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Minimal-Burden Risk Adjusters for the Medicare Risk Program

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EXECUTIVE SUMMARY

The Medicare risk program, often touted as a solution to the high rates of increase in Medicare costs, will not save the government money if payments to risk plans exceed the cost that HCFA would have incurred under traditional fee-for-service (FFS) Medicare. Most research to date (Brown et al. 1993; Riley et al. 1996; and U.S. General Accounting Office 1997) has shown that, in fact, this is what occurs. Beneficiaries with serious health problems are less likely than other beneficiaries to enroll in a risk plan. Estimates suggest that HCFA pays 6 or 7 percent more to plans than it would have spent had these enrollees been in traditional FFS Medicare, even though the payments are set at 95 percent of the average FFS costs that HCFA expects to incur for beneficiaries with similar demographic characteristics.

The overpayment occurs because the mechanism for setting the capitation rates that risk plans are paid for providing coverage of Medicare services fails to reflect health status adequately. The payment method, based on the Adjusted Average Per Capita Cost (AAPCC), adjusts for some factors that are associated with Medicare costs, including age, sex, whether enrolled in Medicaid, whether residing in a nursing home, and county of residence. However, studies have repeatedly shown that this measure explains only about one percent of the variance in beneficiary cost.

This concern prompted HCFA to fund several studies, including this one, to develop more effective risk adjusters for the general Medicare population. HCFA has decided to phase out the AAPCC-based adjuster by blending it with one of these adjusters, the Principal Inpatient Diagnostic Cost Group (PIPDCG), beginning in January 2000. The PIPDCG model sets payments to plans for a given enrollee based on the principal diagnoses for hospital admissions the enrollee had during the prior year, plus the beneficiary's age, sex, and Medicaid status. The weight on the PIPDCG component in this blended rate will gradually increase over time. In 2004, HCFA intends to move to a risk adjuster that includes diagnoses from other Medicare-covered services (physician visits, skilled nursing facility, and home health claims).

Although this study was completed too late to influence the choice of risk adjusters, we believe that it may provide some useful guidance and possible alternatives as risk adjusters, and the HMO data systems on which they depend, evolve over the next few years. While the simple adjuster that we had originally set out to test does not predict costs with sufficient accuracy, the one that we ultimately derived performs much better than the AAPCC and still requires substantially less data than the best-known diagnosis-based adjusters.

THE CHSF ADJUSTERS

Using Medicare claims data for 1989 to 1993 on a sample containing over 3.6 million Medicare beneficiaries, we developed three adjusters, with increasing levels of accuracy and complexity. Our initial objective, based on findings from a prior study for HCFA (Brown and Hill 1994), was to develop an adjuster that required hospital data on only a few common conditions that are highly associated with future costs. Our hypothesis was that a substantial fraction of the overpayment under the Medicare risk program could be eliminated by creating separate rate cells for these beneficiaries, thereby reducing the

rate paid for healthier beneficiaries. Such an adjuster should reduce overpayment to HMOs experiencing favorable selection.

Our CHSF-I adjuster creates separate rate cells for beneficiaries who have been hospitalized within the past four years for any of 12 major conditions that elderly people suffer--cancer (seven types), heart disease (congestive heart failure, myocardial infarction, and ischemic heart disease), stroke, and hip fracture. (For two types of the cancer diagnoses, lung and prostate cancer, we also included hospital outpatient care.) Regression models were used to adjust payments within disease cells based on beneficiaries' age, gender, original reason for entitlement, Medicaid status, admissions for other CHSF conditions, and admissions in prior years for the same condition.

Models Based Only on Hospital Stays Are Insufficient

The model predicted only slightly better than the AAPCC for a number of biased subgroups. Costs in 1993 for the 15 percent of surviving beneficiaries with CHSF discharges in 1989 to 1992 were $692 per month, 2.6 times greater than the mean for beneficiaries without these conditions. Monthly payment rates ranged from a low of $174 to a high of $3,410 (for a leukemia patient) in our sample. For groups of beneficiaries defined by whether they have a history of CHSF, our adjuster predicts mean costs nearly perfectly (by design), whereas the AAPCC overpredicts costs by 20 percent for beneficiaries with no CHSF history. When groups are defined by prior year Medicare costs, however, the CHSF-I adjuster overpredicts costs for those in the lowest quintile by 52 percent. While somewhat better than the AAPCC (68 percent overprediction), this is substantially worse than Ellis et al.'s (1996) HCC adjuster (30 percent) or the ADG-HOSDOM adjuster (8 percent) developed by Weiner et al. (1996).

This disappointing performance, which resulted because payments under the CHSF-I adjuster for 85 percent of the Medicare population are determined solely by demographic or eligibility variables available from administrative data, led us to develop a second adjuster for those *without* CHSF admissions. This adjuster provides payments for beneficiaries who are not in a CHSF rate cell but have physician visits (ambulatory or inpatient) for one or more of four chronic conditions (diabetes, hypertension, heart disease, and chronic obstructive pulmonary disease) in the prior year. Again, this approach requires far less information from plans than the ADG-HOSDOM and HCC adjusters, which need data on physician visits for hundreds of diagnoses. This CHSF-CC adjuster placed an additional one-third of the Medicare population in higher-cost rate cells, leaving just over half of all beneficiaries in the "no-condition" cells, for which rates are determined by administrative data only.

Including Outpatient Care for Four Chronic Conditions Reduces Overpayment Substantially

Regression models were estimated to predict 1993 costs as a function of the demographic/eligibility variables plus a set of binary variables indicating which combination of chronic conditions the beneficiary was treated for in 1992. A separate model was estimated for those with no conditions. Rates for those with chronic conditions (except for those with hypertension only) were typically 50 to 100 percent higher than the rates for beneficiaries with no conditions, which fell substantially below the AAPCC rates for any age group. For example, the payment rate for females age 65 to 69, not on Medicaid, and originally entitled because of age was 40 percent of the monthly average for all beneficiaries, compared to the

AAPCC rate of 55 percent of the average for Part A costs and 70 percent for Part B costs. Overpayment for beneficiaries in the bottom quintile of Medicare expenditures for the prior year dropped to 38 percent, substantially better than both the AAPCC and the CHSF-I adjusters. The adjuster still overpredicted substantially for some healthier-than-average subgroups, however. For example, the model overpredicted costs by 34 percent for the two-fifths of beneficiaries who rank their health as excellent. Nonetheless, the CHSF-CC adjuster substantially outperforms the AAPCC (49 percent overprediction) for this group.

Retrospective Payments for Incident-CHSF Cases Further Improves Predictive Accuracy

We then sought to lower payments even further for healthy beneficiaries by adding a retrospective component to the adjuster. This component provides retroactive payments to plans for beneficiaries who are not in a CHSF rate cell at the beginning of the year but are admitted to the hospital for one of these conditions during the year. Approximately 6 percent of the Medicare population falls into this group (and an additional 1.5 percent have CHSF admissions late in the prior year, for which they will receive retrospective payments). The payment is equal to the estimated average Medicare FFS costs that are incurred for such beneficiaries during a six-month window around the time of admission (the two months before, the month of, and the three months after admission).

The retrospective component, though applicable to only a small proportion of the non-CHSF population, led to substantial decreases in prospective payment rates for the chronic-condition portion of the population and the no-condition group. For example, for beneficiaries originally entitled to Medicare because of age, payment rate factors dropped by 20 to 40 percent relative to those for the CHSF-CC adjuster, for both those with chronic conditions and those with no conditions. For beneficiaries age 65 to 69 (male or female), plans would receive prospective payments equal to only 30 percent of the average for all beneficiaries. This is about one-tenth the prospective rates on average for those hospitalized for a CHSF condition in the prior year. As a result, the extent of overpayments for various low-cost groups drops substantially. For example, overpayments for beneficiaries in the lowest quintile on prior-year costs were about 20 percent less than the estimated overpayment under the CHSF-CC adjuster with no retrospective component. This adjuster eliminates two-thirds of the 76 percent overpayment for this group that occurs under the AAPCC. Overpayments for those in excellent health also drop to 29 percent, compared to 56 percent for the AAPCC, and 34 percent for the CHSF-CC.

ADVANTAGES OF THE CHSF ADJUSTERS

Although it does not predict as accurately as the ADG-HOSDOM and HCC risk adjusters, the CHSR-R adjuster developed here has a number of advantages relative to these other risk adjusters. First, the adjuster is more feasible and less expensive for plans to implement, because it requires far less data from them than the other adjusters do. Second, it predicts much more accurately than the AAPCC for favorably selected subgroups of beneficiaries and not much worse than the two diagnosis-based adjusters. Third, by focusing on a few specific diseases, our adjuster may encourage plans to market to beneficiaries with these conditions and develop disease-specific protocols for treating them efficiently and effectively. Fourth, the data required for the adjuster yields, as a by-product, indicators of the quality of care. Fifth, the retrospective component of the adjuster reduces financial risk to plans while requiring no more data than that needed to implement the prospective component of the adjuster.

Reduced Data Demands Enhance the Potential for Net Savings

While limiting our adjuster to only a few common chronic conditions reduces the accuracy relative to the ADG and HCC adjusters, which both use hundreds of diagnoses, the greatly reduced data demands on the plans could be well worth the small sacrifice in precision. Plans would be required to report and verify only the hospitalizations for CHSF diagnoses and one physician visit (or perhaps two visits, depending upon how it is implemented) for any of the four chronic conditions claimed for a patient. Because plans' data systems are often primitive, the cost of creating systems capable of generating extensive detailed data is high. Higher data costs, in turn, may offset much of the savings in resource costs from HMOs' more cost-effective utilization patterns, perhaps leaving too little for HCFA, the plans, and beneficiaries all to benefit.

Plans May Seek Beneficiaries with Serious or Chronic Illnesses

Another advantage of the CHSF-R adjuster--that it should lead plans to seek out beneficiaries with these high-cost conditions--is shared by other diagnosis-based adjusters, but the influence may be stronger under the CHSF-R adjuster because of the focus on a few major conditions. Under the AAPCC adjuster, plans sometimes avoid contracting with highly regarded specialists who may provide the best care for people with serious and chronic diseases, for fear of attracting their FFS patients into the HMO. Under diagnosis-based risk adjustment, such patients suddenly become much more attractive, because payments reflect average FFS costs, and managed care is most effective at generating real cost savings on patients who tend to require the most care. Thus, the potential (and expected) profit margin is much greater for these patients. The focus of the CHSF-R adjuster on a select set of these conditions will highlight for plans the advantage of affiliating with the top specialists in those diseases. Whereas the other diagnosis-based adjusters could inspire the same plan behavior, the CHSF-R adjuster makes it clear to plans where they should target their effort, both in selecting providers and in developing disease-management protocols. Ideally, plans would create "centers of excellence" for treatment of patients with CHSF and the chronic diseases included in the adjuster and compete for such beneficiaries on the basis of the quality of care that they provide.

Risk Adjuster Data Yields Quality-of-Care Indicators, Which Could Minimize Upcoding

Using the diagnosis information supplied by the plans to develop quality-of-care indicators could be a powerful tool for discouraging upcoding as well as a boon to beneficiaries trying to decide whether to enroll in a particular risk plan. Under the CHSF-R adjuster, plans have some incentive to readmit CHSF patients in order to receive higher payment in future years (since prospective payments are greater the more recent the hospitalization). Patient distributions can be easily monitored for evidence of upcoding. Furthermore, HCFA could publish, as an indicator of plans' quality of care, data indicating the proportion of CHSF beneficiaries in each plan who are readmitted in the subsequent year. These rates, one for each of the 12 CHSF diseases, could be presented for each plan and for FFS in each market area, enabling easy comparisons. Thus, plans that readmitted patients unnecessarily so as to receive higher prospective rates may become less attractive to beneficiaries with high-cost diagnoses, resulting in a loss of market share among this potentially profitable group and overall.

A Retrospective Component to Risk Adjustment May Help During Initial Implementation

Finally, the retrospective component of the adjuster reduces risk to plans by compensating them at actuarially fair rates for non-CHSF beneficiaries who develop one of these diseases, while requiring no more data than is needed to update the prospective adjuster. This retrospective component could be modified to make implementation easier for plans by relying on only a retrospective component in the first year while accumulating the data necessary for the prospective component. This approach could be used incrementally to build the four-year history required for the full CHSF-R adjuster, while paying plans actuarially fair rates on a combined prospective-retrospective basis.

LIMITATIONS OF THE CHSF-R ADJUSTER

Our adjuster has a number of limitations, some that are inherent in its design and others that can be remedied with little additional effort. As noted above, by limiting the number of diseases, the adjuster will not predict as well for some subgroups of beneficiaries. However, the loss in predictive accuracy is not severe.

Risk Selection May Occur Within Disease Category

One potentially major concern, however, is that selection bias may occur within rate cells if risk plans tend to attract the healthier beneficiaries with particular conditions. The U.S. General Accounting Office (1997) provided some evidence that such selection occurs, showing that among beneficiaries with the chronic conditions that we use, those who enrolled in risk plans had lower FFS costs (in the year before enrollment) than beneficiaries with these same diseases who did not enroll.

All risk adjusters suffer from this potential problem of biased selection within rate cells, however defined, but three features of the CHSF-R adjuster should help to ameliorate these effects. First, to some degree we control for greater severity of disease by paying higher rates for those with multiple CHSF conditions. Second, we adjust payments for age, original reason for entitlement, gender, and Medicaid status separately for each CHSF condition and for chronic conditions. Third, and most important, payment rates for CHSF depend upon when the most recent CHSF discharge occurred, and whether there were hospitalizations for previous episodes of the disease in prior years. The latter feature is unique among the diagnosis-based adjusters.

Underpayment for Rare Diseases Will Be Exacerbated

One additional drawback to the CHSF-R adjuster is that plans will be substantially underpaid for beneficiaries with rare diseases that are not incorporated into either the CHSF or chronic-condition components. This situation is worse than under the AAPCC and other risk adjusters, because our adjuster classifies these individuals in the "no-condition" rate cell, which has much lower payment rates than under the AAPCC (or under a risk adjuster that accounts for the disease). Nonetheless, the rates are still actuarially fair if plans have neutral selection on these rare conditions, and plans are likely to continue to have favorable selection. By including most of the commonly occurring diagnoses in our adjuster, the

number of high-cost cases with omitted diseases, and any resulting over- or underpayment in the aggregate, should be relatively small.

Minor Modifications Could Improve the Adjuster

Other shortcomings of the adjuster can be remedied with little effort. The major changes that should be considered are the timing of the retrospective window, the inclusion of severe mental illness/dementia as an additional diagnosis, and elimination of the inpatient-outpatient distinction. The retrospective window of two months before the month of admission and three months after does not capture the months of highest cost for some of the diseases, because average costs during the months before admission tend to be lower than those four and five months after the admission month. Modifying this window to include only one month before the month of admission and four months after would capture a larger share of costs surrounding the time of the admission. Inclusion of severe mental illness and dementia in the risk adjustment formula may be desirable because of the large share of Medicare hospital costs that are associated with these diagnoses. However, these diagnoses are quite gameable, so close monitoring would be required of the proportion of patients classified in this cell. Finally, while plans are much more likely to be able to supply data on inpatient care than on ambulatory visits, the restriction of our CHSF component to inpatient care may discourage innovative outpatient solutions to patients' health problems. While monitoring can overcome this to some extent, in the longer run it may be useful, for some conditions, to drop the inpatient-outpatient distinction inherent in the CHSF-R adjuster.

POLICY IMPLICATIONS

Although HCFA has decided to begin diagnosis-based risk adjustment for Medicare by phasing in the PIPDCG adjuster, the results presented here offer some useful guidance and potential alternatives if plans are unable to supply the data required to implement the HCC adjuster. We have found, as have others, that a simple adjuster based on only inpatient treatment will not yield very accurate predictions for a number of beneficiary subgroups of healthier-than-average (or sicker-than-average) beneficiaries. However, it appears that incorporating higher payments for a small number of common chronic conditions treated in any setting can lead to substantial improvements in the predictive accuracy. Adding a relatively simple retrospective component can further improve predictive accuracy and reduce plans' financial risk without requiring any additional data from plans beyond that required for the prospective component.

Features of the CHSF-R Adjuster May Be Adapted to Address Data Shortcomings

The implications and importance of our findings depend in part on the experience under PIPDCG, the adjuster that HCFA intends to use initially for the Medicare risk program in place of the AAPCC. If a large number of plans have difficulty supplying data of adequate quality under PIPDCG, HCFA could consider switching to an adjuster like the CHSF-R. By limiting data requirements to identification of enrollees with hospital discharges for a few particular conditions, plans may be able to comply. The components of the CHSF-R adjuster that are implemented could depend on the nature of the difficulty

plans are having. Alternatively, features of the CHSF-R could be incorporated into the PIPDCG or other adjusters if desired.

Suppose, for example, that plans are able to supply the hospitalization data required for the PIPDCG adjuster but are not able to supply diagnoses for physician visits and are likely to require several years to develop the capability to do so. In that case, HCFA may wish to consider instituting a multiyear version of PIPDCGs (similar to our CHSF-I adjuster) to increase predictive accuracy. HCFA could also consider adding a retrospective component to this adjuster (such as our retrospective component) to improve predictive accuracy further without requiring any additional data. Finally, even if plans are unable to provide full diagnosis data for all physician encounters, it may be feasible for them to supply the limited data needed to implement our chronic-conditions component. If plans are able to provide proof of at least one encounter for our limited set of chronic conditions, it will be possible to adjust rates for the large number of beneficiaries with chronic conditions who do not require an inpatient stay. This approach has the added benefit of greatly reducing the amount of data that HCFA must process.

Assessing what data plans are able to provide will be difficult, because plans with favorable selection would prefer to minimize the extent of risk adjustment that is performed. Furthermore, the costs of supplying the required data may reduce profitability. Thus, plans are likely to exaggerate the costs and difficulty of supplying the diagnosis data required by risk adjusters. Plans could, however, be paid lower rates if they do not supply the required data.

The Risk Adjuster Could Lead to Better Quality of Care and Beneficiary Choices

A final lesson is that it may be possible to use the data required for whatever risk adjuster is implemented to derive indicators of the quality of care being provided by plans. An important goal of the Medicare + Choice program is to increase beneficiaries' options, but there is much concern about the accessibility of useful information to assist beneficiaries in making these choices. With the CHSF-R adjuster, hospital readmissions for CHSF could be compared across plans and to FFS, as described above, and published for beneficiaries to use in making choices. Differences among plans in the likelihood of readmission for patients with congestive heart failure, for example, might drive a beneficiary with this condition to choose a plan with lower rates, other things being equal. Ultimately, HCFA could consider using such information in setting the payment rates to plans, or in providing bonus payments or financial penalties, as a further impetus to plans to provide high-quality care. Such an approach ultimately could lead to competition among plans on the basis of quality as well as cost, and may be a more effective way to ensure quality than many of the legislative solutions currently under consideration.

I. INTRODUCTION

The Medicare risk program, often touted as a solution to the high rates of increase in Medicare costs, will not save the government money if payments to risk plans exceed the cost that HCFA would have incurred under traditional fee-for-service (FFS) Medicare. Most research to date (Brown et al. 1993; Riley et al. 1996; and U.S. General Accounting Office 1997) has shown that, in fact, this is what occurs. Beneficiaries with serious health problems are less likely than other beneficiaries to enroll in a risk plan. Estimates suggest that HCFA pays 6 or 7 percent more to plans than it would have spent had these enrollees been in traditional FFS Medicare, even though the payments are set at 95 percent of the average FFS costs that HCFA expects to incur for beneficiaries with similar demographic characteristics.[1]

The overpayment occurs because the mechanism for setting the capitation rates that risk plans are paid for providing coverage of Medicare services fails to reflect health status adequately. The payment method, the Adjusted Average Per Capita Cost (AAPCC), adjusts for some factors that are associated with Medicare costs, including age, sex, whether enrolled in Medicaid, whether residing in a nursing home, and county of residence. However, studies have repeatedly shown that this measure explains only about one percent of the variance in beneficiary cost.

A. THE NEED FOR HEALTH STATUS RISK ADJUSTERS

Several studies have shown that enrollees and nonenrollees differ on a range of health status indicators. Brown et al. (1993) show that the enrollees had fewer impairments on Activities of Daily

[1]While some unpublished studies suggest that this overpayment no longer exists (for example, Rogers and Smith [1995] and a study by Lewin Associates released to the press in 1997), these studies were both funded by a trade association for health maintenance organizations (HMOs) and have not been peer-reviewed, which casts suspicion on the findings. It is still widely believed that beneficiaries enrolled in Medicare HMOs are healthier on average than those who are not.

Living (ADLs), such as bathing, dressing, and eating, and Instrumental Activities of Daily Living (IADLs), such as housekeeping, paying bills, and cooking. Enrollees also rated their health better than did nonenrollees, were less likely to die in the forthcoming year; were less likely to have had cancer, heart disease, or a stroke in years past; and worried less about their health than did nonenrolled beneficiaries residing in the same zip codes as the enrollees. Hill and Brown (1992) find that these differences persist even after taking into account the differences in demographic factors that the AAPCC mechanism adjusts for. Brown and Hill (1994) find that these characteristics all have statistically significant, independent effects on beneficiary costs. Thus, failure to account for them directly in the payment mechanism leads to overpayment by HCFA and failure to realize the intended five percent savings. Riley et al. (1996) find very similar results with a more recent but much smaller sample of risk plan enrollees. These and other studies are the basis for the current consensus that health-based risk adjusters can eliminate the overpayment to plans and are the rationale for the mandate of the Balanced Budget Amendment (BBA) of 1997 that payments to Medicare + Choice plans use health status risk adjusters beginning January 1, 2000.

