatient hospital services, home health services, and qualifying skilled nursing services. To the extent that patients who require long-term institutional care also require more of these services than do other patients, Medicare outlays on their behalf are higher than for other patients. The current adjustments to capitation rates for institutional status suggest that Medicare outlays for patients in institutional settings are two times higher than outlays for other Medicare patients.

The largest payor for nursing home care in the United States is Medicaid. In 1984, Medicaid payments accounted for 43 percent of all nursing home revenues (Levit et al., 1985). Thus, if we are looking for a population of patients who have used nursing home care, we might do well to look in Medicaid records.

The problem here is that the content, format, and quality of Medicaid records vary considerably from state to state. Each state maintains its own records. Drawing a truly national sample of institutional care users is therefore probably out of the question.

It should be possible, however, to use Medicaid records from at least a few states to identify a sample of frail elderly. The key to this identification lies in databases that are being built for HCFA by
Systemetrics, Inc. of Santa Barbara, California. Collectively, these databases are known as the Tape-to-Tape Data Base. The Tape-to-Tape project is an attempt to produce clean, easily accessible files of Medicaid information in a standard format. The project has produced files for California, Michigan, New York, Tennessee, and Georgia.

Two types of files produced by the Tape-to-Tape project are of particular interest. The first of these are the so-called Early Returns Person-Level Files. These files contain detailed and apparently reliable information on the types of services used by Medicaid patients. In particular, they identify patients who have used SNF, ICF, or home health care—potential identifiers of frail patients. By the fall of 1986 these files were complete for the following years: California and Michigan, 1980 through 1984; New York, 1980 through 1982; Georgia, 1980 through 1983; and Tennessee, 1980 and 1981. California and Michigan provide opportunities for calculating frailty adjustments during the period when the Medicare prospective payment system (PPS) was in effect for acute care hospitals. Given the major changes in the costs of care that seem to have come with the PPS, it would probably be wise to focus on calculating adjustments in the post-PPS period.

The Early Returns Files identify patients by their Medicaid identification numbers. These numbers do not generally correspond to Social Security numbers or to Medicare beneficiary numbers. To calculate the costs to Medicare of treating patients identified in Medicaid records as frail, we need a link between Medicaid and Medicare identification numbers. Fortunately, the Tape-to-Tape project has produced such a link in what are called the the Uniform Enrollment Files. These files contain the Medicaid identification number, the Social Security number, and Medicare beneficiary number (if there is one) for all patients whose care was reimbursed by Medicaid. This link will allow us to find the Medicare records of patients identified as frail on the basis of their Medicaid histories. The Uniform Enrollment Files also have information on date of birth, sex, race, and place of residence. This information is also available on Medicare records and can be used to confirm matches of Medicaid with Medicare records.
The Uniform Enrollment File also contains an indicator of institutional status. This is supposed to identify patients who are certified for institutional care, but discussions with the Tape-to-Tape project manager suggest that these indicators are not reliable. The only reliable method for identifying Medicaid patients who received institutional care seems to be to use the Early Returns Files.

Using the Tape-to-Tape data to identify institutionalized Medicare beneficiaries is far from ideal. Medicare outlays for Medicaid-eligible patients may be systematically different from outlays for non-Medicaid beneficiaries. (Indeed, the current AAPCC contains an adjustor for Medicaid eligibility.) There is also wide variation from state to state in the propensity of Medicare beneficiaries to use nursing home and home health services (Neu and Harrison, 1986), and relying on data from only two states may introduce important (and unknown) biases into calculations of adjustment factors. Finally, the Tape-to-Tape data provide no information on the reasons for nursing home care. It is impossible to distinguish between acute and chronic care needs—presumably important determinants of long-run costs of care.

For all these shortcomings, though, the Tape-to-Tape data offer the only currently available means of identifying a large sample of elderly receiving nursing home care. At the very least, using these data would allow an updating of the AAPCC adjustment factor for some important demographic cells—Medicaid-eligible, institutionalized Medicare beneficiaries. Current adjustors for these cells are still based on experience from the mid-1970s. Given the changes that have marked the Medicare system in recent years, this update might be valuable.