This consensus and the potential to reap savings from the Medicare risk program prompted HCFA to fund a significant amount of research to develop more effective risk adjusters for the general Medicare population. These risk adjusters rely on diagnoses from claims or encounter data (Pope et al. 1998; Ellis et al. 1996; and Weiner et al. 1996) or on measures of health and functional status obtained from beneficiary surveys (Pope et al. 1998; and Gruenberg et al. 1996). The two best-known adjusters are the Ambulatory Care Group (ACG) and Diagnostic Cost Group (DCG) families of risk adjusters. Both involve constructing a set of variables for a given beneficiary based on whether they have hospital or physician claims for treatment for various groupings of diagnoses. The groupings are based on a combination of empirical evidence and clinical judgment, with the

balance between the two depending upon the adjuster. Costs for a given calendar year are then regressed on these binary indicators of diagnosis groupings for the prior year to determine the relationship of the conditions to future costs. The models include additional regressors for age, gender, original reason for entitlement to Medicare, and state buy-in.

Beginning in January 2000, HCFA will use one of the DCG adjusters, the Principal Inpatient Diagnostic Cost Group (PIPDCG) adjuster, to meet the BBA's mandate to employ health status risk adjusters. The adjuster will be phased in over a period of 4 years. This adjuster relies only on diagnoses from inpatient claims, because most plans are unable to provide complete and accurate diagnosis data for physician visits or other Medicare-covered services. In 2004, HCFA intends to move to an adjuster that will have much greater predictive power than the PIPDCG, by incorporating diagnoses from physician visits and other Medicare services. As HCFA gains experience using health status risk adjusters in the Medicare risk program, there will be a need for greater refinement of existing adjusters and for development and testing of new adjusters to ensure that they are effective at achieving program goals.[2]

B. THE BASIS FOR OUR HEALTH STATUS RISK ADJUSTER

1. Key Issues in Creating a Risk Adjuster

Development of a health status adjuster that avoids overpayment must balance the feasibility and cost of obtaining accurate data on indicators of enrollees' health status with the need for good predictors of Medicare costs. These requirements lead to often-repeated lists of the characteristics that a good risk adjuster should exhibit:

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[2]For instance, Mathematica Policy Research, Inc., in a HCFA-funded project, is testing and refining risk adjusters for the dual-eligible population (Brown et al. 1998), which accounts for a disproportionate share of Medicare and Medicaid costs.

- ***Feasibility.*** Proposing an adjuster that uses data that can be provided only at great cost to the plans or to HCFA will tend to result in poor-quality data and will eliminate much or all of the cost-saving potential.

- ***Predictive Accuracy.*** For both high-risk and low-risk patient groups, plans must be paid amounts that are roughly comparable to the average costs of treatment, to avoid (1) overpayment due to favorable selection, (2) incentives to favorably select, and (3) excessive cost pressure that could lead to poor quality of care.

- ***Verifiability of Data.*** It must be possible for HCFA periodically to audit the data on health status or diagnoses provided to them by the plans.

- ***Minimal Opportunities for Gaming.*** The opportunities to obtain higher reimbursement by providing services to patients who do not really need them must be minimized and must be amenable to monitoring.

Other criteria have been proposed (such as clinical relevance), but we believe the above are the most important. Balancing them can be extraordinarily difficult.

The motivation for this project was to develop an adjuster that would make an explicit trade-off between accuracy and feasibility that falls somewhere between the current AAPCC (obviously feasible at low cost, but not accurate) and variants of the ACG and DCG risk adjusters that require diagnostic data on all inpatient and outpatient encounters but are considerably more accurate than the AAPCC.

2. The Importance of History of Serious Illness

The Brown et al. (1993) study found that 83 percent of the estimated overpayment in the risk program was due to the differences between enrollees and nonenrollees on health status measures, rather than on attitudes about health care or socioeconomic variables, and one of these measures--whether ever had cancer, heart disease, or stroke--accounted for far more of the difference (38 percent) than any of the other health indicators. Survey data indicated that about 28 percent of risk plan enrollees had such a history, compared with about 33 percent of nonenrollees in the same zip

codes. Furthermore, we found that differences between the two groups on the AAPCC demographic characteristics explained almost none of the difference between the two groups on this measure. We also found that those who had such a history had far higher costs (about 2.5 times higher) than those who did not.

A simulation we conducted showed that had this extremely crude indicator of health status (history of cancer, heart disease, or stroke) been part of the AAPCC, HCFA actually would have saved about one percent, instead of losing money relative to FFS reimbursement. That is, the projected average AAPCC rate for enrollees under this new rate structure would have dropped by about 7 percent, so that the expected FFS cost for enrollees would have been about 96 percent of this lower AAPCC. While HCFA would not be saving the intended five percent (because enrollees still differ from nonenrollees on other health status and sociodemographic factors that influence costs), at least costs would not be *increased* by the risk program.

The simplicity of this solution led us to propose this study. A single rate for all persons who had ever had cancer, heart disease, or stroke would obviously be too simplistic. However, we thought a more credible but still simple adjuster could be developed using just these three conditions--by paying different rates depending upon which condition (or conditions) the patient had and how recently it had been a major problem. Theoretically, this adjuster should eliminate some of the overpayment not captured by the crude measure that we had simulated earlier. If enrollee-nonenrollee differences were greatest for the most costly conditions, or fewer enrollees had multiple conditions, or the latest episode for enrollees occurred longer ago on average than the most recent episode for nonenrollees, then the payment rate for enrollees would drop (appropriately) even further than it would by adjusting only for whether beneficiaries ever had cancer, heart disease, or a stroke.[3]

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[3]A recent General Accounting Office report (U.S. General Accounting Office 1997) suggests (continued...)

C. THE CANCER, HEART DISEASE, STROKE, HIP FRACTURE ADJUSTERS

We developed three separate adjusters with the goal of creating a health status risk adjuster that was substantially more accurate than the AAPCC yet with far fewer data requirements than the well-known DCG and ACG families of risk adjusters. The resulting Cancer, Heart Disease, Stroke, Hip Fracture (CHSF) risk adjusters are consistent with that original intent, although the number of diagnoses have expanded to include 12 inpatient diagnoses, including leukemia; breast, lung, skin, colon, prostate, and other cancers; myocardial infarction; ischemic heart disease; congestive heart failure; stroke; and hip fracture. All three CHSF adjusters are based on diagnoses from hospital stays for these 12 conditions (plus hospital outpatient department treatment for lung and prostate cancers) over the past four years.

The three adjusters differ in how they capture differences in costs among beneficiaries with no history of CHSF over the past four years (the "non-CHSF" group) and whether or not the adjuster includes a retrospective payment. The first, the CHSF-I (for "CHSF-inpatient only") adjuster, captures variation in non-CHSF beneficiaries using demographic categories similar to those used in the AAPCC. The other two, the CHSF-CC (for "chronic conditions") and CHSF-R adjusters, capture variation in costs among non-CHSF beneficiaries by setting rates according to whether these beneficiaries were treated for diabetes, hypertension, chronic obstructive pulmonary disease (COPD), and certain heart conditions, as well as demographic categories. The last adjuster, the CHSF-R adjuster, includes a retrospective payment for non-CHSF beneficiaries who become hospitalized for the first time.

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[3](...continued)
that such differences may exist. Enrollees were found not only to be less likely to have chronic conditions, but among beneficiaries with the conditions, enrollees had fewer coexisting conditions and lower costs during the year preceding enrollment.

In the remaining chapters of this report, we describe the samples and data used in this study (Chapter II), then present the methodology used to construct each of the adjusters, along with the rates and predictive accuracy of the models (Chapters III through V). We then discuss implementation issues that arise with the CHSF adjusters.

II. SAMPLES AND DATA

Construction of the adjusters required data from several sources, with separate samples for the different years and conditions. The data used are for the period from 1989 to 1993.

A. SAMPLES AND SELECTION CRITERIA

We used three samples in this study to create our payment rates and test their predictive accuracy. These included samples of (1) beneficiaries with a history of CHSF during 1989-1992, (2) the Continuous Medicare History Sample (CMHS), and (3) a test sample from the Medicare Current Beneficiary Survey (CBS).

The first sample consists of Medicare beneficiaries with inpatient stays for one or more of our CHSF diagnoses in the four years prior to 1993. We also included beneficiaries with hospital outpatient treatment for lung cancer or prostate cancer over this time period. We call this the CHSF sample. These beneficiaries were identified from the MEDPAR and Outpatient Standard Analytic Files (SAFs). For most diagnoses, this "sample" actually contained all beneficiaries who were hospitalized with the diagnosis and met our other criteria (see below). Because so many beneficiaries have one of our heart disease diagnoses, we took a random sample of approximately 60,000 heart disease cases for each year.[1] For those hospitalized in 1989, 1990, or 1991 for a heart diagnosis only, we drew a 15 percent sample to generate this number of cases. From those hospitalized in 1992 for a heart diagnosis only, we selected 12 percent for our sample. Beneficiaries who were hospitalized multiple times for different diagnoses in the same year, regardless of whether it was for a heart condition or not, were always included in our sample, to ensure adequate numbers

[1]A random sample of 60,000 beneficiaries is sufficient to yield a 95 percent confidence interval of ±2 percent of mean reimbursements, based on a coefficient of variation of 2.5.

of observations for estimating the effect of coexisting conditions. The sample was used to estimate average reimbursement regression models, which will determine payment rates for those with prior conditions.

The second sample used was HCFA's CMHS, which is a random five percent sample of all Medicare beneficiaries, selected on the basis of the last two digits of their Health Insurance Claim number. We used this sample mainly to estimate payments for those beneficiaries who did not have a prior hospitalization for CHSF. Those without prior conditions represent the vast majority of Medicare beneficiaries (87 percent). While the CMHS also contained many beneficiaries who had prior conditions, we did not use them to estimate reimbursement rates for such beneficiaries because the sample size was too small for accurate estimation. We call the subset of the CMHS containing only beneficiaries without prior conditions the "no-prior-condition" sample.

The third sample is a test sample, which we use to assess the accuracy of our proposed payment method and to compare it with the AAPCC payment rates. The main source of data for this sample is the Round 4 CBS, which was collected in 1992. The survey data contain additional information not available in the other data sets, which allows us to compare the accuracy of our proposed adjuster among subgroups of beneficiaries with different characteristics. Of particular importance are subgroups based on characteristics associated with both HMO enrollment and health status, such as the ability to perform ADLs without assistance.

We restricted each of our three samples to Medicare beneficiaries who met the following criteria:

- Living on January 1, 1993, and enrolled in Medicare Part A or B at some time during 1993.
- Medicare or auto insurance was the primary payer on claims from 1992 to 1994. This requirement leads to the exclusion of working individuals who have primary coverage

through employers. (Auto insurance takes precedence over Medicare only for limited time periods after an accident. Only about one percent of beneficiaries have a spell during which auto insurance is the primary payer for Medicare-covered services.) For the prospective CHSF-I and CHSF-II adjusters, the primary payer condition is only necessary during the period for which we are examining reimbursement, which is 1993. However, reimbursement data for 1992 and 1994 are needed for creating a retrospective adjuster. Since we use the same sample for both adjusters, we drop any beneficiary whose primary payer was not Medicare or auto insurance during the entire possible reimbursement period.

- Not entitled under End Stage Renal Disease (ESRD) between 1992 and 1994. Because of the high cost and easy identification of those with ESRD, current AAPCC rates for those beneficiaries are calculated separately. This study does not address payment rates for those with ESRD.

- Not in an HMO from 1989 through 1993. Information on reimbursement and hospitalization is available only for those in the FFS sector.

For the three main samples, we need a certain minimum amount of information to define the sample and to estimate our payment rate models. The following data items were extracted for all samples:

- History of hospitalization for our set of diagnoses in 1989 to 1992
- Part A and Part B payments for 1993
- Months enrolled under Part A and Part B in 1993
- Age, sex, Medicaid status as of January 1, 1993
- Primary payer in 1992 through 1994
- ESRD status in 1992 to 1994
- HMO enrollment status in 1989 to 1994

B. DATA SOURCES

A number of sources were used to create the samples and analysis files. In addition to the ones mentioned above (MEDPAR, Outpatient SAF, CMHS, CBS), we also used (1) the Enrollment Data

Base (EDB), to obtain certain characteristics of beneficiaries; and (2) other SAFs, to determine reimbursements.

The MEDPAR data set contains information on all inpatient stays. For each stay, there is one record with information on diagnoses and dates of admissions and discharges, along with other information. We used this database to identify beneficiaries who had inpatient discharges during the four years prior to the base year. We extracted all records for stays that had any of the diagnoses listed in Chapter I. These data were used to identify our samples (based on date of discharge and diagnosis) and then to construct the four-year prior-condition history for each sample member. We also used this data set to determine the prior conditions for beneficiaries in the CMHS and the CBS test sample.

We used the SAFs to construct the dependent variable and to supplement our sample of beneficiaries with prior conditions. For most of the conditions, we selected only individuals with inpatient stays. However, for lung and prostate cancer, we included beneficiaries with hospital outpatient visits as well, because patients are often treated for these conditions in this setting rather than as inpatients (see Chapter III for discussion). The 1989 to 1992 outpatient SAFs were used for this purpose. We used all institutional and noninstitutional SAFs in 1993 to determine total reimbursements in 1993, for both our prior condition sample and CBS test samples.

For each beneficiary, the CMHS contains a summary record with reimbursement data and other information for each year of a multiyear period. Almost all the data elements required for the full five percent sample and no-prior-condition subsample were drawn from the CMHS. The remaining elements were taken from the EDB, which contains demographic and enrollment information for every Medicare beneficiary. It was used with all the samples to obtain the necessary information not

available from the samples' primary source, including dates of Medicare enrollment and primary payer.

The CBS data set contains much more extensive information on a much smaller random sample of Medicare beneficiaries. It contains both Medicare administrative data and survey data. Weights were provided with the data set so that the weighted sample would reflect the entire population of Medicare beneficiaries. We used the Round 4 data, which was collected in 1992, rather than the Round 7 data, which was collected in 1993, the year for which we are examining reimbursements. Using Round 7 data would have restricted the sample to those who survived until their interview date in 1993. Such a sample would not have been representative of the population we are interested in--all beneficiaries who were on Medicare for at least a month in 1993.

Sample sizes and descriptive statistics for these data sources are provided in Chapter III.

C. DATA ELEMENTS

We extracted the following data elements from the sources identified above. We used the Health Insurance Claim number to link across years and files.

MEDPAR

- Diagnosis code

SAFs

- Claim payment amount (for all bills)
- Diagnosis code (for outpatient institutional bills)

EDB

- Birth date
- Sex

- Part A entitlement begin date, end date
- Part B entitlement begin date, end date
- Primary payer begin date, end date, payer code
- Entitlement reason change date, reason code (to determine original reason for entitlement)
- Residence change date, state, and county
- Medicare status code, change date (to determine if entitled under ESRD)
- Group health organization enrollment and disenrollment date (to determine if in an HMO)

CMHS

- 1993 Part A reimbursement
- 1993 Part B reimbursement
- Original reason for entitlement
- Part A entitlement start and end date
- Part B entitlement start and end date
- Group health plan indicator
- ESRD indicator
- Part B third party indicator (to determine Medicaid status)

CBS

- Type of interview (to determine whether residing in institution)
- Survivor indicator
- Date of birth
- Sex
- Medicaid eligibility for December 1992

- Income
- Marital status
- Ever had myocardial infarction, angina pectoris/chronic heart disease, stroke, or cancer
- ADLs
- IADLs
- Self-rated general health condition

D. DATA PROBLEMS

We examined the reimbursement fields carefully and found some improbable values and inconsistencies between reported values from different files. In many cases, however, very large reimbursements are likely to be legitimate, or may be balanced by errors in the other direction, which are harder to detect. Thus, we were generally reluctant to remove or modify records.

One source of anomalous data was claims for home health care. Of the 3 million home health SAF records that we extracted, 13 had 1993 reimbursements of over $200,000. Comparison of the reimbursement amounts with the total claim amount suggested that the decimal point had been misplaced for these cases. Since the recorded reimbursements were unlikely, we dropped the 13 beneficiaries associated with the claims from the study. Some inpatient SAF records also contained high reimbursements. However, since inpatient reimbursement could have been that high, we left them in the sample.

A second problem was conflicting data on reimbursements from different data sources for some of the 135,000 beneficiaries who were in both the prior condition sample and the CMHS sample. For the prior condition sample, reimbursements were extracted from the SAF files, while for the CMHS sample, reimbursements were extracted from the CMHS file (which in turn were presumed to have come from the same claims files as the SAFs). On average, Part A reimbursements in the

CMHS file were 3.44 percent higher and Part B reimbursements were 1.25 percent lower than the SAF calculated amounts. We found that, for 75 percent of the overlapped sample, 1993 monthly Part A reimbursements from the two sources were within $10 of each other, and 92 percent of the sample had Part B differences of $10 or less. We scaled the CMHS reimbursement for each sample member by the ratio of SAF costs to CMHS costs observed in the overlap sample. These adjustments affect (slightly) only the relative payment rates for those with history of illnesses versus those without. They did not affect the relative payment levels among those with a history of illness.

Finally, we substituted the SAF data on reimbursements for the reimbursement data in the CBS files for the CBS sample to account for shortcomings of the latter. Reimbursements in 1993 for the CBS test sample were provided in the CBS file only if the individual was reinterviewed in Round 7. However, those interviewed in Round 7 were a biased sample of the Round 4 respondents, since they had to have survived to the Round 7 interview date. There were also discrepancies between the SAF and CBS data on reimbursements. For both reasons, we used the SAF reimbursements for the CBS test sample.

III. A PROSPECTIVE ADJUSTER BASED ON COMMON HIGH-COST CONDITIONS

A. RATIONALE

Our objective was to develop an adjuster that would make an explicit trade-off between accuracy and feasibility, one that would fall somewhere between the current AAPCC (obviously feasible at low cost, yet not accurate) and variants of the ACG and DCG families of risk adjusters with the greatest predictive power, which require diagnostic data on all inpatient and outpatient encounters but are considerably more accurate than the AAPCC. Our chosen approach was to (1) construct a risk adjuster that included a limited number of highly predictive and common inpatient conditions, (2) select inpatient conditions that previous literature suggests is highly predictive of Medicare costs, and (3) measure history of inpatient conditions over several years in the past. Thus, the design of the CHSF-I adjuster reflects the trade-offs inherent in developing an administratively feasible yet more accurate adjuster.

1. Limiting the Conditions

The advantage of the CHSF-I adjuster over the ACG and DCG adjusters is that it requires far less data, because the risk payment to a plan for a beneficiary depends only on whether he or she had been treated for a few specific diagnoses. Plans would need only supply data on whether each patient had been hospitalized for cancer, heart disease, stroke, or hip fracture in the past four years and on when the most recent incident arose. Limiting the number of conditions in our adjuster reduces the potential for the coding proliferation and gameability inherent in ACG and HCC adjusters. Because HCFA's monitoring task is easier the fewer the number of conditions, risk plans would have an incentive to submit accurate claims, especially if HCFA penalized risk plans that

submitted false claims. To further simplify the data and reduce gaming potential, the CHSF-I adjuster uses hospital diagnoses, not ambulatory or outpatient visits.[1] Using hospital diagnoses reduces gameability, because we select conditions for which hospitalization is likely to be necessary for adequate treatment.[2]

Previous research motivated our desire to construct an adjuster based on a few highly predictive and prevalent conditions. In earlier studies of the Medicare risk program (Brown et al. 1993; and Brown and Hill 1994), we estimated that risk plans were paid 5.7 percent more on average than it would have cost Medicare had plan enrollees been in the FFS sector. We estimated that FFS reimbursements for those who actually enrolled in risk plans would have been about 90 percent of the AAPCC rate. Thus, paying risk plans 95 percent of the AAPCC led to an overpayment of about 5.7 percent (.95/.899=1.057). However, we also discovered that including a history of serious illness (cancer, heart disease, or stroke) as a risk factor in the determination of payment rates to HMOs would essentially eliminate the estimated overpayment to risk plans (assuming no difference in severity of illness for enrollees and nonenrollees in this rate cell). This finding suggested that a simple risk adjuster based on history of cancer, heart disease, and stroke might enable HCFA to generate savings from the Medicare risk program, as originally intended.

The results of our earlier study are also consistent with evidence reported by the General Accounting Office (GAO) on risk plan enrollment in California. The GAO report reveals that beneficiaries with selected chronic conditions are less likely than other beneficiaries to enroll in an

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[1]We do, however, identify history of chronic conditions from both inpatient and hospital outpatient records for prostate and lung cancers.

[2]An added benefit to relying almost exclusively on inpatient diagnoses in the CHSF-I adjuster is that it reduces the potential to treat in an ambulatory setting those patients who require more intensive inpatient treatment.

HMO, which provides evidence for favorable selection (U.S. General Accounting Office 1997). The report identifies five conditions that are associated with higher Medicare costs *and* reduced likelihood of HMO enrollment, including (1) diabetes mellitus, (2) ischemic heart disease, (3) congestive heart failure, (4) hypertension, and (5) chronic obstructive pulmonary disease.

2. Controlling for Disability

While our initial work on this adjuster included only cancer, heart disease, and stroke diagnoses, further evidence suggested the need to incorporate into our adjuster some indicators of disability. This need, however, is balanced by data problems and costs. There is evidence that self-reported measures of health, including perceived health status and limitations in ADLs, are highly predictive of Medicare costs for the disabled. For instance, Gruenberg et al. (1996) find that perceived health and three ADL variables (requiring assistance in bathing, eating, and toileting) explain a significant amount of variation in the prospective Medicare costs of nursing home certifiable beneficiaries, even after controlling for a number of self-reported chronic conditions. Brown and Hill (1994) find a similar result.

Because of the high data collection costs and the lack of stability over time (or across interviews) in self-reported measures of disability, we decided to use variables available from other sources to capture the effects of disability. These other measures include whether a beneficiary was originally entitled to Medicare because of a disability (available from Medicare's EDB files) and whether the beneficiary had been treated for hip fracture, a condition often associated with disability, within the past four years.

The disability, mortality, and cost profile of hip fracture patients suggested that hip fracture would be a good condition to include in our adjuster for this purpose. (The inclusion of stroke patients also serves this purpose.) First, hip fracture is highly associated with disability and

mortality among the elderly. The probability that a person with a hip fracture will die within one year is as high as 24 percent for some age subgroups. Many with hip fracture have prolonged rehabilitative stays often lasting two or more months in specialized units, and only 50 percent of hip fracture patients regain the mobility and independence they had 12 months prior to the fracture (Schurch et al. 1996). Second, hip fracture is extremely prevalent in some population groups. The lifetime risk of hip fracture is about 17 percent for white women and 6 percent for white men (Kannus et al. 1997). Third, hip fracture is extremely costly, a result of lengthy hospital and nursing home stays and intensive use of rehabilitative services (Brainsky et al. 1997). Total costs during the first year after hip fracture average $21,000, with only one-third due to immediate hospital care (Johnell 1997). Thus, we considered it advantageous to include history of hip fracture in our adjuster in addition to the conditions supported by our earlier study of the Medicare risk program.

3. Measuring Illness over Multiple Years

Finally, we decided to measure history of inpatient conditions over several years, because of the evidence that hospitalizations from as far back as four years are highly predictive of future costs. For instance, Ash et al. (1989) find not only that the average costs of people hospitalized for one of their DCGs were three times higher than the mean costs of those not hospitalized, but also that a cost differential continued for three years, even among beneficiaries who were not readmitted. Gruenberg et al. (1989) show that hospitalized people have significantly higher hospital use rates (and therefore potentially higher costs) for as much as six years into the future. Finally, Lamers and van Vliet (1996) use Netherlands cost data to estimate the effects of DCGs from three years in the past. They estimate 1992 medical costs as a function of demographic variables and up to 24 dummy variables for whether the sample member had one of eight DCGs in a given year (from 1989 through 1991). They find that (1) all but two of the DCGs are significant for all three years, and (2) more recent

DCGs are more strongly associated with prospective costs than less recent ones. This adjuster was apparently being developed as we were working on the CHSF-I adjuster, which measures inpatient diagnoses over four years in the past. We chose this time period because earlier inpatient diagnoses (with no more recent admission) do not appear to explain much variation in costs and comprise a small proportion of the population (see further discussion below).

B. SELECTED CONDITIONS IN THE CHSF-I ADJUSTER

Although our preliminary research suggested including measures of cancer, heart disease, and stroke because of their strong association with future costs and their prevalence in the Medicare population, we assessed a number of specific diagnoses (CHSF and non-CHSF) to determine whether to include them in our adjuster. The selection of diagnoses took place in three stages. In the first stage, we started with a list of the 44 most frequently occurring diagnoses in the Medicare population (see Table III.1) and eliminated all those diagnoses considered to be very difficult to verify at reasonable cost. During the second stage, we considered additional diagnoses besides those remaining from stage one to include in our adjuster. These included hip fracture (see Section A) and various specific cancers that were not as common as the four that appeared on our initial list of diagnoses. In the third stage, the physician authors (Retchin and Penberthy) of this report assigned scores from 1 to 4 to each of the remaining diagnoses based on (1) verifiability, (2) prevalence, (3) likely predictive power, and (4) gameability. Our final selection included only those diagnoses that had a high score on all four measures, indicating that the diagnosis was administratively feasible, common, highly predictive, and relatively ungameable.

The First Stage. Table III.1 lists the 44 most common hospital diagnoses that we assessed in the first stage. We considered three sets of diagnoses to be infeasible and eliminated them in this stage. The first set included diagnoses that were associated with high future costs only if a

TABLE III.1

LIST OF MOST COMMON PRIMARY HOSPITAL DIAGNOSES
FOR MEDICARE BENEFICIARIES

Diagnosis	ICD-9-CM Code	Number of Hospital Discharges[a] (Thousands)	Comments on Utility for Risk Adjuster
Heart Failure[b]	411	696	Cases range from severe to very mild; principal concern is over ability of verification process to judge severity without further testing (for example, echocardiogram)
Congestive Heart Failure[b]	428	681	As above
Acute Myocardial Infarction[b]	410	446	Easily verified by audit; diagnosis is very specific, and routine diagnostic tests (for example, cardiac enzymes) are conventionally available as standard practice
Pneumonia, Organism Unspecified	486	419	Cases range from severe to very mild; principal concern is over ability of verification process to judge severity; even with further testing (for example, chest X ray), there is broad range of severity
Cardiac Dysrhythmias	427	380	Although requires further definition in terms of type of dysrhythmia, it should be easily verified through audit
Other Acute and Subacute Forms of Ischemic Heart Disease[b]	411	361	Requires further definition in terms of diagnostic specificity; however, could be verified if part of standard testing
Intermediate Coronary Syndrome[b]	411.1	335	Requires further definition in terms of diagnostic specificity; however, could be verified if part of standard testing
Disorders of Fluid, Electrolyte and Acid-Base Balance	276	302	Cases range from severe to very mild; principal concern is over ability of verification process to judge severity
Other Forms of Chronic Ischemic Heart Disease	414	289	See #411 above
Fracture of Neck or Femur	820	276	Verification should be uncomplicated; diagnosis easily established through audit
Coronary Atherosclerosis	414	258	See #411 above
Osteoarthrosis and Allied Disorders	715	246	Cases range from severe to very mild; principal concern is over ability of verification process to judge severity

TABLE III.1 *(continued)*

Diagnosis	ICD-9-CM Code	Number of Hospital Discharges[a] (Thousands)	Comments on Utility for Risk Adjuster
Other Disorders of Urethra and Urinary Tract	599	224	Cases range from severe to very mild; principal concern is over ability of verification process to judge severity
Occlusion of Cerebral Arteries[b]	434	214	Verification should be uncomplicated; diagnosis easily established through audit
Urinary Tract Infection, Site Not Specified	599	204	See #599 above
Atrial Fibrillation and Flutter	427.3	195	See #427 above
Volume Depletion	276.5	189	See #276 above
Diabetes Mellitus	250	182	Cases range from severe to very mild; principal concern is over ability of verification process to judge severity; glycosylated hemoglobin is not a reliable estimate of severity or future costs
Septicemia	38	180	Verification could be performed through conventional testing (for example, blood cultures); however, future costs are likely to reflect underlying diseases (for example, cancer), not septicemia
Atrial Fibrillation	427.31	178	See #427 above
Other Bacterial Pneumonia	482	163	See #486 above
Cerebral Artery Occlusion, Unspecified[b]	434.9	163	See #434 above
Cholelithiasis	574	161	Cholelithiasis has broad range of severity; many cases are either asymptomatic or symptoms are unrelated to gallstones; future costs cannot be reliably predicted by presence of diagnosis
Chronic Bronchitis	491	159	Broad range of severity; could be verified with testing that is performed frequently but not uniformly (for example, pulmonary functions); may lead to unnecessary testing in some cases
Obstructive Chronic Bronchitis	491.2	158	See #491 above
Subendocardial Infarction	410.7	147	See #410 above
Chronic Airway Obstruction, Not Elsewhere Classified	496	146	See #491 above

TABLE III.1 *(continued)*

Diagnosis	ICD-9-CM Code	Number of Hospital Discharges[a] (Thousands)	Comments on Utility for Risk Adjuster
Osteoarthrosis, Localized, Not Specified Whether Primary or Secondary	715.3	144	See #715 above
Hyperplasia of Prostate	600	140	Future costs are unlikely to be predicted by presence of prostatic hyperplasia; wide range of symptoms and consequences make utility poor
Acute Myocardial Infarction, Subendocardial Infarction, Initial Episode of Care[b]	410.71	137	See #410 above
Acute, but Ill Defined, Cerebrovascular Disease	436	131	See #434 above
Diverticula of Intestine	562	131	As with cholelithiasis, many cases are either asymptomatic or symptoms are unrelated to diverticula; future costs cannot be reliably predicted by presence of diagnosis
Pertrochanteric Fracture, Closed	820.2	130	See #820 above
Diverticula of Colon	562.1	129	See #562 above
Transient Ischemia Attack (TIA)	435	129	Presence of TIAs do not reliably predict future costs; this is a reversible condition, though many cases do suffer completed strokes at a future time
Intestinal Obstruction Without Mention of Hernia	560	127	Verification could be performed through medical record review, since gaming is unlikely; however, future costs are likely to reflect underlying diseases (for example, cancer), not intestinal obstruction itself
Unspecified Transient Cerebral Ischemia	435.9	114	See #435 above
Intertrochanteric Section	820.21	113	See #820 above
Other Cellulitis and Abscess	682	104	Verification difficult, since diagnosis can be nonspecific without positive identification by wound culture; this may not be performed uniformly; thus, verification could lead to unnecessary testing
Other Diseases of Lung	518	101	Nonspecific diagnosis
Angina Pectoris	413	101	See #411 above

TABLE III.1 *(continued)*

Diagnosis	ICD-9-CM Code	Number of Hospital Discharges[a] (Thousands)	Comments on Utility for Risk Adjuster
Other and Unspecified Angina Pectoris	413.9	101	See #411 above
Malignant Neoplasm of Trachea, Bronchus, and Lung[b]	162	100	Verification accomplished through medical record audit or through tumor registry information
Malignant Neoplasm of Colon[b]	153	76	Verification accomplished through medical record audit or through tumor registry information

SOURCE: Graner, E.J. "Detailed Diagnosis and Procedures. National Hospital Discharge Survey, 1993." National Center for Health Statistics. *Vital Health Statistics*, vol. 13, no. 122, 1995.

[a]Discharges for persons 65 or older in the United States, 1995.

[b]Conditions used in the CHSF-I adjuster.

beneficiary had a severe case and in which there were few objective or inexpensive ways of determining severity. This included chronic lung diseases and related lung disorders (491 and 496), which are not easily monitored through claims data or readily verified with inexpensive and reliable clinical or laboratory testing. Although spirometry testing would objectively measure severity of lung dysfunction, the test is very expensive and especially impractical for patients with minimal levels of lung dysfunction (for example, patients with smoke-related lung dysfunction). Most liver function tests inadequately measure the severity or the chronicity of liver disease. While more expensive and invasive testing (such as biopsy) effectively measure severity, requiring such tests would subject most liver disease patients to inappropriate and unacceptable risks.

The second set of diagnoses excluded in the first stage were those that we thought were not likely to be independently associated with high future costs. Many of the acute conditions listed in Table III.1 are related to higher future costs only because beneficiaries with the condition tend to have some other expensive disease. Thus, we excluded diagnoses that do not adequately specify the underlying condition affecting future costs. These included many acute conditions, such as pneumonia (486), septicemia (038), and disorders of fluid and electrolytes (276). Both pneumonia and septicemia are acute infections that are often a complication of some other underlying condition. It is highly unlikely that individuals with only pneumonia or septicemia (and no other underlying condition) would have such high future costs. Similarly, abnormality of fluid and electrolytes suggests dehydration resulting from fever, diarrhea, or other chronic diseases. Again, it is probably the underlying chronic disease, not the abnormality itself, that is associated with higher costs.

The Second Stage. A number of cancer diagnoses did not appear on our first-stage list (see Table III.1), because they were not as prevalent as other diseases. Nevertheless, we considered it advantageous to include additional cancer diagnoses, for two reasons. First, malignancies in general

are highly prevalent. For instance, lung, breast, colon, and prostate cancers combined are responsible for over 304,890 deaths per year in the United States--over 56 percent of all cancer deaths. Moreover, most patients diagnosed with any of these four cancers will require inpatient surgery. Thus, inpatient diagnoses of these cancers should occur with great frequency. Second, cancers are extremely high-cost diseases. Cancer treatment accounts for 12 percent of total health care costs. In 1996, an estimated 50 billion dollars was spent on the direct costs of cancer. People who have been treated for cancer have a greater risk of contracting cancer in the future or requiring ongoing treatment for cancers that cannot be completely eliminated.

After considering a number of cancer diagnoses, we assessed the verifiability and gameability of the diagnoses. Cancer diagnoses are generally difficult to game or upcode.

The Third Stage. Table III.2 lists all the diagnoses remaining after the first stage and the scores for verifiability, prevalence (or frequency), predictive power, and gameability. The scores range from 1 to 4, where high scores correspond to greater verifiability, prevalence, and so forth. Virtually all of them score high on verifiability, since we eliminated the most unverifiable conditions in the first stage. Leukemia and heart conditions were the most prevalent, and some cancers were moderately prevalent. Only skin cancer and congestive heart failure, with gameability scores of 1, were assessed as highly gameable.

In the end, we decided to exclude hypertension and diabetes from the CHSF-I adjuster, because they are not usually the primary reason for admission to the hospital. We also decided to exclude chronic obstructive pulmonary disease because of the difficulty verifying severity. In general, the conditions that we decided to include in the CHSF-I adjuster score very well across all the assessment dimensions, which indicates their suitability for use as risk adjusters. They include three heart disease categories (acute myocardial infarction, ischemic heart disease, and congestive heart

TABLE III.2

SCORING OF SECOND-STAGE DIAGNOSES

	Verifiability	Prevalence	Predictive Power	Gameability
Skin Cancer (172-173)	1.75	3.5	2	1
Ischemic Heart Disease (411.xx)	2.75	3	1.5	2
Leukemia (200-208)	2.25	4	2	2
Other Cancers (140-152, 155-161, 163-171, 175-184, 186-194)	2.25	3	2.5	2
Hip Fracture (80.x)	4	3.5	3	4
Stroke (431,434.x, 436.x)	3.25	3	3	3
Lung Cancer (162)	4	2.5	2.5	4
Colon Cancer (153)	4	2.5	3	4
Breast Cancer (174)	4	2.5	2.5	4
Prostate Cancer (185)	3.5	2	2	2.5
Congestive Heart Failure (428.xx)	2.25	4	3.5	1
Myocardial Infarction (410.xx)	3.75	4	3.5	2
Hypertension (401)[a]	2.25	2.5	1	2.5
Diabetes Mellitus (250.xx)[a]	3	3	3	2.5

NOTES: Diagnoses were assigned a score ranging from 1 (least desirable) to 4 (most desirable) on each of the four characteristics considered important for risk adjustment. Thus, for example, myocardial infarctions are easily verifiable, have high frequency, and bear a strong relationship to future costs, but they are considered somewhat gameable.

ICD-9-CM codes for each condition are in parentheses. The "x's" indicate that all subclassifications are included in the broader class.

[a]Not included as diagnosis in the CHSF-I adjuster.

failure), stroke, seven kinds of cancers (colon, breast, lung, prostate, leukemia, skin, and other), and hip fracture (see Table III.2).[3]

C. SAMPLES

Other researchers have used the CMHS as the data for developing their adjusters (Ellis et al. 1996; and Weiner et al. 1996). However, because our adjuster is based on a select few chronic conditions (history of CHSF over the past four years), we needed to ensure that our estimation sample contained a sufficient number of cases with the conditions in order to accurately estimate payment rates. Thus we used the CMHS--a five percent random sample of the Medicare population--for the "no prior conditions" sample (those who had not been hospitalized for CHSF in the past four years) but pulled from MEDPAR and the SAF condition-specific samples of beneficiaries hospitalized for CHSF in the past four years. This approach enabled us to include in our estimation sample the entire population of FFS beneficiaries with a CHSF condition. Because so many beneficiaries had a history of stroke or one of our three heart conditions, however, we decided to sample from the population of beneficiaries with those conditions.

Composition. Our "no-condition" group (from the CMHS) consists of a five percent sample of the 25 million FFS Medicare beneficiaries in the nation in 1993 who had never been hospitalized for CHSF between 1989 and 1992 (see Table III.3). Given our eligibility criteria (see Chapter II), the final sample size for this no-condition group was about 1.3 million cases. We used the MEDPAR and the SAF to create the samples of beneficiaries in 1993 who had a CHSF inpatient condition between 1989 and 1992. The final sample consisted of about 3.7 million cases--2.4

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[3]In the end, we decided to include skin cancers because of their high prevalence and moderate predictive power. However, we suggest heavy monitoring of this condition because of its high gameability and low verifiability.

million with one or more prior conditions and 1.3 million with no condition. The no-condition sample includes 5 percent of Medicare beneficiaries without prior conditions; the prior conditions sample represents 59 percent of all 1993 Medicare beneficiaries with a CHSF admission in the previous four years.

In constructing our payment rates for the various conditions, we assigned each individual to a single rate cell. Thus, people who were hospitalized for more than one CHSF condition in any given year, or in multiple years, had to be assigned to a particular condition-year cell. For example, we could not use data on someone hospitalized for both lung cancer and congestive heart failure to construct the average cost for both lung cancer patients and congestive heart failure patients, since our adjuster is designed to pay plans based on the unique rate cell into which a beneficiary falls. Thus, we classified individuals with multiple conditions in the same year into the cell for the condition associated with the highest average 1993 costs among those with only a single CHSF diagnosis that year. We placed those with CHSF admissions in multiple years into the rate cells for the most recent year in which they had a CHSF admission. The next section of this chapter describes this methodology and rationale in greater detail.

Table III.3 provides the sample sizes and mean Part A reimbursement for the CHSF sample across each condition-year cell. Sample sizes range from a low of 5,279 (for 1989 skin cancer admissions) to 157,417 (for 1992 hip fracture hospital admissions). Sample sizes for Part B are the same (see Table III.4).

The 1992 admissions account for about 43 percent of all "prior condition" cases:

TABLE III.3

SAMPLE SIZES AND MEANS FOR PRIOR CONDITION SAMPLE, PART A

Latest Year of Hospitalization	Condition	Sample Size	Estimated Beneficiaries in Nation	Percentage of Total Beneficiaries with CHSF	Mean 1993 Reimbursement per Month	Standard Deviation	Coefficient of Variation
1992	Heart Problems						
	Myocardial infarction	30,081	171,834	3.9	508	1,415	2.78
	Ischemic heart disease	42,958	257,561	5.9	459	1,184	2.58
	Congestive heart failure	148,171	625,270	14.3	837	1,690	2.02
	Hip Fracture	157,417	157,417	3.6	462	1,038	2.24
	Stroke	148,758	148,758	3.4	657	1,375	2.09
	Cancers						
	Colon	65,269	65,269	1.5	537	1,282	2.39
	Breast	51,148	51,148	1.2	296	927	3.13
	Lung	61,679	61,679	1.4	991	1,883	1.90
	Prostate	139,734	139,734	3.2	346	971	2.80
	Leukemia	44,207	44,207	1.0	1,049	2,101	2.00
	Skin	9,750	9,750	0.2	549	1,411	2.57
	Other	110,469	110,469	2.5	781	1,720	2.20
1991	Heart Problems						
	Myocardial infarction	18,233	98,280	2.3	311	907	2.91
	Ischemic heart disease	35,923	195,842	4.5	336	942	2.80
	Congestive heart failure	70,016	283,392	6.5	538	1,212	2.25
	Hip Fracture	120,427	120,427	2.8	345	896	2.60
	Stroke	103,446	103,446	2.4	453	1,098	2.42
	Cancers						
	Colon	43,744	43,744	1.0	348	977	2.81
	Breast	43,436	43,436	1.0	233	765	3.28
	Lung	17,335	17,335	0.4	464	1,093	2.36
	Prostate	76,397	76,397	1.8	263	817	3.11
	Leukemia	15,890	15,890	0.4	482	1,231	2.55
	Skin	7,161	7,161	0.2	383	1,071	2.79
	Other	56,669	56,669	1.3	393	1,116	2.84
1990	Heart Problems						
	Myocardial infarction	13,640	75,520	1.7	302	996	3.30
	Ischemic heart disease	26,924	148,973	3.4	313	936	2.99
	Congestive heart failure	38,048	166,840	3.8	468	1,133	2.42
	Hip Fracture	93,853	93,853	2.2	329	895	2.71
	Stroke	76,625	76,625	1.8	415	1,072	2.58
	Cancers						
	Colon	32,587	32,587	0.7	292	836	2.86
	Breast	37,214	37,214	0.9	222	795	3.58
	Lung	10,267	10,267	0.2	375	1,019	2.72
	Prostate	47,245	47,245	1.1	258	871	3.37
	Leukemia	9,663	9,663	0.2	406	1,048	2.58
	Skin	5,917	5,917	0.1	321	866	2.69
	Other	42,874	42,874	1.0	315	954	3.02

TABLE III.3 *(continued)*

Latest Year of Hospitalization	Condition	Sample Size	Estimated Beneficiaries in Nation	Percentage of Total Beneficiaries with CHSF	Mean 1993 Reimbursement per Month	Standard Deviation	Coefficient of Variation
1989	Heart Problems						
	Myocardial infarction	10,606	61,317	1.4	282	861	3.06
	Ischemic heart disease	20,072	112,042	2.6	307	862	2.81
	Congestive heart failure	22,938	106,629	2.4	438	1,139	2.60
	Hip Fracture	73,147	73,147	1.7	323	986	3.06
	Stroke	57,205	59,204	1.4	395	1,060	2.68
	Cancers						
	Colon	26,252	26,252	0.6	254	829	3.26
	Breast	31,378	31,378	0.7	219	763	3.48
	Lung	6,733	6,733	0.2	340	1,153	3.40
	Prostate	31,572	31,517	0.7	256	872	3.41
	Leukemia	6,441	6,441	0.1	349	934	2.68
	Skin	5,272	5,272	0.1	301	863	2.87
	Other	33,679	33,679	0.8	285	896	3.14
	Total with Conditions	**2,378,470**	**4,362,520**	**100.0**	**480**	**1,234**	**2.57**
	No Conditions[a]	**1,298,792**	**25,975,840**	**--**	**166**	**674**	**4.06**
	Total	**3,677,262**	**30,338,360**	**--**	**211**	**787**	**3.73**

SOURCE: MEDPAR and Standard Analytical File.