It would be unwise, however, though, to accept results of analyses based on the Tape-to-Tape data without some independent assessment of the representativeness of a sample generated with these data. A limited test of this sort might be managed through the use of the Long-Term Care Survey data described in the preceding section. Nursing home residents were excluded from the 1982 sample, but respondents to the 1982 survey who had entered nursing homes by 1984 were retained in the 1984 sample. If it is possible to track down Medicare outlays on behalf of this small sample of nursing home patients, we may be able to verify some of the
results obtained for the larger sample drawn from the Tape-to-Tape data.¹

It would be possible to supplement the sample of frail elderly identified as nursing home residents in the Tape-to-Tape files with elderly Medicare beneficiaries who made use of home health care. Users of Medicaid-reimbursed home health care can be identified in the Tape-to-Tape files. It is also possible, though, to identify a large number of home-health users from Medicare records.

There is currently no limit on the number of home health visits that Medicare will reimburse. Neither is any previous hospital stay required for Medicare reimbursement of home health care. The result is that Medicare pays for a large fraction of home health services for the elderly. More to the point, Medicare eligibility criteria for home health care provide a reasonable definition of frailty. Specifically, to be eligible for Medicare-covered home health services a patient must be confined to the home (or some other institution that is neither a hospital, SNF, or rehabilitation institution), under the care of a physician, and in need of intermittent skilled nursing care or physical or speech therapy. By drawing a sample of home health patients from Medicare and Medicaid records, we can assess the health care costs of a broader population of "frail" elderly.

CALCULATING MEDICARE EXPENDITURES FOR A FRAIL POPULATION

If we are to focus our efforts on estimating additional Medicare outlays for frail patients in the PPS environment, we will be restricted to drawing our samples of frail patients from California and Michigan, the only two states for which the Tape-to-Tape files will be complete through 1984. Further, to keep the computational tasks involved to manageable proportions, we must restrict ourselves to the readily available Medicare datasets described above: 20 percent of inpatient hospital and SNF stays, 40 percent of home health stays, and 5 percent

¹The problem here will probably likely lie in tracking Medicare expenditures. If we are forced to rely on existing samples of Medicare payment records, we may be able to find records of Medicare payments for physician services, for example, for 5 percent of those members of the 1982 sample who were in nursing homes. This could be a very small number.
of Part B services. Will we be able to trace enough frail patients from the California and Michigan Medicaid records into the Medicare records to calculate a meaningful average Medicare expenditure for frail patients?

(In the calculations that follow we restrict our attention to the narrow definition of "frail" elderly--those residing in nursing homes. This is the most demanding case; a sample of home health patients can be drawn from national Medicare files, not from the Medicaid files of only a few states. The home health sample, then, should be larger.)

We do not have to calculate all components of Medicare costs for a frail population from the same sample. We may be restricted to calculating the average costs of Part B services on the basis of a 5 percent sample. However, we would be able to calculate the average costs of inpatient hospital and SNF services on the basis of a 20 percent sample and the average costs of home health services on the basis of a 40 percent sample. Average total Medicare costs can be estimated simply by adding together the average costs of each component of care.\textsuperscript{2} How many cases will we have for calculating each of these components?

In the illustrative calculations that follow, we will use statistics for calendar year 1984, the latest year for which the Tape-to-Tape dataset is (or soon will be) available, and it is therefore the basis for any calculation of a new frailty adjustor.

In 1984, 27.1 million Americans 65 or over were enrolled in the Medicare hospital insurance program. In the same year, California and Michigan accounted for 13.2 percent of the total U.S. population 65 or older (9.6 percent in California and 3.6 percent in Michigan). This suggests that some 3.6 million elderly Medicare beneficiaries lived in these two states. The 1980 Census found that 4.6 percent of elderly Americans were receiving institutional care in old age homes, nursing homes, or convalescent homes (Gornick et al., 1985). Thus, the total frail Medicare population in California and Michigan on any given day

\textsuperscript{2}Estimates of confidence limits for these averages will require some linking of records from each of the files and thus a restriction to a 5 percent sample from all files. For more on this point, see the discussion below of computational procedures.
might be some 165,000. Presumably, we would be able to find more frail patients than this. We would count as frail all patients who received institutional care any time during a year, not just those patients who happened to be receiving such care on a particular date. If we were to adapt a less stringent definition of frail—including, say, patients receiving home health care—the population of frail patients would obviously be still larger. For the purposes of this calculation, however, we will stick with the conservative estimate of 165,000.