[a] The "no-conditions" sample was constructed from the CMHS, a five percent random sample of Medicare beneficiaries.

TABLE III.4

SAMPLE SIZES AND MEANS FOR PRIOR CONDITION SAMPLE, PART B

Latest Year of Hospitalization	Condition	Sample Size	Estimated Beneficiaries in Nation	Percentage of Total Beneficiaries with CHSF	Mean (1993) Reimbursement per Month	Standard Deviation	Coefficient of Variation
1992	Heart Problems						
	Myocardial infarction	30,081	171,834	3.9	199	281	1.41
	Ischemic heart disease	42,958	257,561	5.9	214	278	1.30
	Congestive heart failure	148,171	625,270	14.3	288	371	1.29
	Hip Fracture	157,417	157,417	3.6	183	260	1.42
	Stroke	148,758	148,758	3.4	256	346	1.35
	Cancers						
	Colon	65,269	65,269	1.5	321	423	1.32
	Breast	51,148	51,148	1.2	211	290	1.38
	Lung	61,679	61,679	1.4	439	504	1.15
	Prostate	139,734	139,734	3.2	237	294	1.24
	Leukemia	44,207	44,207	1.0	444	553	1.24
	Skin	9,750	9,750	0.2	251	338	1.35
	Other	110,469	110,469	2.5	358	461	1.29
1991	Heart Problems						
	Myocardial infarction	18,233	98,280	2.3	152	236	1.55
	Ischemic heart disease	35,923	195,842	4.5	180	252	1.40
	Congestive heart failure	70,016	283,392	6.5	217	298	1.38
	Hip Fracture	120,427	120,427	2.8	153	232	1.52
	Stroke	103,446	103,446	2.4	194	282	1.45
	Cancers						
	Colon	43,744	43,744	1.0	213	319	1.49
	Breast	43,436	43,436	1.0	158	228	1.44
	Lung	17,335	17,335	0.4	245	331	1.35
	Prostate	76,397	76,397	1.8	188	265	1.41
	Leukemia	15,890	15,890	0.4	275	371	1.35
	Skin	7,161	7,161	0.2	193	296	1.53
	Other	56,669	56,669	1.3	222	325	1.47
1990	Heart Problems						
	Myocardial infarction	13,640	75,520	1.7	143	216	1.51
	Ischemic heart disease	26,924	148,973	3.4	171	240	1.40
	Congestive heart failure	38,048	166,840	3.8	196	278	1.42
	Hip Fracture	93,853	93,853	2.2	146	220	1.50
	Stroke	76,625	76,625	1.8	180	270	1.50
	Cancers						
	Colon	32,587	32,587	0.7	183	282	1.54
	Breast	37,214	37,214	0.9	150	220	1.46
	Lung	10,267	10,267	0.2	209	296	1.42
	Prostate	47,245	47,245	1.1	181	243	1.34
	Leukemia	9,663	9,663	0.2	234	313	1.34
	Skin	5,917	5,917	0.1	171	278	1.63
	Other	42,874	42,874	1.0	185	277	1.50

TABLE III.4 *(continued)*

Latest Year of Hospitalization	Condition	Sample Size	Estimated Beneficiaries in Nation	Percentage of Total Beneficiaries with CHSF	Mean (1993) Reimbursement per Month	Standard Deviation	Coefficient of Variation
1989	Heart Problems						
	Myocardial infarction	10,606	61,317	1.4	142	232	1.63
	Ischemic heart disease	20,072	112,042	2.6	168	233	1.39
	Congestive heart failure	22,938	106,629	2.4	185	268	1.45
	Hip Fracture	73,147	73,147	1.7	143	219	1.53
	Stroke	57,205	59,204	1.4	171	257	1.50
	Cancers						
	Colon	26,252	26,252	0.6	163	247	1.51
	Breast	31,378	31,378	0.7	146	214	1.47
	Lung	6,733	6,733	0.2	186	273	1.47
	Prostate	31,572	31,517	0.7	173	236	1.36
	Leukemia	6,441	6,441	0.1	209	309	1.48
	Skin	5,272	5,272	0.1	158	296	1.88
	Other	33,679	33,679	0.8	169	258	1.53
	Total	**2,378,470**	**4,048,887**	**100.0**	**212**	**297**	**1.40**
	No Conditions[a]	**1,298,792**	**25,975,840**	**--**	**99**	**188**	**1.90**
	Total	**3,677,262**	**30,024,727**	**--**	**115**	**210**	**1.83**

SOURCE: MEDPAR and Standard Analytical File.

[a]The "no-conditions" sample was constructed from the CMHS, a five percent sample of Medicare beneficiaries.

Year	Percentage of CHSF Cases
1992	42.5
1991	25.8
1990	18.2
1989	13.5

Beneficiaries whose most recent CHSF discharge was in 1989 account for only 13.5 percent of the prior conditions sample, because many of them had died by January 1, 1993 (and were therefore not in our sample) or had been subsequently discharged for the same or different CHSF diagnosis in the 1990-1992 period (and were therefore included only in the later sample).

Beneficiaries discharged in 1992 for at least one of the three heart conditions make up about one-fourth of the population of beneficiaries with CHSF and the largest share (about 9 percent) of the CHSF condition-year samples. (Recall that we selected only 15 percent of heart patients for our samples in 1989-1991 and 12 percent of 1992 patients.) Heart disease dominates the population and samples of those whose most recent CHSF discharge was in 1989-1991 as well. Combining across years, heart disease patients account for 55 percent of CHSF cases nationally. Because there were so many beneficiaries with heart disease, and because reimbursements differed substantially across ICD-9-CM codes, we created separate rate cells for each of the three heart diagnoses. Column 4 of Table III.3 shows that beneficiaries admitted to the hospital in 1992 for congestive heart failure (code 428) alone account for about 14 percent of all 1993 beneficiaries with one or more CHSF admissions in 1989-1992.

Costs. The mean 1993 reimbursement for those with CHSF ($692 per month for Part A and Part B combined) is about 2.6 times that of individuals without such a history ($265). Thus, the 14.7 percent of all FFS beneficiaries with a history of CHSF accounted for about 29 percent of total

Medicare reimbursements in 1993. The difference is somewhat larger for Part A than for Part B costs.[4]

Average costs in 1993 for CHSF beneficiaries with more recent CHSF diagnoses are higher and less variable (Tables III.3 and III.4). For example, average monthly Part A cost in 1993 for beneficiaries hospitalized with stroke in 1989 was $395, with a coefficient of variation (COV) of 2.68. Those hospitalized for stroke in 1992, however, had the largest costs in 1993 ($462 for Part A) and the smallest COVs (2.24) of the stroke patients. Costs also vary markedly across conditions, ranging from $296 per month for Part A for 1992 breast cancer patients to $1,049 per month for 1992 leukemia discharges. This variability across conditions and with the recency of the illness suggests that the CHSF adjuster can account for important variation in costs just by sorting people into diagnosis-year groups.

D. DESIGN AND RATES

Although we classified beneficiaries into particular risk cells based on their history of CHSF, we also adjusted payment rates *within cells* to account for differences in the reoccurrence of an illness, presence of other conditions, and demographic characteristics. Our approach was first to classify beneficiaries into rate cells defined by whether they had a history of cancer, heart disease, stroke, or hip fracture (CHSF), and the timing of the most recent episode, and then estimate regression models within each cell to further improve predictive accuracy. We constructed rate cells based on history of hospitalization in the past four years (1989 to 1992) for the 12 CHSF conditions identified in Table III.3: stroke, breast cancer, colon cancer, leukemia, lung cancer, other cancers, prostate cancer, skin cancer, congestive heart failure, ischemic heart disease, myocardial infarction,

[4]They account for about 31 percent of average monthly cost but since those with CHSF are more likely to die during 1993, they account for a slightly lower percentage of total costs.

and hip fracture. These rate cells classify beneficiaries by the year of discharge and diagnosis. Thus, there are 48 total condition-based rate cells--12 conditions for each year. Beneficiaries with no hospital discharge for these conditions during the four years were classified into the no-condition group, which was then split into finer rate cells based on demographic and program eligibility characteristics.[5]

1. Classifying Beneficiaries into Unique Rate Cells

The CHSF Conditions Group. We distributed beneficiaries with multiple hospitalizations for CHSF among the 48 diagnosis-year rate cells, using three simple rules. First, if a beneficiary had a hospital discharge with 2 or more of our 12 conditions listed among the diagnoses, we classified the discharge based on the first CHSF diagnosis listed on the MEDPAR file record. Second, we placed beneficiaries with multiple hospital discharges for CHSF diagnoses in a single year into the rate cell with the highest mean cell costs (calculated over beneficiaries having only one condition in a given year). The fourth column of Tables III.3 and III.4 shows mean 1993 beneficiary costs for the 48 rate cells for Part A and Part B. Each year (1989-1992) has its own mean cell cost ranking based on total (Part A plus Part B) costs. For instance, the condition for which average total 1993 reimbursements are highest for those hospitalized in 1992 is leukemia, followed by lung cancer. However, among those last hospitalized with a CHSF condition in 1991, congestive heart failure patients had the highest average total 1993 reimbursements. Thus, if a beneficiary was hospitalized for both leukemia and congestive heart failure in 1992, we placed that beneficiary into the 1992 leukemia rate cell. If a beneficiary was hospitalized in 1991 for these same two conditions (and had no episodes of CHSF in 1992), we placed that beneficiary into the 1991 congestive heart failure cell.

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[5]As noted earlier, the rate cells for lung cancer and prostate cancer included patients receiving treatment in hospital outpatient departments as well as those treated as inpatients.

Third, we placed beneficiaries with hospital stays in multiple years into the more recent cell. Thus, we placed a beneficiary hospitalized for leukemia in 1992 and 1991 into the 1992 leukemia rate cell. We placed a beneficiary with lung disease in 1992 and leukemia in 1991 into the 1992 lung cancer rate cell.

These classification decisions for cases with multiple conditions over the four years are somewhat arbitrary but are probably relatively unimportant for predictive power. We classified each hospital discharge on the basis of the first cancer, heart disease, or stroke ICD-9 code listed, because diagnoses are usually listed in approximate order of importance for the stay. We classified beneficiaries with multiple CHSF discharges in a single year into the highest cost rate cell for which they qualify, because that condition accounts for the largest expected future expenditures. Finally, we classified beneficiaries with discharges in multiple years into cells based on their most recent discharge, because the most recent hospitalization is a stronger predictor than other hospital stays.

These decisions probably have little effect on predictive power, because within-cell regressions should pick up the effect of coexisting conditions in the same year and the effects of CHSF discharges from previous years. Thus, predicted values are likely to be similar regardless of how beneficiaries meeting multiple criteria are initially classified.[6] However, classifying beneficiaries based on their most recent hospital stay for a CHSF illness rather than their earliest one may create incentives for plans to readmit CHSF patients who do not really need a hospital stay because of the increase in reimbursement rates. We return to this issue in Chapter VI.

The No-Condition Group. We classified beneficiaries without CHSF inpatient conditions between 1989 and 1992 into rate cells defined by age, sex, Medicaid status, and original reason for entitlement. Our age and sex categories are analogous to the AAPCC's rate cells. We included

[6]This may not be strictly true in all cases if cell sizes become small.

original reason for entitlement to capture higher-than-average costs among the long-term disabled. We included Medicaid as a risk factor, as does the AAPCC, because those on Medicaid tend to have greater health care needs on average, reflecting the greater frailty among the population. However, we are unable to include nursing home residence as the AAPCC does, because it is not captured on any Medicare files for beneficiaries unless they are in managed care plans.

Following the AAPCC, we calculate cell rates separately for Part A and Part B costs in order to obtain a fuller understanding of the relationship between our chronic conditions and costs. We initially designed cells based on five-year age groups but combined adjacent cells when differences in mean cell costs were trivial. This classification system resulted in a total of 156 rate cells.

2. Rates for the No-Condition Group

Mean overall Medicare costs among beneficiaries in the no-condition rate cells (Table III.5) range from $159 per month (for non-Medicaid, nondisabled female beneficiaries age 65 to 69) to $453 per month (for male Medicaid beneficiaries over age 85, whose original reason for entitlement was age). Part A costs are always higher than Part B costs for beneficiaries in the same rate cell. In all cases, total costs increase monotonically with age. Costs for males are always higher than those for females of the same age among elderly beneficiaries whose original reason for entitlement was age. Cost differences by sex are less consistent among the other beneficiary groups. Although they are a small share of most risk plans, Medicaid beneficiaries have higher average total costs, even after controlling for age, sex, and original reason for entitlement. The greatest difference is between 65- to 69-year-old beneficiaries whose original reason for entitlement was age. Medicaid beneficiaries in this group have mean costs of $278 per month, while non-Medicaid beneficiaries have mean costs of only $159 per month. Note also that elderly beneficiaries whose original reason

TABLE III.5

MEAN CELL COST AMONG BENEFICIARIES
WITHOUT CHSF
(1993 Dollars)

	Part A		Part B		Total	
Age Group	Males	Females	Males	Females	Males	Females
Medicaid Beneficiaries						
Disabled Medicare Beneficiaries						
Younger than 35	185	193	101	122	286	315
35 to 44	190	179	119	128	310	308
45 to 54	201	188	120	142	321	329
55 to 59	226	219	115	138	342	357
60 to 64	243	219	126	142	369	361
Elderly Beneficiaries--Original Entitlement Due to Disability						
65 to 69	242	234	133	148	374	382
70 to 74	242	266	143	148	386	414
75 and older	295	284	151	156	446	440
Elderly Beneficiaries--Original Entitlement Due to Age						
65 to 69	196	166	110	112	306	278
70 to 74	199	186	117	115	316	301
75 to 79	261	233	138	131	399	364
80 to 84	276	242	143	131	419	372
85 and older	309	261	144	136	453	397
Non-Medicaid Beneficiaries						
Disabled Medicare Beneficiaries						
Younger than 35	170	138	74	89	243	227
35 to 44	160	168	78	99	239	267
45 to 54	158	178	79	107	238	285
55 to 59	177	187	89	112	266	298
60 to 64	199	232	101	122	300	354
Elderly Beneficiaries--Original Entitlement Due to Disability						
65 to 69	210	238	112	130	322	368
70 to 74	249	268	124	139	373	407
75 and older	312	288	135	138	448	425
Elderly Beneficiaries--Original Entitlement Due to Age						
65 to 69	115	87	78	72	193	159
70 to 74	147	114	96	85	242	199
75 to 79	192	154	114	99	306	254
80 to 84	240	202	124	106	364	308
85 and older	307	269	126	111	433	380

for entitlement was disability have substantially higher average costs than those originally entitled because of age.

The ratio of mean cell costs for the no-condition group to average costs for all beneficiaries is the basis for setting monthly capitation rates for beneficiaries who had not been hospitalized for CHSF in the past four years. The reimbursement is the product of the beneficiary's cell ratio (see Table III.6) and the county AAPCC. The cell ratio is analogous to the beneficiary cost factor used in HCFA's current method of payment.

The pattern of these cell ratios reveals the low payment rates for beneficiaries with no CHSF condition, especially the three largest groups (share of population in first two columns). For example, costs for males age 65 to 69, not on Medicaid, and originally entitled because of age are only 59 percent of the overall average; costs for females in this cell are less than half the overall average. Costs for slightly older (70 to 74) females with these characteristics are similarly low (61 percent). These three groups together represent nearly one-third of all beneficiaries (and a larger share of Medicare HMO enrollees). On the other hand, male Medicaid beneficiaries age 75 and older whose original reason for entitlement was disability have mean monthly Medicare costs 37 percent higher than all Medicare beneficiaries, even though they have not had any CHSF admissions in the four previous years.

3. Setting Rates for Beneficiaries with CHSF Conditions

Beneficiaries classified in our CHSF diagnosis-year cells had much higher costs and wider variation (see Table III.7) than those in the no-condition cells. All the CHSF beneficiary cells have substantially higher costs than those who had no CHSF condition. Like the no-condition sample, Part A costs are always higher than Part B costs. Total costs range from $365 per month (beneficiaries last hospitalized for breast cancer in 1989) to $1,493 per month (beneficiaries

TABLE III.6

PAYMENT RATE FACTORS FOR BENEFICIARIES WITHOUT CHSF

	Percentage of Population		Part A		Part B		Total	
Age Group	Males	Females	Males	Females	Males	Females	Males[a]	Females
Medicaid Beneficiaries								
Disabled Medicare Beneficiaries								
Younger than 35	0.57	0.35	0.88	0.91	0.88	1.06	0.88	0.96
35 to 44	0.57	0.40	0.90	0.85	1.04	1.12	0.95	0.94
45 to 54	0.39	0.40	0.95	0.89	1.04	1.23	0.98	1.01
55 to 59	0.17	0.24	1.07	1.03	1.00	1.20	1.05	1.09
60 to 64	0.18	0.28	1.15	1.03	1.10	1.24	1.13	1.11
Aged Beneficiaries--Original Entitlement Due to Disability								
65 to 69	0.15	0.22	1.14	1.11	1.15	1.28	1.15	1.17
70 to 74	0.08	0.18	1.15	1.26	1.24	1.28	1.18	1.27
75 and older	0.09	0.19	1.39	1.34	1.32	1.36	1.37	1.35
Aged Beneficiaries--Original Entitlement Due to Age								
65 to 69	0.41	1.04	0.93	0.79	0.96	0.97	0.94	0.85
70 to 74	0.31	0.97	0.94	0.88	1.01	1.00	0.97	0.92
75 to 79	0.22	0.81	1.24	1.10	1.20	1.14	1.22	1.11
80 to 84	0.19	0.77	1.30	1.14	1.25	1.13	1.28	1.14
85 and older	0.19	0.98	1.46	1.23	1.25	1.18	1.39	1.21
Non-Medicaid Beneficiaries								
Disabled Medicare Beneficiaries								
Younger than 35	0.42	0.20	0.80	0.65	0.64	0.77	0.75	0.70
35 to 44	0.78	0.35	0.76	0.80	0.68	0.86	0.73	0.82
45 to 54	0.95	0.48	0.75	0.84	0.69	0.93	0.73	0.87
55 to 59	0.61	0.36	0.84	0.88	0.77	0.97	0.81	0.91
60 to 64	0.88	0.54	0.94	1.10	0.88	1.06	0.92	1.08
Aged Beneficiaries--Original Entitlement Due to Disability								
65 to 69	0.89	0.53	0.99	1.13	0.98	1.13	0.99	1.13
70 to 74	0.65	0.45	1.18	1.26	1.08	1.21	1.14	1.25
75 and older	0.53	0.48	1.48	1.36	1.18	1.20	1.37	1.30
Aged Beneficiaries--Original Entitlement Due to Age								
65 to 69	9.40	12.26	0.54	0.41	0.68	0.63	0.59	0.49
70 to 74	7.01	9.91	0.69	0.54	0.83	0.74	0.74	0.61
75 to 79	4.21	7.73	0.91	0.73	0.99	0.86	0.94	0.78
80 to 84	2.84	5.29	1.13	0.95	1.08	0.92	1.11	0.94
85 and older	1.87	4.61	1.45	1.27	1.10	0.97	1.33	1.16

[a]Percentages represent the fraction of the entire Medicare population falling into the cell.

TABLE III.7

MEAN 1993 MONTHLY REIMBURSEMENT AMONG BENEFICIARIES WITH CHSF, BY YEAR OF MOST RECENT DISCHARGE

	Part A				Part B				Total			
Conditions	1989	1990	1991	1992	1989	1990	1991	1992	1989	1990	1991	1992
Leukemia	349	406	482	1,049	209	234	275	444	558	640	758	1,493
Lung Cancer	340	375	464	991	186	209	245	439	525	584	708	1,430
Other Cancers	285	315	393	781	169	185	222	358	455	500	615	1,139
Congestive Heart Failure	438	468	539	837	185	196	217	288	623	664	755	1,125
Stroke	395	415	453	657	171	180	194	256	566	595	647	914
Colon Cancer	254	292	348	537	163	183	213	321	418	475	562	858
Skin Cancer	301	321	384	549	158	171	193	251	459	492	577	799
Myocardial Infarction	282	302	312	508	142	143	152	199	424	445	464	707
Ischemic Heart Disease	307	313	336	459	168	171	180	214	475	484	516	673
Hip Fracture	323	330	345	463	143	146	153	183	466	476	498	646
Prostate Cancer	256	258	263	346	173	181	188	237	429	440	451	583
Breast Cancer	219	222	233	296	146	151	158	211	365	372	392	507

NOTE: Conditions are ordered by size of the overall mean for the 1992 cohort (last column).

hospitalized for leukemia in 1992). Beneficiaries hospitalized in the previous year for leukemia, congestive heart failure, lung cancer, and "other cancers" all have total mean monthly costs well over $1,000. Total monthly Medicare costs increase the more recent the hospitalization; however, the biggest cost difference is between hospitalization last year (1992) and hospitalization two years ago. This may reveal something about the effects of a disease on Medicare costs over time. For instance, total 1993 costs among women hospitalized for breast cancer is only two percent higher for those last discharged in 1990 than for those discharged in 1989, and only five percent higher for 1991 discharges than 1990 cases. However, total mean costs jump by nearly 30 percent if the most recent hospital stay was in 1992 rather than 1991. This suggests that although postdischarge costs remain high (probably a result of monitoring and treatments, including skilled nursing, home health, and chemotherapy), costs decline with time since the last hospital stay, because the most severe cases from earlier years either died or were readmitted before 1993.