Not all of these patients will be identified in Medicaid records, because Medicaid will not be paying for all of these patients. In 1984, Medicaid payments accounted for 43 percent of all nursing home revenues (Levit et al., 1985). We might presume, then, that at least 43 percent of nursing home patients will show up in Medicaid records. This is almost certainly an underestimate, because many patients begin nursing home care as private pay patients but eventually become Medicaid patients. Medicaid would pay only a portion of their charges, but we would still be able to identify them as frail from Medicaid records. As above, though, we will keep to conservative assumptions. If Medicaid records allow us to identify 43 percent of the frail Medicare beneficiaries in California and Michigan, we will have some 71,000 identified frail patients.

We could supplement this list by including patients receiving Medicare SNF benefits. During 1983 (the last full year for which data are conveniently available), 10 of every thousand Medicare enrollees over age 65 received Medicare-reimbursed SNF care. (Gornick et al., 1985). If this utilization rate held for 1984, 271,000 aged Medicare beneficiaries received SNF care. The 20 percent sample of Medicare SNF patients in the INP file would allow us to identify some 54,000 of these patients. Of these, we might expect to find 13.2 percent, or about 7,000 in California and Michigan. Not all of these 7,000 patients will represent additions to our list of frail Medicare beneficiaries. An unknown fraction will already have been identified in Medicaid records. (This will happen when Medicaid pays for nursing home care after a patient's Medicare benefit has been exhausted.) Assuming that 60 percent of these patients (almost certainly too high) will also show up in Medicaid records, we should get an additional 3,000 frail elderly
Medicare beneficiaries from this source. We might, then, be able to identify some 74,000 Medicare-eligible frail elderly in California and Michigan through the use of Medicare and Medicaid records.

Of these 74,000 patients, we would have 20 percent (or 15,000) available for calculating average inpatient hospital and SNF costs, 40 percent (30,000) for calculating average home health costs, and 5 percent (3,700) for calculating average Part B costs. (Actually, we would have more than this. The frail patients identified through Medicare records would all be in the sample of hospital and SNF patients and in the sample of home health patients.) Would these samples be adequate?

A crucial unknown here is how much costs of care vary within the population of frail patients. Whether estimates derived from these samples will be sufficiently precise for policy purposes will depend on these variances. The more the variance in costs, the less precise will be any estimates of average costs. We are aware of no estimates of these variances for a population of frail elderly. We can, however, make some illustrative calculations.

In 1984, average Medicare outlays per enrollee were about $2328 (Levit et al., 1985). The current frailty adjustor is 2.0, suggesting that annual costs of care for frail patients are double the costs for other patients. Thus, average Medicare outlays for frail elderly patients may have been in the neighborhood of $4700 (2.0 times $2328 = $4656). We do not know what the standard deviation of this distribution is. For the purposes of illustration, let us assume a range of values for this standard deviation: one times the mean ($4700), three times the mean ($14,100), and five times the mean ($23,500). Stated differently, we let the coefficient of variation (the standard deviation divided by the mean) of this distribution take on values of 1, 3, and 5.

If we estimate mean health care expenditures for the frail population on the basis of a sample of n frail elderly, the standard deviation of this estimate will be smaller than the standard deviation of the underlying distribution by a factor equal to the square root of n. In our case, the smallest n we may expect to work with is 3700. The square root of 3700 is about 60.8. Thus, if the standard deviation of health care costs for the frail elderly is equal to the mean ($4700),
then an estimate of average health care costs for this population based on a sample of 3700 will be about $77 (4700/60.8). If the underlying standard deviation is three times the mean ($14,100) or five times the mean ($23,500), the standard deviations of the estimates will be $232 and $386 respectively. Even $386 is only about 8 percent of the 1984 average payment for institutionalized elderly Medicare beneficiaries, and thus the available samples should be adequate for calculating a new institutional status adjustor. By modeling costs of care as a function of patient and provider characteristics rather than simply estimating cell means, we can probably improve the precision of these estimates.