In general, ratios of mean cell costs to average overall costs for the CHSF sample are much higher than the ratios for the no-condition sample (compare Tables III.8 and Table III.6). These ratios indicate the degree to which 1993 costs for a particular group exceed the mean costs among all beneficiaries. For example, total 1993 costs for beneficiaries hospitalized for breast cancer in 1989 were only 12 percent higher than the overall average, while total costs for beneficiaries hospitalized in 1992 for leukemia were over four and one-half times higher than the average.

While these ratios could be used to set payments (as we do for the no-condition sample), we adjusted rates within each cell, using regression models estimated on each cell separately to account for multiple conditions, demographic differences, and admissions in prior years. Using ordinary least squares, we estimated a total of 96 regressions--one for each of the 48 Part A rate cells and 48

TABLE III.8

RATIO OF MEAN CELL COST TO AVERAGE OVERALL COST
AMONG BENEFICIARIES WITH CHSF

	Part A				Part B				Total			
Conditions	1989	1990	1991	1992	1989	1990	1991	1992	1989	1990	1991	1992
Leukemia	1.65	1.92	2.28	4.96	1.82	2.04	2.39	3.86	1.71	1.96	2.32	4.57
Lung Cancer	1.61	1.77	2.19	4.69	1.61	1.81	2.12	3.81	1.61	1.79	2.17	4.38
Other Cancer	1.35	1.49	1.86	3.69	1.47	1.60	1.92	3.11	1.39	1.53	1.88	3.49
Congestive Heart Failure	2.07	2.21	2.55	3.96	1.61	1.70	1.88	2.50	1.91	2.03	2.31	3.44
Stroke	1.87	1.96	2.14	3.11	1.49	1.56	1.68	2.23	1.73	1.82	1.98	2.80
Colon Cancer	1.20	1.38	1.65	2.54	1.42	1.59	1.85	2.79	1.28	1.45	1.72	2.63
Skin Cancer	1.42	1.52	1.81	2.59	1.37	1.48	1.68	2.18	1.41	1.51	1.77	2.45
Myocardial Infarction	1.33	1.43	1.47	2.40	1.23	1.25	1.32	1.73	1.30	1.36	1.42	2.17
Ischemic Heart Disease	1.45	1.48	1.59	2.17	1.46	1.49	1.56	1.86	1.45	1.48	1.58	2.06
Hip Fracture	1.53	1.56	1.63	2.19	1.24	1.27	1.33	1.59	1.43	1.46	1.52	1.98
Prostate Cancer	1.21	1.22	1.24	1.64	1.51	1.57	1.63	2.06	1.31	1.35	1.38	1.78
Breast Cancer	1.04	1.05	1.10	1.40	1.27	1.31	1.37	1.83	1.12	1.14	1.20	1.55

NOTE: Conditions arranged by size of overall ratio for the 1992 cohort (last column).

Part B rate cells.[7] For a cell defined by a hospital discharge in Year t for diagnosis i (the "primary discharge"), we regressed 1993 FFS Medicare costs on age categories, gender, original reason for entitlement, hospitalization for the condition i in years before t, hospitalization for each other condition ($\neq i$) in year t, and hospitalization for each other condition in year $t - 1$.[8] All the regressors are binary variables.

The final regressions are the result of several rounds of winnowing out independent variables. We generally dropped independent variables if they represented characteristics displayed by less than one percent of the cell sample or if the p-value of its coefficient was more than .01. We did, however, retain variables representing characteristics possessed by less than one percent of the cell sample if they had highly significant coefficients, provided that there were at least 100 cases that had the characteristic or condition. We also checked for whether adjacent age ranges had equal effects. If they did, we collapsed them into single, wider age ranges. Similarly, we checked for whether the effects of hospitalization for other CHSF conditions (not the primary one) depended on whether the stay occurred in the same year as the primary discharge or in the previous year. If the effects were not significantly different, we grouped these variables together as well. Thus, in some regressions there are variables representing whether the beneficiary was hospitalized for a particular additional condition in the same year as the primary discharge *or* in the previous year. We also checked for

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[7]We estimate separate regressions for Part A and Part B costs because some diagnoses may affect Part A costs, such as for hospital or home health care, but have little effect on physician services or other Part B costs. By selectively excluding from each of these two regressions variables that have an insignificant impact on costs of that type, the precision of the overall adjuster should be improved.

[8]Hospitalizations for CHSF conditions other than the primary condition are included only if they occur in the same year as the primary discharge or the immediately preceding year. Earlier admissions for such conditions were found to have little or no effect on 1993 costs except for a few anomalous cases.

whether discharges for the primary condition in earlier years had different effects. For example, in the 1992 congestive heart failure regressions, we began with three binary variables measuring prior hospitalization for congestive heart failure in 1991, 1990, and 1989. If these prior hospitalization variables were significant but their coefficients were not significantly different from each other, we combined them to form a variable called, for instance, "hospitalized for congestive heart failure in 1991 or 1990." If prior hospitalization for the primary condition was not significant for any earlier year, we dropped it from the regression.

After winnowing out insignificant variables, we eliminated a small number of variables for which small cell sizes appeared to have led to an anomalous result. For several diagnoses, hospitalization for another condition in the same year as the primary discharge (or the preceding year) was significant in cells defined by primary discharge in earlier years (1989 or 1990) but not in cells defined by more recent discharges (1991 or 1992). For smoothing purposes, we eliminated these variables from the regressions unless we had at least 200 beneficiaries with the condition. In each case, these were characteristics that represented less than one percent of the cell sample.

To illustrate, we present the regressions for four conditions, including (1) congestive heart failure, (2) leukemia, (3) stroke, and (4) hip fracture.

Congestive Heart Failure. The intercepts for congestive heart failure, ranging from $604 per month for the 1989 cohort to $919 for the 1992 cohort, follow the pattern of cell means for congestive heart failure (see Table III.9). These intercepts measure the monthly rate in 1993 for female beneficiaries age 65 to 69 whose original reason for entitlement was age and who had no other hospital stays for a CHSF condition between 1989 and 1992 besides the one indicated by the cell in which she had been placed (congestive heart failure in 1992, in our example). We refer to this

TABLE III.9

REGRESSION COEFFICIENTS FOR TOTAL 1993 COSTS (PART A AND PART B) FOR BENEFICIARIES WITH CONGESTIVE HEART FAILURE, BY YEAR OF MOST RECENT CONGESTIVE HEART FAILURE DISCHARGE

	1992			1991			1990			1989		
Regression	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**
Intercept	656	263	**919**	468	206	**674**	447	181	**628**	421	183	**604**
Hospitalizations for Reference Discharge in Prior Years												
Congestive Heart Failure Last Year	332	72	**404**	192	48	**240**		38	**38**			
Congestive Heart Failure Two Years Ago	279	56	**335**	192	48	**240**						
Congestive Heart Failure Three Years Ago	279	39	**318**									
Hospital Stays for Other CHSF Conditions in the Same or Prior Year as the Reference Discharge												
Ischemic Heart Disease Same Year	189	48	**237**		37	**37**	55	32	**87**			
Ischemic Heart Disease Prior Year	90	48	**138**	135	37	**172**	55	32	**87**			
Myocardial Infarction Same Year	305	55	**361**									
Myocardial Infarction Prior Year	55		**55**									
Stroke Same Year	280	98	**378**	139	44	**183**						
Stroke Prior Year	280	56	**336**	139	44	**183**		53	**53**			
Prostate Cancer Same Year	172	88	**260**		66	**66**						
Prostate Cancer Prior Year		88	**88**									
Hip Fracture Same Year	145	28	**173**									
Hip Fracture Prior Year		28	**28**									
Colon Cancer Same Year	238		**238**									
Colon Cancer Prior Year	238	85	**323**									
Breast Cancer Same Year		53	**53**									
Breast Cancer Prior Year		53	**53**									
Lung Cancer Prior Year	287	114	**401**	585	116	**701**						
Leukemia Prior Year		111	**111**									
Other Cancer Prior Year	125	76	**201**									

TABLE III.9 *(continued)*

Regression	1992			1991			1990			1989		
	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**
Demographics/Eligibility												
Under 65[a]	100	62	**162**		79	**79**		47	**47**		49	**49**
75 to 79		-17	**-17**									
80 to 84	-35	-37	**-72**		-19	**-19**						
85 and Older	-72	-64	**-135**		-31	**-31**		-16	**-16**		-21	**-21**
Male								8	**8**			
Original Reason for Entitlement Was Disability	163	40	**202**	163	46	**209**	119	44	**163**	118	44	**161**

NOTE: All estimates given are statistically significant at the .01 level. Thus, a blank space in a particular row and column implies that the variable in that row had no effect on 1993 costs for beneficiaries whose most recent CHSF stay was in the year signified by that column. Identical estimates for any pair of values in any column indicate that the variables were found to have impacts on reimbursements that did not differ from each other significantly.

[a] Beneficiaries 65 through 74 are in the reference category.

group as the "standard" group to which all other beneficiary groups are compared. All the other parameters in the model measure the difference between the standard rate and the rates for beneficiaries who had characteristics differing from the standard set, as defined in the first column of the table. For instance, males with congestive heart failure basically have the same rates as females (the standard group), other things being equal. The male rate is only $8 per month greater than the female rate for beneficiaries who had been hospitalized for congestive heart failure in 1990.

Surprisingly, older beneficiaries with a history of congestive heart failure have lower rates on average than younger beneficiaries. We thought it quite possible that age would have little effect on payment rates, since we already control for the major chronic conditions associated with age; however, rates for congestive heart failure beneficiaries (and many others) fall with age. This result could indicate that costs are lower on average for older age groups because they may be less likely to go through intensive treatment if their congestive heart failure worsens or they develop other conditions. This difference may occur because they choose not to undergo the treatment or because their physician believes they are not strong enough to survive it.

As expected, beneficiaries who first became entitled to Medicare because of disability have higher-than-average costs. Among the standard group of beneficiaries hospitalized for congestive heart failure, a history of disability increases total 1993 costs for 1992 congestive heart failure patients by 22 percent (202/919). For those last discharged for congestive heart failure in 1991, disability history increases 1993 costs by nearly a third. Original reason for entitlement has a similarly positive strong effect across all the CHSF regressions. We believe this effect reflects the greater frailty and diverse health needs of such beneficiaries beyond those captured by the conditions already measured by history of CHSF.

Previous hospitalizations for the primary diagnosis are associated with much higher costs. If a standard beneficiary was hospitalized for congestive heart failure in 1992 and 1991, for example, her rate would be 44 percent (404/919) higher than if she had been hospitalized only in 1992. If she was hospitalized in 1992, 1991, and 1990, her rate would be 80 percent (739/919) higher than the standard rate for 1992 discharges. If she was hospitalized for congestive heart failure in all four years, her rate would be nearly $2,000 per month, over twice as high as the standard beneficiary.

Hospitalizations for other CHSF conditions in 1992 or 1991 are also associated with higher rates for the 1992 congestive heart failure cohort. The payment rate for a 1992 congestive heart failure patient would increase by $361 per month if the beneficiary had also been hospitalized for myocardial infarction in 1992. This implies a rate 39 percent higher than the standard group. Hospital stays for other CHSF conditions in the preceding year also are associated with higher costs. For example, congestive heart failure patients discharged in 1992 who had a hospital stay for lung cancer in 1991 had costs $401 (44 percent) higher than the standard beneficiary. Many other cancer conditions are also associated with higher payment rates, including prostate, colon, and breast cancers, though not nearly as much as lung cancer.

Some apparently anomalous results in Table III.9 are not actually flaws in the adjuster, but rather a matter of classifying cases into particular diagnosis cells based on 1992 admissions. The table suggests that having a hospital stay for leukemia in 1991 leads to higher 1993 costs for congestive heart failure patients whose last congestive heart failure admission was in 1992. However, leukemia admissions in 1992 for these congestive heart failure patients do not appear to affect costs. This odd-looking result arises from the fact that patients admitted in 1992 for both leukemia and congestive heart failure are classified in the 1992 leukemia cell rather than the congestive heart failure cell, because future costs are higher for leukemia patients than for congestive

heart failure patients. The regression for the 1992 leukemia cohort shows that patients with admissions for both leukemia and congestive heart failure in 1992 have predicted 1993 costs of $2,004, compared to estimated costs from Table III.9 regressions of $1,030 (919+111) for otherwise similar beneficiaries with a congestive heart failure admission in 1992 and a leukemia admission in 1991. A similar explanation exists for the inclusion in the congestive heart failure regression of variables for 1991 admissions for lung and other cancers, but not of variables for 1992 admissions for these diseases (see Table III.8, last column, for relative 1993 costs of different disease cohorts by year).

Stroke. Many of the same patterns in the congestive heart failure regressions appear in the stroke regressions. First, the intercept increases gradually as time since last discharge decreases for stroke beneficiaries last discharged between 1989 and 1991, then jumps for those discharged in 1992 (see Table III.10). Second, beneficiaries who first became entitled as a result of disability have much higher payment rates. Third, hospitalization for cancer or other heart conditions is associated with much higher costs.

There are, however, some notable differences. First, sex differences in payment rates are more varied for stroke beneficiaries. Payments are higher for males than females among those most recently hospitalized for stroke in 1989 or 1990, but slightly lower for males among those hospitalized in 1991 or 1992. Differences are small, however. The payment rates for males discharged for stroke in 1989 or 1990 are as much as five percent higher than the rate for females, while payment rates are about one to two percent lower for males than females among those with discharges in 1991 or 1992. Second, age effects are reversed. Unlike the pattern for beneficiaries with congestive heart failure, greater age is associated with higher payment rates for stroke patients. For instance, beneficiaries 85 and older in the 1992 cohort have 1993 payment rates eight percent

TABLE III.10

REGRESSION COEFFICIENTS FOR TOTAL 1993 COSTS (PART A AND PART B) FOR BENEFICIARIES WITH STROKE ADMISSIONS, BY YEAR OF MOST RECENT STROKE DISCHARGE

	1992			1991			1990			1989		
Regression	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**
Intercept	562	233	**795**	374	185	**559**	345	164	**510**	335	157	**492**
Hospitalizations for Reference Discharge in Prior Years												
Stroke Last Year	209	55	**264**		55	**55**	132	40	**172**			
Stroke Two Years Ago	209	55	**264**	178	55	**233**						
Stroke Three Years Ago	209	55	**264**									
Hospital Stays for Other CHSF Conditions in the Same or Prior Year as the Reference Discharge												
Myocardial Infarction Same Year	172	47	**219**									
Breast Cancer Same Year		52	**52**								69	**69**
Ischemic Heart Disease Same Year	183	61	**244**	121	47	**167**	111	48	**160**			
Ischemic Heart Disease Last Year	111	40	**151**	121	47	**167**	111	48	**160**			
Colon Cancer Same Year	150		**150**									
Colon Cancer Prior Year		36	**36**		73	**73**						
Prostate Cancer Same Year	114	75	**189**	103		**103**						
Prostate Cancer Prior Year	114	75	**189**		54	**54**						
Skin Cancer Same Year	287	117	**404**							89		**89**
Skin Cancer Prior Year	287	42	**329**	235	79	**314**						
Hip Fracture Same Year	130	45	**175**					18	**18**		33	**33**
Hip Fracture Last Year	72	45	**117**		29	**29**		28	**28**			
Congestive Heart Failure Same Year								44	**44**			
Congestive Heart Failure Prior Year	241	63	**304**	207	57	**263**	146	44	**190**			
Lung Cancer Prior Year	328	116	**443**		82	**82**						
Leukemia Prior Year	257	66	**322**									
Other Cancer Prior Year		42	**42**									

TABLE III.10 *(continued)*

Regression	1992			1991			1990			1989		
	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**
Demographics/Eligibility												
Under 65[a]		25	**25**									
70 to 74												
75 to 79	32	6	**38**	48		**48**	36	6	**42**	56	12	**68**
80 to 84	43	8	**51**	68		**68**	61	14	**74**	56	12	**68**
85 and Older	54	8	**61**	81		**81**	61	14	**74**	56	12	**68**
Male		-8	**-8**		-10	**-10**	29		**29**	17		**17**
Original Reason for Entitlement Was Disability	163	44	**207**	141	43	**184**	106	42	**147**	115	45	**160**

NOTE: All estimates given are statistically significant at the .01 level. Thus, a blank space in a particular row and column implies that the variable in that row had no effect on 1993 costs for beneficiaries whose most recent CHSF stay was in the year signified by that column. Identical estimates for any pair of values in any column indicate that the variables were found to have impacts on reimbursements that did not differ from each other significantly.

[a] Beneficiaries 65 through 74 are in the reference category.

higher (compared to the standard group of 65- to 69-year-olds), and those in the 1989 through 1991 cohorts of stroke patients have rates about 15 percent higher than the 65- to 69-year-olds. Rates for elderly people with earlier strokes may be higher than those for beneficiaries with more recent strokes, because there are fewer conditions in the earlier cohort regressions measuring age-associated chronic conditions.

None of these age effects, however, increase costs nearly as much as other CHSF conditions. Lung cancer and leukemia, for example, have large effects. Prior hospitalization for these conditions increases monthly payment rates for 1992 stroke beneficiaries by $443 and $322, respectively. Furthermore, among stroke beneficiaries hospitalized in 1992, a hospitalization for congestive heart failure in 1991 increases monthly costs from $795 to $1,099 (38 percent), and a hospitalization for ischemic heart disease in 1992 increases monthly costs to $1,039. This is not surprising, since these heart conditions are risk factors for stroke.

Leukemia. Beneficiaries hospitalized between 1989 and 1992 for leukemia have the highest costs, so sorting them out into cells already accounts for a great deal of variation. The advantage of the regressions is revealed in Table III.11, which shows a great number of coexisting conditions in all three years affecting total costs. The heart conditions have very large effects--even among beneficiaries hospitalized in earlier years. For instance, the combined Part A and Part B mean monthly payment rate for standard leukemia beneficiaries discharged in 1992 is $1,480, but the rates increase by $524 if the beneficiary had also been hospitalized in 1992 for congestive heart failure. Among leukemia beneficiaries last hospitalized in 1989, those who were also hospitalized for ischemic heart disease that year had monthly costs $116 (almost 25 percent) higher than the $495 monthly rate for a standard beneficiary in this cell. Previous hospitalizations for leukemia have the highest effect, indicating that repeated hospitalizations for this chronic condition signal a higher

TABLE III.11

REGRESSION COEFFICIENTS FOR TOTAL 1993 COSTS (PART A AND PART B) FOR BENEFICIARIES WITH LEUKEMIA ADMISSIONS, BY YEAR OF MOST RECENT LEUKEMIA DISCHARGE

	1992			1991			1990			1989		
Regression	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**	Part A	Part B	**Total**
Intercept	1,013	467	**1,480**	421	269	**690**	361	220	**581**	295	201	**495**
Hospitalizations for Reference Discharge in Prior Years												
Leukemia Last Year	266	65	**331**	195	73	**268**	73	35	**108**			
Leukemia Two Years Ago	165	45	**210**	195	49	**244**						
Leukemia Three Years Ago	113	35	**148**									
Hospital Stays for Other CHSF Conditions in the Same or Prior Year as the Reference Discharge												
Lung Cancer Same Year Only	365	159	**525**									
Skin Cancer Same Year											318	**318**
Hip Fracture Same Year				310		**310**						
Congestive Heart Failure Same Year Only	459	65	**524**	223		**223**						
Congestive Heart Failure Last Year	263	65	**328**	223		**223**						
Ischemic Heart Disease Same Year		37	**37**		66	**66**					116	**116**
Ischemic Heart Disease Prior Year		37	**37**		66	**66**						
Other Cancers Same Year Only	395	91	**486**									
Other Cancers Prior Year		91	**91**									
Prostate Cancer Same Year		60	**60**									
Prostate Cancer Prior Year		60	**60**									
Demographics/Eligibility												
Under 65[a]	219	44	**263**									
70 to 74	-118	-39	**-158**									
75 to 79	-150	-87	**-237**		-29	**-29**						
80 to 84	-207	-149	**-356**		-48	**-48**				125		**125**
85 and Older	-249	-223	**-472**		-80	**-80**	100	-39	**62**	125		**125**
Male		41	**41**		31	**31**		24	**24**			
Original Reason for Entitlement Was Disability	38	609	**647**	107	330	**436**	168	24	**192**	110	52	**162**

NOTE: All estimates given are statistically significant at the .01 level. Thus, a blank space in a particular row and column implies that the variable in that row had no effect on 1993 costs for beneficiaries whose most recent CHSF stay was in the year signified by that column. Identical estimates for any pair of values in any column indicate that the variables were found to have impacts on reimbursements that did not differ from each other significantly.

[a] Beneficiaries 65 through 74 are in the reference category.

likelihood of future hospitalizations and higher medical costs than those with only a single hospitalization. In fact, regardless of the year of the most recent hospitalization (except 1989, where we do not have a variable for past hospitalizations for CHSF), a previous hospitalization for leukemia is associated with higher payment rates. Payments are 39 percent (268-690) higher for beneficiaries hospitalized in both 1990 and 1991 for leukemia than for those hospitalized only in 1991. If a beneficiary had also been hospitalized in 1989, her payments would have been 74 percent [(268+244)/690] higher than those of the standard case for 1991 leukemia patients.

Hip Fracture. The regressions for beneficiaries hospitalized for hip fracture between 1989 and 1992 are very different from the other regressions. First, all other CHSF conditions have an effect on the payment rates--even across years (see Table III.12). Being hospitalized for any CHSF condition in 1991 increases the payment rate for those hospitalized for hip fracture in 1992, though the increase varies by condition. Having a discharge for prostate cancer in the year preceding the one in which the primary hip fracture discharge occurred increases monthly payments by only $41 for the most recent cohort, but hospitalization for lung cancer last year increases monthly payments by $282--yielding a rate nearly 50 percent higher than the standard rate. Second, the effects occur even among beneficiaries hospitalized for hip fracture in previous years. Earlier stroke, ischemic heart disease, and congestive heart failure all have effects on the 1993 costs of hip fracture cohorts, whether the hip fracture occurred in 1990, 1991, or 1992. Similarly, hospitalizations for cancers have large effects even for those most recently hospitalized for hip fracture in 1989. For instance, beneficiaries hospitalized for "other cancers" and hip fracture in 1989 have a payment rate of $774, while those hospitalized only for hip fracture in 1989 have a payment rate of $428.

Other Regressions. Results for the regressions for other conditions are in the appendix. The patterns discussed above, except those for hip fracture, generally hold true for the other regressions.

TABLE III.12

REGRESSION COEFFICIENTS FOR TOTAL COSTS (PART A AND PART B) FOR BENEFICIARIES WITH HIP FRACTURE ADMISSIONS, BY YEAR OF MOST RECENT HIP FRACTURE DISCHARGE

	1992			1991			1990			1989		
Regression	Part A	Part B	Total	Part A	Part B	Total	Part A	Part B	Total	Part A	Part B	Total
Intercept	406	171	577	312	146	458	307	138	446	291	137	428
Hospital Stays for Other CHSF Conditions in the Same or Prior Year as the Reference Discharge												
Myocardial Infarction Same Year								29	29	133	33	166
Myocardial Infarction Prior Year	83	29	113				89		89			
Colon Cancer Same Year								34	34			
Colon Cancer Prior Year	97	35	132		45	45						
Breast Cancer Same Year	176	71	248									
Breast Cancer Prior Year	91	34	124		35	35						
Prostate Cancer Same Year	227	100	328								51	51
Prostate Cancer Prior Year		41	41									
Skin Cancer Same Year											85	85
Skin Cancer Prior Year	182	62	243				399	67	467			
Other Cancers Same Year										280	67	346
Other Cancers Prior Year	131	52	184	166	59	225		73	73			
Ischemic Heart Disease Prior Year	134	56	190	101	52	153	76	39	115			
Congestive Heart Failure Prior Year	202	61	263	163	54	217	170	45	215			
Stroke Prior Year	129	44	173	89	38	127	142	49	192			
Lung Cancer Prior Year	232	49	282	207	72	279						
Leukemia Prior Year	145	61	206	176	75	251	216	80	296			
Hip Fracture Prior Year				55	16	72	68	15	83			
Demographics/Eligibility												
Under 65[a]	-59		-59							-92	-14	-106
75 or Older[b]				-29		-29	-49		-49			
80 to 84										18		18
85 and Older		-14	-14		-10	-10				18		18
Male	126	28	153	89	18	107	77	15	92	76	14	90
Original Reason for Entitlement Was Disability	135	49	184	124	47	170	112	45	157	109	48	157

NOTE: Identical estimates for any pair of values in any column indicate that the variables were found to have impacts on reimbursements that did not differ from each other significantly.

[a] Beneficiaries 65 through 74 are in the reference category.

[b] For 1990 and 1991, all beneficiaries age 75 or older are grouped together. For 1989, those age 75 to 79 are grouped with those age 65 to 74.

Table III.13 contains summary statistics of the predicted costs monthly from all the regressions. This table reveals how payment rates would differ across conditions. The distribution of payment rates is generated by differences in the regression coefficients. For instance, total 1993 costs per month for beneficiaries hospitalized for leukemia in 1992 range from $1,008 to $3,410 depending on a beneficiary's age, sex, coexisting conditions, Medicaid enrollment, and original reason for entitlement. Generally, there is less variation in 1993 predicted costs among beneficiaries hospitalized in earlier years, because fewer independent variables remained in the regressions. For example, 75 percent of all beneficiaries hospitalized for hip fracture in 1989 have predicted Part B costs of $137 per month, because there are so few other characteristics that had a significant effect on Part B costs among 1989 hip fracture beneficiaries. Similarly, there is less variation for diagnoses with lower average cost. For example, predicted Part A costs for colon cancer patients is $459 for over 75 percent of all such cases.

The median total payment for those with no CHSF condition ($286) is less than half the median rate for most CHSF cohorts with 1992 discharges. The rank order is quite different, however, for those whose primary discharge was in 1989, and those for whom it occurred in 1992. For the 1992 cohort, leukemia and lung cancer patients had the highest medians. For the 1989 cohort, CHF and stroke patients had the highest medians.

E. PREDICTIVE ACCURACY

One of the key criteria for a fair risk adjuster is how well it predicts FFS costs for various groups of beneficiaries. To address this question, we use the Medicare CBS and the CMHS to assess predictive accuracy for groups of beneficiaries defined by characteristics that are related to costs. We also show how payments to plans would be affected for different degrees of favorable selection if plans were paid according to the CHSF-I adjuster instead of the AAPCC.

TABLE III.13

SUMMARY STATISTICS OF PREDICTED MONTHLY COSTS WITHIN EACH CELL

Year	Payment	Cell	Summary Statistics					
			Minimum	First Quartile	Median	Third Quartile	Maximum	Mean
Non-CHSF	Part A		99	128	180	208	301	166
Non-CHSF	Part B		74	83	109	110	154	99
Non-CHSF	Total		174	217	286	218	442	265
1992	Part A	Leukemia	765	863	1013	1161	2612	1049
		Lung Cancer	897	897	897	1047	2625	991
		Heart Failure	585	656	793	956	2359	837
		Other Cancers	633	657	704	872	2423	781
		Stroke	562	593	605	725	1640	657
		Skin Cancer	448	448	448	614	2066	549
		Colon Cancer	459	459	459	459	1860	537
		Myocardial Infarction	348	416	468	536	1721	508
		Hip Fracture	406	406	406	532	1275	463
		Ischemic Heart Disease	303	357	433	513	1523	459
		Prostate Cancer	217	217	289	451	1335	346
		Breast Cancer	214	214	251	339	2124	296
	Part B	Leukemia	244	379	464	508	837	444
		Lung Cancer	178	395	457	490	827	439
		Other Cancers	237	314	350	384	839	358
		Colon Cancer	192	260	331	369	760	321
		Heart Failure	199	245	265	326	778	288
		Stroke	225	232	241	280	559	256
		Skin Cancer	199	210	239	270	685	251
		Prostate Cancer	205	205	232	247	567	237
		Ischemic Heart Disease	169	185	197	231	572	214
		Breast Cancer	194	194	194	194	606	211
		Myocardial Infarction	177	177	192	218	482	199
		Hip Fracture	157	157	171	199	507	183
	Total	Myocardial Infarction	525	593	659	724	2147	707
		Ischemic Heart Disease	472	539	654	744	1968	673
		Congestive Heart Failure	784	902	1085	1283	3077	1125
		Stroke	787	824	846	1006	2176	914
		Colon Cancer	651	752	790	852	2514	858
		Breast Cancer	408	408	445	533	2657	507
		Lung Cancer	1090	1304	1368	1480	3339	1430
		Prostate Cancer	422	422	521	695	1833	583
		Leukemia	1008	1283	1455	1663	3410	1493
		Skin Cancer	653	684	718	839	2597	799
		Other Cancer	870	996	1054	1254	3229	1139
		Hip Fracture	564	564	577	731	1737	646
1991	Part A	Heart Failure	468	468	468	632	1491	539
		Leukemia	421	421	421	527	1149	482
		Lung Cancer	421	421	421	528	1087	464
		Stroke	374	374	442	455	1114	453
		Other Cancers	339	339	339	413	1188	393
		Skin Cancer	312	312	415	415	809	384
		Colon Cancer	310	310	310	383	1025	348
		Hip Fracture	283	312	312	401	895	345
		Ischemic Heart Disease	224	261	307	402	1174	336
		Myocardial Infarction	245	245	284	349	835	312
		Prostate Cancer	163	183	235	310	1002	263
		Breast Cancer	178	178	215	247	819	233

TABLE III.13 *(continued)*

Year	Payment	Cell	Summary Statistics					
			Minimum	First Quartile	Median	Third Quartile	Maximum	Mean
	Part B	Leukemia	189	240	269	300	487	275
		Lung Cancer	187	243	243	243	433	245
		Other Cancers	174	198	226	226	483	222
		Heart Failure	175	187	206	235	495	217
		Colon Cancer	158	199	214	238	426	213
		Stroke	175	175	185	185	413	194
		Skin Cancer	168	168	191	191	424	193
		Prostate Cancer	156	166	185	198	408	188
		Ischemic Heart Disease	150	163	175	191	549	180
		Breast Cancer	150	150	150	150	341	158
		Hip Fracture	136	136	146	154	358	153
		Myocardial Infarction	136	136	149	149	317	152
	Total	Myocardial Infarction	381	381	433	498	1121	464
		Ischemic Heart Disease	374	424	482	596	1541	516
		Congestive Heart Failure	643	655	674	883	1941	755
		Stroke	549	559	617	640	1527	647
		Colon Cancer	490	514	533	548	1447	562
		Breast Cancer	328	328	365	397	1129	392
		Lung Cancer	638	664	664	769	1412	708
		Prostate Cancer	318	349	420	508	1312	451
		Leukemia	609	672	692	827	1442	758
		Skin Cancer	480	503	583	605	1210	577
		Other Cancer	537	537	565	615	1608	615
		Hip Fracture	429	448	458	555	1231	498
1990	Part A	Heart Failure	447	447	447	447	621	468
		Stroke	345	374	406	435	798	415
		Leukemia	361	361	361	462	602	406
		Lung Cancer	328	328	328	425	1108	375
		Hip Fracture	258	307	307	335	1019	330
		Skin Cancer	276	276	276	381	648	321
		Other Cancers	254	254	280	372	787	315
		Ischemic Heart Disease	234	234	293	370	764	313
		Myocardial Infarction	266	266	266	339	402	302
		Colon Cancer	258	258	258	346	809	292
		Prostate Cancer	182	182	228	286	833	258
		Breast Cancer	170	170	207	247	693	222
	Part B	Leukemia	182	220	244	244	302	234
		Lung Cancer	201	201	201	201	340	209
		Heart Failure	165	181	189	214	407	196
		Other Cancers	159	167	186	195	363	185
		Colon Cancer	147	170	177	200	280	183
		Prostate Cancer	157	166	183	183	361	181
		Stroke	164	164	178	178	312	180
		Skin Cancer	163	163	163	163	318	171
		Ischemic Heart Disease	142	159	169	178	310	171
		Breast Cancer	146	146	146	146	274	151
		Hip Fracture	138	138	138	153	316	146
		Myocardial Infarction	140	140	140	140	213	143

TABLE III.13 *(continued)*

Year	Payment	Cell	Summary Statistics					
			Minimum	First Quartile	Median	Third Quartile	Maximum	Mean
	Total	Myocardial Infarction	406	406	406	501	615	445
		Ischemic Heart Disease	377	403	462	539	1069	484
		Congestive Heart Failure	612	628	636	666	1024	664
		Stroke	510	538	584	613	1110	595
		Colon Cancer	436	436	459	492	1067	475
		Breast Cancer	316	316	353	393	915	372
		Lung Cancer	530	530	530	626	1372	584
		Prostate Cancer	338	348	411	477	1109	440
		Leukemia	581	581	605	667	905	640
		Skin Cancer	439	439	439	545	863	492
		Other Cancer	413	441	474	545	1142	500
		Hip Fracture	396	446	446	488	1319	476
1989	Part A	Heart Failure	421	421	421	421	539	438
		Stroke	335	390	390	408	612	395
		Leukemia	295	295	295	419	530	349
		Lung Cancer	326	326	326	326	418	340
		Hip Fracture	291	309	309	309	756	323
		Ischemic Heart Disease	263	263	263	372	428	307
		Skin Cancer	262	262	262	373	398	301
		Other Cancers	215	251	291	330	472	285
		Myocardial Infarction	252	252	252	313	400	282
		Prostate Cancer	181	181	257	257	377	256
		Colon Cancer	194	223	252	301	389	254
		Breast Cancer	166	166	198	238	403	219
	Part B	Leukemia	201	201	201	201	570	209
		Lung Cancer	181	181	181	181	211	186
		Heart Failure	162	162	183	183	276	185
		Prostate Cancer	160	160	177	177	210	173
		Stroke	157	169	169	169	283	171
		Other Cancers	152	152	152	182	215	169
		Ischemic Heart Disease	153	153	167	167	214	168
		Colon Cancer	136	152	152	178	207	163
		Skin Cancer	154	154	154	154	264	158
		Breast Cancer	142	142	142	142	203	146
		Hip Fracture	137	137	137	137	270	143
	Total	Myocardial Infarction	385	385	394	455	569	424
		Ischemic Heart Disease	416	416	430	545	642	475
		Congestive Heart Failure	583	583	604	604	815	623
		Stroke	492	560	560	577	859	566
		Colon Cancer	346	376	405	437	596	418
		Breast Cancer	308	308	340	380	605	365
		Lung Cancer	507	507	507	507	629	525
		Prostate Cancer	342	342	434	434	587	429
		Leukemia	495	495	495	620	975	558
		Skin Cancer	416	416	416	527	661	459
		Other Cancer	368	408	447	485	686	455
		Hip Fracture	428	446	446	446	1021	466

1. Overall Accuracy

The CHSF-I adjuster explains more variation in Part B costs than in Part A costs (with R-squareds of .0769 and .0410 respectively) and explains more variation in total costs among beneficiaries with CHSF (with an R-squared equal to .0542) than among beneficiaries without CHSF (with an R-squared of .0142). The CHSF-I adjuster explains 5.36 percent of the variation in total costs among beneficiaries with and without CHSF. This is substantially higher than the one percent of variance explained by the AAPCC but substantially lower than the roughly eight percent explained by the HCC and ADG-HOSDOM adjusters.

2. Accuracy of the Adjuster for Biased Subgroups

The R-squared for the adjuster provides some guide to the precision of the adjusters, but more important than explaining the variation across individuals is the ability of the adjuster to predict costs accurately for groups not randomly selected from the population. As Newhouse (1986) has noted, the maximum proportion of the variance of Medicare costs that is explainable with prior information is about 20 percent. The task at hand is to predict as well as possible for subgroups of individuals who are healthier on average than the Medicare population, without using variables that are highly gameable or data that are very expensive to collect.

We assessed the accuracy of the CHSF-I adjuster relative to that of the AAPCC for subgroups of the Medicare CMHS (five percent sample) defined by selected characteristics that are related to expected costs. The beneficiary characteristics used to create these subgroups include (1) whether had a history of CHSF, (2) whether died in 1993, (3) whether on Medicaid, and (4) whether originally entitled to Medicare as a result of disability. We also examine predictive accuracy for subgroups defined by the quintile into which a beneficiary's actual 1993 reimbursement fell.

The predicted payments are normalized to enable us to distinguish the two adjusters on their relative ability to adjust payments for individual differences in health status. The normalization factor, equal to the ratio of average actual cost to average predicted cost for the full sample, is necessary to eliminate variation in payments resulting from forecast errors in county-level AAPCC rate projections.[9]

The normalized predictive ratios are displayed in Table III.14. The predictive ratio is the predicted costs (using the adjuster in question) times the normalization factor (1.086 for the CHSF-I adjuster and 1.082 for the AAPCC), divided by the actual observed costs. Values greater than one indicate that the adjuster predicts costs to be higher than they actually are, while values less than one indicate that the adjuster predicts costs to be lower than they actually are. Values close to one for a particular subgroup suggest that the adjuster accurately predicts costs for the subgroup.

When the sample is split by whether the beneficiary had a history of CHSF, the CHSF-I adjuster predicts far better than the AAPCC, as expected. The CHSF-I adjuster overpredicts by about one percent for those with a CHSF history and underpredicts by one percent for those without such a history. However, the AAPCC underpredicts by nearly 50 percent for those with a CHSF history and overpredicts by 20 percent for those with no CHSF condition in the past four years.

When the sample is split by other indicators of health status, however, the CHSF-I adjuster predicts costs only slightly better than the AAPCC. For example, for beneficiaries who died during 1993, the CHSF-I adjuster underpays by 75 percent, compared to 82 percent for the AAPCC. The adjusters overpay by 16 and 18 percent, respectively, for survivors.

The results for beneficiaries on Medicaid and those whose original reason for entitlement was disability follow expected patterns. Both the AAPCC and the CHSF-I adjusters include separate

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[9]For instance, HCFA's expected Part B USPCC in 1993 was 20 percent higher than the actual Part B USPCC in 1993.

TABLE III.14

PREDICTIVE ACCURACY, FIVE PERCENT SAMPLE OF CMHS
(1993 Costs)

	Number of Cases	Percentage of FFS Population	Predictive Ratio		Mean Absolute Deviation (MAD)		Mean Squared Error (MSE)	
			CHSF	AAPCC	CHSF	AAPCC	CHSF	AAPCC
Overall	1,484,932	100.0	100	100	402	421	808,962	842,050
Subgroups								
CHSF History								
Yes	218,126	14.7	101	54	728	651	1,892,200	2,089,794
No	1,266,806	85.3	99	120	347	382	626,629	632,028
Died in 1993								
Yes	71,796	4.8	25	18	1,802	1,895	13,365,213	14,051,550
No	1,413,136	95.2	116	118	363	380	459,937	474,867
Medicaid								
Yes	182,485	12.3	101	97	468	478	717,159	743,767
No	1,302,447	87.7	100	101	392	413	822,077	856,091
Original Reason for Entitlement								
Disabled	230,795	15.5	100	75	485	458	1,184,174	1,245,911
Elderly	1,254,137	84.5	100	106	387	414	740,806	768,690
Actual 1993 Reimbursement								
Lowest quintile	308,413	20.8	49,372	57,055	254	294	78,795	98,302
Second quintile	288,817	19.5	1,996	2,224	258	289	87,348	95,635
Third quintile	287,969	19.4	684	720	264	281	102,302	92,402
Fourth quintile	289,617	19.5	208	203	202	186	88,089	51,266
Highest quintile	310,116	20.9	32	26	1,029	1,053	3,688,703	3,873,037

NOTE: The predictive ratio is the ratio of average payment under the adjuster to average Medicare cost, multiplied by 100, for the subgroup of interest. MAD is the mean absolute deviation of payment from the actual cost. MSE is the mean squared error, the mean of the squared difference between predicted and actual cost.

cells for Medicaid; thus, both predict costs for Medicaid groups very well. However, the CHSF-I adjuster overpredicts costs for Medicaid by one percent, while the AAPCC underpredicts by three percent. Because original reason for entitlement remains significant in nearly every regression, and because the no-condition group contains separate rate cells for it, the CHSF-I adjuster predicts costs with nearly 100 percent accuracy on average for originally disabled beneficiaries. On the other hand, the AAPCC underpredicts their costs by 25 percent and overpredicts costs for those originally entitled because of age by 6 percent.

Both adjusters perform poorly across enrollee groups defined by quintiles of actual 1993 reimbursements. However, the CHSF-I adjuster predicts better than the AAPCC for three quintiles and nearly the same amount for the other two quintiles. Both overpredict by large fractions for the bottom four quintiles and underpredict badly for the highest quintile. This result is quite similar to that found for the HCC adjuster (Ellis et al. 1996), which had a predictive ratio of 34 for the highest quintile (versus 32 for the CHSF-I adjuster) and 51,441 for the lowest quintile (compared to 49,372 for CHSF).

We also compared the two adjusters on two other measures of predictive power--the mean absolute deviation (MAD) of predicted from actual cost, and the mean squared error (MSE). The last two series of columns of Table III.14 display the comparisons. The MAD is usually about 5 to 10 percent lower for the CHSF-I adjuster, although for a few groups of enrollees, the AAPCC has a smaller MAD. The MSE is also generally lower for the CHSF-I adjuster, by 3 to 20 percent.