What we know of Medicare costs suggests that standard deviations are unlikely to be larger than five times the mean. Indeed, they are probably much smaller. The standard deviation of Medicare costs for all Medicare enrollees in 1976 was about three times the average outlay per enrollee (Beebe, Lubitz, and Eggers, 1985). The standard deviation of costs for frail patients may be smaller, though, inasmuch as these patients may be more homogeneous than is the entire Medicare population. Frail patients, after all, all require institutional care. Other estimates of the standard deviation of costs incurred by Medicare enrollees who actually use care are less than three times the mean outlay. For example, the standard deviation of covered charges for Medicare Part A services for all inpatient episodes in acute-care services in the year from April 1984 through March 1985 was only about 1.2 times the mean charge for these episodes. The standard deviation of Part A covered charges for all episodes of care in rehabilitation hospitals was only about 0.8 times the average charge. Adding the advantage of being able to compute components of the average cost of care on the basis of samples larger than 3700 leads us to the conclusion that the sample sizes available should be sufficient for better estimates of an appropriate frailty adjustor than we currently have. Because we have made conservative assumptions about sample size throughout this illustrative calculation, actual sample sizes will almost certainly be larger than suggested here. Indeed, it is quite probable that California alone might be sufficient to generate a sample of adequate size to calculate an improved frailty adjustor.
Appendix

COMPUTATIONAL PROCEDURES FOR INTERIM CALCULATION OF FRAILTY ADJUSTOR

Major computational tasks are necessary for calculating a new interim value for the frailty adjustor. They require reading, sorting, and selecting records from several very large datasets. These tasks appear feasible, however. RAND Corporation programmers and analysts have had extensive experience with the HCFA Part A datasets and have successfully carried out more complex linkages and merges of HCFA data files than are required here. Some uncertainties remain, of course. RAND programmers have never worked with either the BMAD file or the Tape-to-Tape files. We have contact with programmers and researchers who have used these files successfully, however. There will always be surprises and problems when using large datasets for the first time, but the fact that others have successfully used them gives us some confidence that no insurmountable obstacles will arise.

Below, we outline the major steps of the computational process of calculating an interim frailty adjustor.

1. Identifying frail patients on Tape-to-Tape files. The first step will be to use the Tape-to-Tape Early Returns files for California and Michigan to identify Medicaid patients who satisfy various definitions of frailty. Patients who received nursing home care and patients who received home health care will be identified and their Medicaid identification numbers written out on tape. In addition to the Medicaid identification number, the output file will also carry an indication of the reason a patient was identified as frail (whether he received nursing home or home health care). This will allow the use of different definitions of frailty in subsequent analyses.

2. Conversion of Medicaid identification numbers to Medicare beneficiary numbers. The next step will be to search the Tape-to-Tape uniform enrollment files for California and Michigan for the Medicaid identification numbers generated in the first step and to attach to each of these numbers the appropriate Medicare beneficiary number, social security number, and relevant demographic information such as age, sex, race, and place of residence.
3. Finding additional frail patients in Medicare records. The next step will be to add those patients receiving SNF care and found in the Medicare INP file. We could also add patients identified in the HHB file as using home health care. As above, the output files of this process would contain indicators for the source of the frailty identification to allow subsequent disaggregated analysis.

4. Extraction of Medicare records for identified frail elderly. This step would require comparing the list of identified frail elderly with the Medicare data files identified above. Records in each of the three Medicare billing files with beneficiary identification numbers matching those on the list of frail patients would be extracted. Additional demographic data would be used to confirm the matches. Only those items in the records that would be relevant for the rest of this analysis (most important, information on covered charges, length of stay, and diagnosis) would be maintained in the extracted records. Different extractions could be carried out for samples of frail patients identified by different definitions. At the outset, it might be best to restrict analysis to one rather narrow definition of frailty. If that analysis and all the computational chores that go with it are successful, other definitions of frailty could be tested. These extractions can be streamlined because we know that certain entries on our lists of frail patients cannot possibly match records in particular Medicare files. For example, the INP file contains information only on patients whose beneficiary numbers end in 0 or 5. It will not be necessary to look for matches for patients with beneficiary numbers ending in other digits. Records for nonfrail patients will also be written out (in the same reduced format as the records for frail patients) for subsequent comparison.