To obtain a broader view of how well the CHS adjuster predicts, we use the MCBS to define various groups of beneficiaries on other measures of health status and test the predictive accuracy of the models for each group (see Table III.15). For the full sample of over 10,000 Medicare beneficiaries, we find that the CHSF-I adjuster underpredicts by about one percent and that the

TABLE III.15

PREDICTIVE ACCURACY, MCBS TEST SAMPLE
(1993 Costs)

	Number of Cases	Percentage of FFS Population	Predictive Ratio		Mean Absolute Deviation		Mean Squared Error	
			CHSF	AAPCC	CHSF	AAPCC	CHSF	AAPCC
Overall	10,090	100.0	99	96	399	411	794,454	818,562
Subgroups								
Functional Impairments								
No impairments	5,766	63.2	114	117	340	354	665,795	674,386
IADL, no ADL impairments	2,441	21.6	93	80	449	441	815,650	854,247
One ADL impairment	540	4.8	86	72	494	516	744,260	846,646
Multiple ADL impairments	1,336	10.3	71	72	627	661	1,546,433	1,600,728
Self-Rating of Health								
Excellent	3,916	41.3	140	149	309	326	464,065	463,354
Good	3,023	30.1	90	89	413	426	878,028	903,841
Fair/poor	3,127	28.4	80	68	522	521	1,193,050	1,251,477
Chronic Conditions								
Heart problem	4,233	41.4	86	75	491	488	1,236,709	1,271,910
No heart problem	5,857	58.6	114	121	336	357	489,562	506,104
Cancer	1,753	17.7	106	86	424	408	786,723	803,480
No cancer	8,337	82.3	97	98	394	411	796,078	821,738
Stroke	1,202	11.1	92	79	509	511	830,230	890,119
No stroke	8,888	88.9	100	99	386	399	790,147	809,954
Diabetes	1,526	15.5	75	63	524	529	1,370,925	1,435,621
No diabetes	8,564	84.5	106	106	377	389	690,560	707,284
Arthritis	5,454	55.0	94	89	406	415	751,511	781,967
No arthritis	4,636	45.1	105	106	391	405	847,199	863,485

TABLE III.15 *(continued)*

	Number of Cases	Percentage of FFS Population	Predictive Ratio		Mean Absolute Deviation		Mean Squared Error	
			CHSF	AAPCC	CHSF	AAPCC	CHSF	AAPCC
Number of Chronic Conditions								
None	2,305	22.3	135	154	304	337	499,111	528,015
One	3,364	34.0	104	108	366	382	604,450	609,114
Two	2,825	28.0	86	80	461	461	1,107,969	1,129,917
Three or more	1,596	15.7	89	69	502	493	1,086,320	1,150,412
Number of Problems with Activities of Daily Living								
None	8,208	84.9	107	104	368	377	708,291	724,362
One	540	4.8	86	73	494	516	744,260	846,646
Two	357	2.9	77	69	575	590	1,231,079	1,252,731
Three or more	979	7.2	69	73	648	690	1,676,657	1,744,962
Number of Problems with Instrumental Activities of Daily Living								
None	5,903	64.3	114	116	342	357	666,224	676,255
One	1,523	14.5	84	80	429	432	829,692	879,676
Two	929	7.4	94	89	499	501	821,198	839,898
Three or more	1,730	13.8	77	67	587	595	1,316,414	1,377,756
Nursing home resident								
Yes	864	6.1	93	124	510	589	739,078	744,276
No	9,226	93.9	99	93	393	400	797,757	823,000
Prior Reimbursement (1992)[a]								
Lowest quintile	1,975	20.0	152	168	322	345	560,754	568,881
Second quintile	1,898	19.6	127	144	312	335	761,228	764,256
Third quintile	1,981	19.8	125	136	322	340	371,058	375,682
Fourth quintile	2,035	20.0	91	95	384	399	603,978	606,267
Highest quintile	2,200	20.7	73	51	658	634	1,676,038	1,778,334

[a]Heart problems include myocardial infarction, arteriosclerosis, congestive heart failure, and other heart conditions.

[b]Number of observations is weighted, so numbers differ slightly across quintiles, which were defined on unweighted data.

AAPCC underpredicts by about four percent (not shown). The results of primary interest, however, are those for subgroups defined by functioning, self-rating of health, the presence of various chronic conditions, nursing home residence, and prior reimbursements. Again, we normalized the predictive ratios to eliminate forecast errors in county-level AAPCC rate projections.

In general, we find that the CHSF-I adjuster underpredicts somewhat less than the AAPCC for the groups that are sicker than average and overpredicts slightly less for those without such conditions. For example, the CHSF-I adjuster underpredicts by 6 percent for beneficiaries who cannot perform one or more IADLs without assistance, compared to an underprediction of 17 percent for this group by the AAPCC. Similarly, the CHSF-I adjuster underpredicts by about half as much (13 versus 25 percent) as the AAPCC for those with an impairment in one ADL). However, the two adjusters are about equally inaccurate for individuals with no ADL or IADL impairments or multiple ADL impairments. For groups defined by self-rating of health, the CHSF-I adjuster predicts somewhat better than the AAPCC, especially for those in the poorest health. This performance is somewhat disappointing, since our adjuster uses original reason for entitlement and conditions such as stroke and CHF, which can lead to problems with functioning.

The comparisons for groups of beneficiaries who reported ever having been told by a doctor that they had certain chronic health problems show that the CHSF-I adjuster predicts substantially more accurately than the AAPCC. The conditions examined include heart problems, cancer, strokes, diabetes, and arthritis. The greater accuracy of the CHSF-I adjuster for the cancer, heart disease, and stroke groups is not surprising, since the adjuster is based on these conditions. However, the CHSF-I adjuster is not guaranteed to predict better, since some of the beneficiaries reporting that they have ever been told by a physician that they had a particular condition will not have had a hospital stay for the condition in the past four years. Furthermore, the CHSF-I adjuster predicts somewhat more

accurately even for beneficiaries with chronic conditions (arthritis, diabetes) that are not accounted for by the adjuster.[10] The CHSF-I adjuster also predicts substantially more accurately for groups of beneficiaries defined by the *number* of chronic conditions that they report in the CBS sample. This distinction is important, given the recent study by the GAO showing that enrollees in Medicare risk plans have fewer chronic conditions at enrollment than do beneficiaries who remain in FFS (U.S. General Accounting Office 1997).

One finding that is not encouraging, however, is that, for almost all the conditions, the CHSF-I adjuster still overpredicts costs by a sizable margin for beneficiaries who report *not* having some conditions. For example, the findings suggest that the CHSF-I adjuster would still overpay by 15 percent for those who say they have never had heart problems. While this is substantially less than the 26 percent overpayments by the AAPCC for those without heart problems, it is still substantial.

The CHSF-I adjuster does predict considerably better than the AAPCC for beneficiaries who never had *any* of the five diseases examined (22 percent of the population). For those with none of these conditions, the CHSF-I adjuster would overpay by 36 percent, compared to 60 percent for the AAPCC.

Surprisingly, the CHSF-I adjuster also predicts much more accurately than the AAPCC for beneficiary groupings defined by whether the individual currently resided in a nursing home, despite the fact that only the AAPCC takes account of nursing home residence in setting the rate. We find that the AAPCC overpays for those in nursing homes by 29 percent, whereas the CHSF-I adjuster underpays by only 6 percent. The differences in predictive accuracy for those not in nursing homes

[10]The CHSF-I adjuster may perform well for arthritis beneficiaries, because arthritis is a risk factor for hip fracture, which we include in the adjuster. Also, arthritis is a common comorbidity for patients with heart and other serious conditions included in the adjuster.

is smaller, with the AAPCC underpaying by three percent and the CHSF-I adjuster overpaying by less than one percent.

Finally, we find that the CHSF-I adjuster predicts more accurately than the AAPCC for subgroups of beneficiaries defined by reimbursements in 1992, the year prior to the one for which reimbursements are being predicted. For four of the five quintiles, the CHSF-I adjuster yields more accurate cost predictions than the AAPCC, though the differences in predictive ratios are not as large as we would like. The CHSF-I overpredicts for those in the lowest quintile by about 54 percent, compared to about 75 percent for the AAPCC. Thus, overpayments for this group would be reduced by about 30 percent. For those in the highest cost quintile in 1992, the CHSF-I adjuster underpredicts by 26 percent, compared to nearly 47 percent for the AAPCC. Thus, there is much less incentive under a CHSF-I adjuster for HMOs to avoid attracting individuals with high costs in prior years.

The CHSF-I adjuster does not appear to perform nearly as well as the HCC and ADG-HOSDOM adjusters for subgroups defined by prior reimbursements, however. Although the comparisons are for different years and different samples (and the ADG adjuster is limited to the elderly), the findings suggest that both those adjusters predict more accurately for each quintile than does the CHSF adjuster:

PREDICTIVE RATIOS FOR DIFFERENT RISK ADJUSTERS[11]

Percentile	AAPCC	CHSF	ADG-HOSDOM	HCC
0-20	168	152	108	130
21-40	144	127	117	124
41-60	136	125	113	114
61-80	95	91	100	99
81-100	51	73	88	85

[11]For the comparison to be fair, the predictive ratios in this table were not normalized.

This result is not surprising, given the much greater number of diagnoses used in these other adjusters, their inclusion of diagnoses from Part B claims in the high rate cells, and the use of diagnoses from only the prior year to set the rates. Thus, people with no services in the prior year automatically are assigned to the lowest rate cell, so these models should predict well for subgroups defined by prior year reimbursements. The comparison shows that the ADG-HOSDOM adjuster overpredicts for the lowest quintile by about 18 percent, compared to 30 percent for the HCC adjuster and 52 percent for the CHSF-I adjuster. The ADG adjuster also predicts best for the highest quintile of prior-year cost, underestimating costs by only about 12 percent, versus 15 percent for the HCC adjuster and 27 percent for the CHSF adjuster.

In general, the CHSF-I adjuster has a slightly smaller MAD and MSE than the AAPCC for each of the comparisons. In a few instances, the AAPCC had a slightly lower MAD or MSE, and in a few others the CHS had substantially lower values than the AAPCC, but these were the exceptions to the general pattern.

3. Effects on Payments to Plans

We present hypothetical results illustrating how a CHSF-I adjuster would affect payments to plans if risk plans enrolled less than their "fair share" of beneficiaries with a history of CHSF-I. Table III.16 presents the payments under the AAPCC and CHSF-I adjusters for those with and without CHSF, using the CMHS sample. As seen earlier, the AAPCC underpays by 54 percent for enrollees with a CHSF history and overpays by 20 percent for those without such a history. The CHSF-I adjuster, on the other hand, overpays slightly (one percent) for those with CHSF and underpays slightly (one percent) for those without CHSF.

The reduction in payments to plans under the CHSF-I adjuster depends upon the proportion of risk plan enrollees who have a history of CHSF. As Table III.16 shows, AAPCC payments to plans

TABLE III.16

HYPOTHETICAL EFFECTS ON PAYMENTS TO PLANS
(Per Enrollee)

	Part A			Part B			Total		
	Payment (in Dollars)	Cost (in Dollars)	Difference (Percentage)	Payment	Cost	Difference (Percentage)	Payment	Cost	Difference (Percentage)
AAPCC									
For those with CHS (14.7 percent)	246	480	-48.68	126	212	-40.64	372	692	-46.21
For those with no CHS (85.3 percent)	205	166	23.41	133	99	34.76	318	265	20.09
Total	211	211	-0.16	115	115	-0.14	326	327	-0.16
CHS Adjuster									
Those with CHS	485	480	1.00	214	212	0.96	699	692	0.99
Those with no CHS	165	166	-0.72	98	99	-0.54	263	265	-0.66
Total	211	211	-0.16	115	115	-0.14	326	327	-0.16
AAPCC Payment to Plan with:									
14.7 percent CHSF (neutral)	212	212	-0.52	115	115	14.40	327	328	-0.48
14 percent CHSF	210	210	0.37	114	115	15.22	324	325	0.31
13 percent CHSF	207	207	1.69	113	114	16.43	320	321	1.48
12 percent CHSF	203	204	3.05	112	112	17.67	316	316	2.68
11 percent CHSF	200	201	4.46	111	111	18.94	311	312	3.91
10 percent CHSF	197	198	5.91	110	110	20.23	307	308	5.18
9 percent CHSF	194	195	7.40	109	109	21.54	303	304	6.48
8 percent CHSF	191	191	8.95	108	108	22.89	298	299	7.82

will equal FFS costs if HMOs enroll a neutral mix (14.69 percent with a CHSF history), because overpayments for those without a CHSF history offset underpayments for those with CHSF. However, if only eight percent of enrollees had a CHSF history, the AAPCC would overpay by about 7.8 percent. Since the CHSF-I adjuster is based on this variable, it would pay plans the correct amount, on average, if the only source of favorable selection was incidence of CHSF history. Thus, payments to plans would drop 7.8 percent relative to AAPCC payments if only eight percent of enrollees had a hospital stay for CHSF in the past four years and HCFA were to base payment on the CHSF-I adjuster. For less favorable selection, the reduction would be less; for more favorable selection, the reduction in payment would be greater.

IV. THE CHSF-CC ADJUSTER: ADDING A CHRONIC-CONDITION COMPONENT TO THE BASE ADJUSTER

While the basic CHSF-I adjuster described in Chapter III performs better than the AAPCC in predicting future costs of beneficiaries in the Medicare risk program, the improvement is limited. In particular, like the AAPCC adjuster, the CHSF-I adjuster substantially overpredicts expected FFS costs for samples of healthier Medicare beneficiaries.

In this chapter, we improve on the predictive accuracy of the CHSF adjuster through the addition of a "chronic-condition" component that assigns payment rates to (non-CHSF) beneficiaries based on their use of physician services, in inpatient or outpatient settings, for selected conditions. The resulting CHSF-CC adjuster proves more effective than the AAPCC in predicting rates for various biased samples, while maintaining its relative ease of use and limited gameability. In Sections A through C, we describe the steps taken to construct the CHSF-CC adjuster; in Section D, we present the payment rates; and in Section E, we examine the adjuster's predictive accuracy.

A. RATIONALE

The fundamental reason for the weak performance of the CHSF adjuster is that only 14.7 percent of Medicare beneficiaries have a history of CHSF. Thus, payment is determined by a medical condition for only a small fraction of beneficiaries. For the others, the payment rates are defined simply by demographic characteristics--age, gender, Medicaid status, and reason for entitlement--which predict average costs poorly for biased groups of beneficiaries.

Results from a GAO report suggest a promising approach to improving the predictive accuracy of the adjuster while maintaining its limited gameability (U.S. General Accounting Office 1997). The GAO finds that Medicare beneficiaries receiving medical care for certain chronic conditions not

only have costs well in excess of the Medicare average, but also are significantly underrepresented among recent entrants into the Medicare risk program. The general chronic conditions identified by the GAO are hypertension, diabetes mellitus, chronic obstructive pulmonary disease (COPD), ischemic heart conditions, and congestive heart failure.[1] The GAO selected these conditions because they reflect the major categories of chronic conditions, are highly prevalent among Medicare beneficiaries, and are associated with high medical expenditures.[2]

The GAO sample included nearly 1.1 million nondisabled Medicare beneficiaries in 14 California counties, who were enrolled in the FFS sector throughout 1992. They chose the sample because California was a mature managed care market with a high degree of MCO penetration and because the 14 counties all had at least one risk contract HMO operating within its boundaries. The GAO defined beneficiaries as having a given chronic condition based on Medicare claims data for 1991 and 1992. Specifically, any beneficiary with a hospital claim or more than one other claim that listed a diagnosis (ICD-9) corresponding to a given condition was assigned that condition. Based on these criteria, about 48 percent of the sample had no conditions, 31 percent had one condition, and 21 percent had two or more conditions. Average 1992 Medicare expenditures for those with no conditions were $127, compared to $515 for those with one or more condition--a fourfold difference.

The basic method the GAO used to evaluate whether Medicare HMOs benefited from favorable selection was to compare the 1992 Medicare expenditures and prevalence of chronic conditions for beneficiaries who enrolled and did not enroll in risk programs over the subsequent 24 months (1993

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[1]The definition of ischemic heart disease used by GAO includes diagnoses related to angina and myocardial infarction as well.

[2]As noted by the GAO, some would also consider cancer a chronic condition, though it is excluded from their analysis. We capture cancer patients through the CHSF component of our adjuster.

and 1994). To the extent that HMOs had proportionally few enrollees with chronic conditions (or otherwise high average costs), this would support the hypothesis that favorable selection had taken place within the sample.

The GAO found very strong and consistent evidence that HMOs experienced favorable selection, much of which was associated with disproportionately low enrollment by beneficiaries with chronic conditions. Overall, beneficiaries who remained in the FFS sector had monthly Medicare expenditures of $280, compared to only $198 for those who enrolled in HMOs--a difference of 40 percent. Among those with "no conditions," 18.4 percent enrolled in Medicare HMOs. These enrollees had average 1992 Medicare expenditures of $81 per month. In comparison, those with one chronic condition had enrollment rates of just 14.9 percent (19 percent lower than nonenrollees) but monthly expenditures of $224 (177 percent higher), and those with two or more conditions had enrollment rates of 13.4 percent (27 percent lower) but monthly expenditures of $580 (616 percent higher). In addition, among beneficiaries who disenrolled from HMOs within six months, 58 percent had one or more chronic conditions, compared to only 42 percent among those that remained in HMOs.

Not all the favorable selection was associated with the prevalence of chronic conditions, however, as there were also large differences in average expenditures between HMO and FFS beneficiaries with the same number of conditions. Among those with no conditions, for example, prior-year expenditures for those in FFS were $117 per month, compared to $81 for those enrolling in HMOs, a difference of nearly 45 percent. Among those with a single condition, this difference was about 23 percent ($275 for FFS, compared to $224 for HMOs), and among those with two or more conditions, this difference was about 19 percent ($692, compared to $580).

Given these results, it seems almost certain that our CHSF-I adjuster (as well as the AAPCC adjuster) would generate substantial overpayments to HMOs. In particular, by pooling all beneficiaries without a history of CHSF to form a single set of rates, the adjuster does not distinguish between the high-cost beneficiaries with one of these chronic conditions and the generally low-cost beneficiaries without a condition. Since beneficiaries with a chronic condition are less likely than those without such conditions to enroll in HMOs, HMOs experience favorable selection, and the CHSF-I adjuster thus would overpay plans. In fact, while the amount of the overpayment depends on the extent of risk adjustment and other factors, each "extra" no-condition beneficiary enrolled by plans could easily return a surplus of 150 percent of the actuarially fair rate--even if HMOs were no more efficient than FFS Medicare.[3]

By refining the CHSF-I adjuster to include a separate set of payment rates for those with a chronic condition, the resulting "CHSF-CC" adjuster should reduce this potentially large source of overpayment. While it may fail to account fully for possible differences between enrollees and nonenrollees in the severity of illness among those with such conditions, adjusting for differences in the prevalence of these conditions should reduce the overpayment.

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[3]For the entire GAO sample, average 1992 monthly expenditures were $328, compared to only $127 for those with no conditions. Assuming that HMOs were simply paid the sample average, each no-condition beneficiary would yield an expected return of $201 ($328 - $127) or 158 percent of the amount they are expected to cost ($127). This return is fairly consistent across age groups; among those 65 to 69, for example, it would be about $141 ($237 - $96), or 147 percent. Thus, the fact that the AAPCC adjusts for age does not reduce the amount of overpayment for those with no condition (but does account somewhat for HMOs' lower proportion of cases with conditions).

B. SAMPLES

We form the CHSF-CC adjuster from three distinct samples:

1. The CHSF sample that includes Medicare beneficiaries with a history of CHSF hospital discharges (or hospital outpatient treatment for lung cancer or prostate cancer) from 1989 through 1992. This sample is the one used to construct rates for the CHSF-I adjuster discussed in Chapter III.

2. The "chronic-condition" sample that includes beneficiaries who received medical care for hypertension, diabetes, COPD, or selected heart conditions in 1992 *and* who do not fall into the CHSF sample.

3. The "no-condition" sample that includes all remaining beneficiaries. This sample is identical to the one used for the CHSF-I adjuster, except that it excludes beneficiaries falling into the (new) chronic-condition sample.

In this section, we provide details only on the chronic-condition sample, since it forms the basis for refining the CHSF adjuster. For a discussion of the other two samples, see Section B of Chapter III.

1. Selection of Diseases for the Chronic-Condition Sample

The GAO (1997) report identifies the general conditions--hypertension, diabetes, COPD, and heart conditions--that we use to form the chronic-condition sample. Within these conditions, however, we selected the associated ICD-9 codes through the same procedure used for the CHSF sample. Specifically, we evaluated each ICD-9 code on three criteria: (1) administrative feasibility/verifiability, (2) predictive power, and (3) gameability. We then selected only those codes that "scored" high on each criterion.

The ICD-9 codes we selected, shown in Table IV.1, differ somewhat from those used by the GAO. Specifically, the GAO includes three additional ICD-9 codes related to hypertension, excludes asthma from the diagnoses related to COPD, and includes two additional diagnoses for "heart conditions." Both the GAO and this study use the same general ICD-9 for diabetes mellitus (250).

TABLE IV.1

SELECTION OF ICD-9s FOR CHRONIC CONDITIONS

List of ICD-9s by General Condition	Used for CHSF-CC Adjuster	Used for GAO Study[a]	Percentage of Population[b]
Hypertension			
401 - Essential Hypertension	x	x	29.2
402 - Hypertensive Heart Disease		x	3.1
403 - Hypertensive Renal Disease		x	0.1
404 - Hypertensive Heart and Renal Disease		x	0.1
405 - Secondary Hypertension		x	0.1
437.2 - Hypertensive Encephalopathy		x	0.1
Diabetes Mellitus			
250 - Diabetes Mellitus	x	x	10.8
COPD			
491 - Chronic Bronchitis	x	x	1.7
492 - Emphysema	x	x	1.2
493 - Asthma	x		2.6
496 - Chronic Airway Obstruction, Not Elsewhere Classified	x	x	5.8
Heart Conditions			
410 - Acute Myocardial Infarction	x	x	1.2
411 - Other Acute and Subacute Forms of Ischemic Heart Disease	x	x	1.9
412 - Old Myocardial Infarction		x	0.7
413 - Angina	x	x	4.4
414 - Other Forms of Chronic Ischemic Heart Disease		x	12.8
428 - Congestive Heart Failure	x	x	6.6

[a]GAO (1997): The list of ICD-9s used by GAO comes from phone contacts with the authors.

[b]Based on one or more claims in the 1992 Standard Analytical File (SAF), Part B payment, containing an ICD-9 shown.

We use a single ICD-9 code related to hypertension (401--essential hypertension) largely because of concerns about the gameability of the remaining diagnoses. Specifically, all the other diagnoses for hypertension are related to more serious conditions with which hypertension may be associated. Thus, including them could substantially increase the rate for hypertension and increase the potential for overpayment if HMOs attract a less-than-representative share of these severe cases. In addition, essential hypertension is by far the most common diagnosis, making the exclusion of the remaining codes of little importance to the overall predictive accuracy of our adjuster. Among those without a history of CHSF, for example, about 93 percent of beneficiaries who have one or more ambulatory visits for hypertension have at least one claim with a corresponding ICD-9 code of 401.[4] Of the remaining beneficiaries with hypertension, nearly all (about 92 percent) have a diagnosis of 402 (hypertensive heart disease). Since most of these beneficiaries would be picked up in the (higher-cost) "heart conditions" category, including this additional diagnosis here would add little to overall predictive accuracy.[5]

We use four ICD-9 codes related to COPD--491 (chronic bronchitis), 492 (emphysema), 493 (asthma), and 496 ("other" forms of COPD). Each of these conditions is fairly prevalent among Medicare recipients and is associated with high future medical expenditures. The GAO used the same codes, except that it excluded 493 (asthma) because it viewed this diagnosis as less important to those age 65 and older. We include it, however, because of its prevalence. Several other codes, not listed in Table IV.1, also fall under a broad definition of COPD but are excluded by both the

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[4]This estimate is based on the Part B payment records from the SAF for 1992.