6. Calculation of Medicare outlays. For Part B services, calculating actual Medicare outlays on behalf of each patient in our sample of frail elderly is straightforward. Claims approved by carriers are recorded on the BMAD file, and Medicare pays these amounts. Outlays for home health services are also straightforward. The covered charges recorded on the HHB file provide a close approximation of actual Medicare outlays. For inpatient hospital care and SNF care, though,
matters are more complicated. Medicare payments to hospitals subject to
the prospective payment system are determined by a patient's DRG. The
INP file records the DRG, and it is a fairly simple matter to calculate
the relevant prospective payment for this DRG. Doing so will require
making adjustments for local wage rates and for indirect teaching costs.
These are hospital-specific adjustments, and it will be necessary to
merge hospital-specific data (available on the so-called HCFA
Provider-Specific File) with the file of patient episodes. Adjustments
must also be made for patient deductibles and copayments. The INP file
contains information on a patient's deductible and copayment status to
allow these adjustments. Outlier payments also have to be included in
this calculation. The necessary information for this adjustment--length
of stay and total covered charges--are also available on the INP file.
These adjustments are tedious and time consuming. They are not
difficult in principle, however, and all of the data necessary are
readily available.

More problematic are additional payments to hospitals by Medicare
for so-called pass-through items. The most important of these are
capital costs and direct teaching costs. These payments are made to the
hospital to reimburse hospital-level expenses--expenses that cannot be
easily allocated to particular patients. The "most correct" way to deal
with these costs would be to calculate what fraction of all services of
a particular type in each hospital was consumed by frail patients and
allocate an appropriate portion of capital and direct teaching costs to
these patients. This is likely to be a very complex calculation,
however, and probably not worth the effort in this instance. Inflating
all Per patient payments by a uniform factor to reflect these pass
through costs will be much easier and probably sufficient for the
purposes of this exercise.

This questioning of how much detail is really desirable in this
calculation can be pushed a step further. A vastly simplified approach
to the whole process of calculating outlays for hospital care might be
simply to deflate total covered charges by a factor reflecting some
average cost-to-charge ratio. There is no way of knowing how much this
simplified approach would change the final results of the exercise
without actually performing the calculations both ways. But this
approach is sufficiently easier than direct calculation of outlays that it would probably make sense to perform the simplified calculations early on in the process to provide at least a preliminary estimate of a new frailty adjustor.

The necessary adjustments to SNF care are not so complicated. After the twentieth day of SNF care, Medicare patients are required to make copayments. These amounts are not directly reflected on the INP file, but they can be calculated from length-of-stay information.

All of the calculations described above would be completed for both the sample of frail patients and a sample of nonfrail patients. (There should be no need to go through these adjustments for the entire set of nonfrail patients represented in the various HCFA databases. Such calculations would be possible, but a smaller sample would serve as well.)

7. Calculation of average Medicare covered charges. For each dataset (hospital and SNF, home health, and Part B) the sum of all adjusted covered charges for the samples of frail and nonfrail patients will be calculated. These sums will be divided by the number of elderly who could possibly have matched in each category. To calculate average hospital or SNF costs for the frail elderly, for example, this divisor will be 20 percent of the total number of frail elderly identified. For home health care the divisor will be 40 percent of the total. For Part B services, it will be 5 percent of the total. For these computations there is no reason ever to merge together the three different Medicare files from which we are drawing data. The average Medicare covered charge for frail patients is simply the sum of the averages for each component of care.

8. Calculation of confidence intervals. Confidence intervals around estimates of average Medicare outlays cannot be computed as easily as the averages themselves. To calculate the variance of the sum of hospital, SNF, home health, and Part B outlays we must know the covariances among the various components of costs. To estimate these covariances we must associate costs in each category with costs in other category for the same patient. This will require linking together information from each of the Medicare files. For this linkage, we will be restricted to collecting all costs for patients who could have
appeared in the 5 percent BMAD file (patients with Medicare beneficiary numbers ending in 05, 20, 45, 70, or 95). From this linked file we will be able to estimate the necessary covariances.

9. Calculation of an interim frailty adjustor for the AAPCC. The final step is a simple one. An interim estimate of the frailty adjustor for the AAPCC is simply the ratio of average Medicare outlays for a frail population to a similar average for the nonfrail population. Confidence intervals around this ratio may be calculated from the confidence intervals around each of its components. The above steps can be repeated for different definitions of frailty to test the sensitivity of the estimate to changes in the definition.

10. Subsidiary analysis. The dataset constructed in the previous steps will allow a variety of subsidiary analyses relevant to applications of the AAPCC to populations of frail elderly. Of particular interest would be a test for large differences in Medicare outlays for different sexes or age groups. The current AAPCC makes such distinctions, but there is no conclusive evidence that they are valid for the frail population.
REFERENCES