[5]It could be argued that excluding the ICD-9 code for hypertensive heart disease, 402, does not allow differentiation of the potentially higher expenditures of those with both a heart condition and hypertension. However, as discussed later, hypertension is found to add nothing to expenditures of those with another chronic condition.

GAO and this study. The ICD-9 code for bronchitis, 490, reflects an acute condition likely to be unrelated to future medical costs. The remaining ICD-9 codes, including 494 (bronchiectasis) and 495 (extrinsic allergic alveolitis) reflect very uncommon diagnoses (at least among those on Medicare) and thus would add little to the predictive accuracy of our adjuster.

The heart conditions that we examine for the chronic-condition adjuster are 410 (acute myocardial infarction), 411 (other acute and subacute forms of ischemic heart disease), 413 (angina), and 428 (congestive heart failure). Except for angina, all these diagnoses overlap with those used for the CHSF sample. We include them for the chronic-condition sample as well because they may be manifested in subacute forms that do not necessarily lead to a hospitalization but do predict high future medical expenditures. We include angina (413) because it is an additional chronic (heart) condition that is fairly common and has valuable predictive accuracy. Gameability is something of a concern for this condition, however, and it may be necessary to rely on clear-cut indicators for verifiability. Two other conditions used by the GAO (but not this study) are old myocardial infarction (412) and "other forms of chronic ischemic heart disease" (414). We exclude them because any beneficiaries who had been hospitalized for myocardial infarction or ischemic heart disease in the past four years would be in the CHSF rate cells, so remaining cases are unlikely to be strongly associated with prospective costs. In addition, the former condition is rare, while the latter lacks diagnostic verifiability, making it difficult to monitor.

2. Formation of the Chronic-Condition Sample

We drew our chronic-condition sample from the 1992 CMHS, a random five percent sample of Medicare beneficiaries that is followed over time. We include only beneficiaries who (1) were living on January 1, 1993, and enrolled in Medicare Parts A and B at some time during 1993; (2) were not enrolled in a Medicare managed care plan between January 1992 and December 1993 (or until death

if died in 1993); (3) had Medicare as their primary payer from 1992 to 1994; and (4) were not entitled due to ESRD. In order to refine the bill records data in the CMHS, we then match this sample with claims data from the 1992 Part B physician/supplier SAF. Chapter II provides details on the CMHS and the SAF, as well as the methods used to match the two files.

For each beneficiary, we obtain a count of medical visits for a given condition by summing across all bill records that (1) contained a service code of "medical care," and (2) list at least one of the ICD-9 codes (shown in Table IV.1) for that condition. We use all the global diagnoses recorded on claims to determine the number of visits each beneficiary received for each condition. In order to avoid double-counting, we count each claim as no more than one visit per condition regardless of the number of medical care services coded on the claim. However, since a single visit may reflect services for more than one condition, a single claim is coded as a visit for every condition recorded on the claim. Thus, while a beneficiary cannot be credited with multiple visits for a given condition based on a single bill, it is possible for one bill to indicate the presence of multiple conditions.

The overall frequency of chronic conditions among non-CHSF beneficiaries depends on the criterion that we use to assign a condition to a patient (Table IV.2). If we consider one or more visits during 1992 to be sufficient evidence that a patient had a particular condition, nearly 40 percent of all non-CHSF beneficiaries have at least one condition. This rate drops sharply to 26 percent if we require beneficiaries to have at least two visits, and it falls to 18 percent under a criterion of three or more visits. Regardless of the criterion used, hypertension is easily the most common condition among those without a history of CHSF, followed by diabetes, COPD, and heart conditions. Under

TABLE IV.2

SAMPLE STATISTICS FOR SELECTED CONDITIONS AMONG THE NON-CHSF MEDICARE POPULATION, DEFINED BY NUMBER OF PHYSICIAN MEDICAL VISITS

Condition	(Number of Visits in 1992)	Sample Size	Percentage of Beneficiaries, 1993[a]	Mean Reimbursement per Month, 1993	Standard Deviation	Coefficient of Variation
Hypertension	0	940,773	72.4	246	768	3.12
	1	130,342	10.0	298	873	2.93
	2	79,950	6.2	295	838	2.84
	3 or more	147,727	11.4	335	896	2.67
Diabetes	0	1,178,038	90.7	248	765	3.09
	1	32,519	2.5	362	979	2.70
	2	20,875	1.6	379	926	2.45
	3 or more	67,360	5.2	480	1,135	2.36
COPD	0	1,200,946	92.5	247	754	3.05
	1	42,563	3.3	385	1,029	2.67
	2	18,454	1.4	418	1,004	2.40
	3 or more	36,829	2.8	616	1,450	2.35
Heart Condition	0	1,217,785	93.8	249	762	3.06
	1	41,286	3.2	467	1,100	2.36
	2	17,190	1.3	494	1,195	2.42
	3 or more	22,531	1.7	574	1,392	2.42
Any Condition	0	795,763	61.3	209	685	3.27
	1	163,697	12.6	294	834	2.84
	2	104,401	8.0	306	829	2.71
	3 or more	234,931	18.1	408	1,059	2.59

SOURCE: Continuous Medicare History Sample (five percent sample; excluding HMO enrollees). Visit counts determined from Standard Analytical File (SAF), Part B payments. Sample size is 1,298,792.

[a] We measure reimbursements over months living and not in an HMO during 1993 for beneficiaries in each cell.

a one-visit criterion, about 28 percent of all non-CHSF beneficiaries have hypertension, while the frequencies of the other conditions are between 6 and 10 percent.[6]

Consistent with the GAO findings, medical costs for beneficiaries with a given condition are well in excess of those without that condition, regardless of the visit criterion used. Among those with just one visit associated with hypertension, for example, next-year medical costs are about $52 (20 percent) higher than the cost of those with no visits associated with hypertension. For all other conditions, the difference in costs between those with no visits and those with just one visit are even higher, ranging from $114 (46 percent) for diabetes to $218 (87 percent) for heart conditions.

Perhaps surprisingly, the difference in 1993 costs for beneficiaries depends very little on whether they had only one or only two visits in 1992 for a given condition. For beneficiaries with one visit for any of our conditions, average monthly costs in 1993 were $294. This is $85 (40 percent) more than the average costs among those with no conditions ($209), but it is only $12 less than those with two visits for any of our conditions ($306). However, there is a substantial increase in costs for those with three or more visits.

Based on these results, we use a criterion of one (or more) medical visits to create the chronic-condition sample. By doing so, we place the largest possible number of beneficiaries into high payment cells that are much more reflective of their average costs. In addition, by removing the maximum number of high-cost beneficiaries from the no-condition sample, the payment cells for those remaining in this group should be more reflective of their (lower) actual costs.

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[6]The incidence of heart conditions is low by this measure, primarily because most individuals receiving treatment for a heart problem would have been hospitalized in the past four years and therefore are classified in the CHSF sample.

The resulting chronic-condition sample contains about 33 percent of all Medicare beneficiaries.[7] Thus, when combined with the chronic-condition sample (comprising about 15 percent of beneficiaries), the CHSF-CC adjuster places about 48 percent of all beneficiaries into payment cells defined by medical conditions. The remaining 52 percent of beneficiaries fall into the no-condition group, a substantial decline from the 86 percent who do so under the CHSF adjuster.

C. CREATION OF THE PAYMENT RATES

In this section, we discuss the creation of the payment rates for beneficiaries in the chronic-condition sample. For beneficiaries in the other two groups (those with a history of CHSF, or those with no conditions), we form the payment rates in precisely the same manner as we did for the CHSF-I adjuster.[8] See Section C of Chapter III for further details.

1. Accounting for the Number of Medical Visits

In calculating payment rates for chronic conditions, we do not create separate rates based on the number of visits a patient receives for the condition. The statistics from Table IV.2 indicate that average costs for a given chronic condition rise as the number of (prior-year) visits increases, which is consistent with higher visits reflecting greater severity. While the difference in costs is fairly small between beneficiaries with one visit and those with two visits (the bulk of the chronic-condition sample), we could improve the accuracy of our adjuster by allowing the payment rates to differ for those with three or more visits. The drawback to this approach, however, is that it

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[7]It includes 39 percent of the non-CHSF group, which comprises 85 percent of all beneficiaries.

[8]The payment rates for the CHSF group are identical to those presented in Chapter III, since that sample is unchanged under the CHSF-CC adjuster. Payment rates for the no-condition group are recalculated for the CHSF-CC adjuster, excluding from the estimate those beneficiaries treated for a chronic condition in 1992.

introduces a major opportunity to "game" the rate structure by providing an excessive number of visits for a given condition and rewards inefficient care.[9] Thus, despite its potential benefits, we ignore the visit count in constructing payment rates for those with a chronic condition.

Although the condition-specific rates are calculated over all persons with at least one visit for the included conditions, we suggest requiring plans to provide at least two visits to receive the higher payment associated with a given condition. Since the payment would reflect an average across all levels of severity, ignoring the visit count could lead to very large overpayments for someone being assigned a given condition as a result of coding error (accidental or intentional) or routine testing for a particular disease. The solution that we propose is to require a plan to provide two (or more) visits for a given condition in order to obtain the chronic-condition payment. This approach makes these rates far less gameable or otherwise subject to error, because recording an inappropriate diagnosis on two visits for a beneficiary without that condition is far less likely to occur than miscoding on only one visit. Moreover, by imposing this restriction, we create the incentive for plans to provide at least the minimum number of visits per year (two) recommended for a beneficiary with any of these conditions (Steven et al. 1995).[10] Alternatively, the one-visit rule could be used if coupled with close monitoring of reported rates of different diagnoses.

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[9]The number of visits for a given condition could be raised in several ways, including overprovision of services, splitting services into multiple visits, or miscoding bill records.

[10]In an ongoing program, the use of a two-visit minimum may lead to underpayment, since many of those in the one-visit group may have a condition but would be treated (for purposes of payment) as if they had no condition. Given the incentive structure of the CHSF-CC adjuster, however, we would expect that beneficiaries with a condition would almost all receive two or more visits soon after implementation.

2. Determining the Set of Unique Condition Cells

Taking all possible comorbidities into account, there are a total of 15 unique "condition cells" that we can construct from the four basic conditions used to form the sample (Table IV.3). However, since many of these cells may have small sample sizes or similar costs, we consider whether to combine cells and create a smaller set of payment rates for beneficiaries with one or more of our chronic conditions.

The four cells corresponding to single conditions reflect the vast majority of beneficiaries in the chronic-condition group. The cell for hypertension accounts for almost half the enrollment months.[11] The remaining single condition cells account for an additional 25 percent. For the remaining 26 percent of beneficiaries--those with multiple chronic conditions--about three out of four enrollment months fall into cells that have hypertension as the only comorbidity. All remaining cells are small, containing from 0.2 to 1.4 percent of total enrollment months.

A key result from Table IV.3 is that hypertension adds nothing to average costs among beneficiaries with at least one other condition. In fact, for beneficiaries with diabetes or COPD, those who have hypertension as a comorbidity have slightly *lower* average costs than those without this comorbidity. This suggests that hypertension can be effectively ignored except as a single condition, reducing the number of condition cells from 15 to 8.

After the cells with and without hypertension as a comorbidity are combined (Table IV.4), the remaining (eight) cells each include at least 2,400 beneficiaries in the CMHS sample, comprising at least 0.5 percent of total enrollment months for the chronic-condition sample. Not surprisingly, the cell with the highest average cost (about $792) includes beneficiaries with all three conditions--

[11]This reflects the number of months that beneficiaries were living and in FFS Medicare during 1993.

TABLE IV.3

SAMPLE STATISTICS FOR THE CHRONIC CONDITIONS
USED IN THE CHSF-CC ADJUSTER[a]

Condition	Sample Size	Percentage of Beneficiaries, 1993[a]	Mean Reimbursement per Month, 1993	Standard Deviation	Coefficient of Variation
Single Condition					
Hypertension Only	241,975	48.1	253	732	2.89
Diabetes Only	48,290	9.6	392	949	2.42
COPD Only	49,527	9.8	432	1,104	2.55
Heart Condition Only	29,374	5.8	429	1,045	2.44
Two Conditions					
Hypertension and Diabetes	48,021	9.5	382	989	2.59
Hypertension and COPD	25,118	5.0	421	1,142	2.71
Hypertension and Heart Condition	24,658	4.9	433	1,073	2.48
Diabetes and COPD	4,708	0.9	576	1,331	2.31
Diabetes and Heart Condition	5,578	1.1	614	1,436	
COPD and Heart Condition	6,451	1.3	668	1,480	2.22
Three Conditions					
Hypertension, Diabetes, and COPD	4,383	0.9	542	1,115	2.06
Hypertension, Diabetes, and Heart Condition	7,287	1.4	592	1,226	2.07
Hypertension, COPD, and Heart Condition	5,172	1.0	664	1,522	2.29
Diabetes, COPD, and Heart Condition	1,082	0.2	791	1,912	2.42
All Four Conditions	1,405	0.3	795	1,772	2.23
Any Condition	503,029	100.0	349	946	2.71

SOURCE: Continuous Medicare History Sample (five percent sample; excluding HMO enrollees). Chronic conditions identified from Standard Analytical File (SAF), Part B payments.

[a]Among those beneficiaries who have at least one physician visit for one of our four chronic conditions in 1992, and who do not fall into any of the CHSF cells for being hospitalized in the past four years.

TABLE IV.4

SAMPLE STATISTICS FOR THE CHRONIC CONDITIONS
USED IN THE CHSF-CC ADJUSTER

Condition	Sample Size	Percentage of Beneficiaries, 1993	Mean Reimbursement per Month, 1993	Standard Deviation	Coefficient of Variation
Chronic-Condition Sample Only					
Hypertension Only	241,975	48.1	253	732	2.89
Diabetes Only[a]	96,311	19.1	387	969	2.50
COPD Only[a]	74,645	14.8	428	1,117	2.61
Heart Condition Only [a]	54,032	10.7	431	1,058	2.46
Diabetes and COPD	9,091	1.8	560	1,232	2.20
Diabetes and Heart Condition	12,865	2.6	602	1,321	2.20
COPD and Heart Condition	11,623	2.3	666	1,499	2.25
Diabetes, COPD, and Heart Condition	2,487	0.5	793	1,834	2.31
Any Condition	503,029	100.0	349	946	2.71
All Beneficiaries					
Chronic-Condition Sample	503,029	33.0	349	946	2.71
CHSF Sample	223,776	14.7	692	1,405	2.03
No-Condition Sample	795,763	52.3	209	686	3.28
All Beneficiaries	1,522,568	100.0	327	927	2.83

SOURCE: Continuous Medicare History Sample (five percent sample; excluding HMO enrollees). Chronic conditions identified from Standard Analytical File (SAF), Part B payments.

NOTE: A substantial fraction of those with diabetes, COPD, or heart condition also have hypertension as a comorbidity. We do not distinguish these individuals.

diabetes, COPD, and heart condition. Those with COPD and heart condition have the next highest cost ($666), followed by diabetes and heart condition ($602), and diabetes and COPD ($560). Among the single-condition cells,[12] heart condition has the highest average cost ($431), followed by COPD ($428), diabetes ($387), and hypertension ($253). All these costs are well in excess of the average cost among beneficiaries with no conditions ($209); however, only the cell for all three conditions has a higher average cost ($793) than those with a history of CHSF ($692).

3. Incorporating Demographic Information

As we did for the CHSF and no-condition samples (See Section B of Chapter III), we refine each of the eight chronic-condition cells using the following demographic information--gender, age, reason for entitlement, and Medicaid coverage. Starting from the least restrictive model, a complete interaction of all demographic characteristics,[13] we applied two general criteria to determine the most appropriate specification for the final payment rates. First, we looked for similar trends in the individual rates, which suggested that the number of interactions might be reduced. Second, we identified cases where cells should be combined because of redundant payment rates or overfitting.

Through this process, we settled on using a fairly simple regression model to determine the payment rates for those with chronic conditions. The dependent variable in the regression is the total monthly cost per Medicare beneficiary in 1993, which is the sum of Part A and Part B payments divided by the overall average monthly Medicare cost for all beneficiaries nationally in 1993. The independent variables include a total of 21 binary variables comprising our eight chronic-condition

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[12]These may include hypertension as a comorbidity.

[13]For each condition, this leads to a total of 60 separate payment cells--40 for beneficiaries whose original reason for entitlement is disabled (10 age groups × 2 gender categories × 2 Medicaid status categories); and 20 for beneficiaries whose original reason for entitlement is age (5 age groups × 2 gender categories × 2 Medicaid status categories).

indicators, 10 age groups, gender, Medicaid status, and original reason for entitlement.[14] There is only one interaction term, a binary variable equal to the product of binary variables for gender and original reason for entitlement, which is used to account for distinctly different trends in costs between groups defined by these characteristics.[15] Observations are weighted by the number of months in 1993 over which their mean monthly cost was calculated (months living and in Medicare FFS).

D. PROSPECTIVE RATES[16]

This section discusses the prospective rates for those with a chronic condition derived from the regression model specified in Section C. In addition, we present revised rates for the no-condition group, which reflect the removal of the chronic-condition sample. The rates for those with a history of CHSF are not discussed here, since they are unchanged from the base adjuster; see Section D of Chapter III for further details.

1. Rates for the Chronic-Condition Group

The regression model used to determine the chronic-condition rates leads to a fairly simple rate structure. For any beneficiary with a given set of demographic characteristics (age, gender, Medicaid status, and original reason for entitlement), there are eight unique payment rates, one for each of the combinations of chronic conditions specified in Table IV.4. From this "base" rate, any

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[14]For identification, we drop one age group variable (65 to 69) and one condition variable (hypertension) from the model.

[15]For beneficiaries whose original reason for entitlement is age, males have uniformly higher costs than women, regardless of age or condition. For beneficiaries whose original reason for entitlement is disability, however, we find no difference by gender.

[16]The rates presented in this section do not account for adjustments based on the county AAPCC, which would be used to determine the final beneficiary rate.

differences in demographic characteristics lead to changes in the payment that are constant across conditions.

The rate factors, shown for single conditions in Table IV.5 and multiple conditions in Table IV.6, capture the dramatic variance in costs described previously.[17] Beneficiaries with hypertension as their only condition have by far the lowest payment factors. They range from 53 percent below the mean (0.47)--for females, age 65 to 69, who aged onto Medicare--to 55 percent above the mean (1.55) for females, 85 and older, whose original reason for entitlement is disability. For the other single conditions, the factors are much higher than for hypertension, and they are almost always above the overall average (1.00). For example, among Medicare beneficiaries currently or originally entitled because of disability, those with diabetes, COPD, or heart conditions have factors ranging from 28 percent to 105 percent higher than the average overall.

The payment factors for multiple chronic conditions (other than hypertension), shown in Table IV.6, are often dramatically higher than the factors for single conditions. For males, all factors are at least 50 percent higher than the overall average, while for females, they are at least 35 percent higher. Among "pairs" of conditions, COPD and heart condition have the highest cost factors--usually more than twice the overall average. For all three conditions, the payment factors are anywhere from two to three times the overall average.

There are several large differences in rates across demographic groups. For beneficiaries under age 65, the rates fall sharply with age and then rise by a small amount. This U-shaped pattern is consistent with the raw data, and it may reflect greater severity in conditions among those classified

[17]The rate factors shown in Table IV.5 and IV.6 are for beneficiaries not on Medicaid. For those with Medicaid coverage, add 0.12 to the factors shown.

TABLE IV.5

RATE FACTORS FOR BENEFICIARIES WITH SINGLE CHRONIC CONDITIONS

Age Group	Hypertension	Diabetes[a]	COPD[a]	Heart Condition[a]
Males				
Disabled Medicare Beneficiaries				
Younger than 35	1.30	1.69	1.80	1.74
35 to 44	1.09	1.48	1.59	1.53
45 to 54	0.89	1.28	1.39	1.33
55 to 59	0.92	1.31	1.42	1.36
60 to 64	0.96	1.35	1.46	1.41
Aged Beneficiaries--Original Entitlement Due to Disability				
65 to 69	0.96	1.35	1.46	1.41
70 to 74	1.07	1.46	1.57	1.52
75 to 79	1.23	1.62	1.73	1.67
80 to 84	1.36	1.75	1.87	1.81
85 and older	1.54	1.93	2.05	1.99
Aged Beneficiaries--Original Entitlement Due to Age				
65 to 69	0.63	1.02	1.13	1.07
70 to 74	0.74	1.13	1.24	1.18
75 to 79	0.89	1.28	1.40	1.34
80 to 84	1.03	1.42	1.53	1.48
85 and older	1.21	1.60	1.71	1.66
Females				
Disabled Medicare Beneficiaries				
Younger than 35	1.30	1.69	1.81	1.75
35 to 44	1.09	1.48	1.59	1.54
45 to 54	0.89	1.28	1.39	1.34
55 to 59	0.92	1.31	1.43	1.37
60 to 64	0.97	1.36	1.47	1.41
Aged Beneficiaries--Original Entitlement Due to Disability				
65 to 69	0.97	1.36	1.47	1.41
70 to 74	1.08	1.47	1.58	1.52
75 to 79	1.23	1.62	1.74	1.68
80 to 84	1.37	1.76	1.87	1.82
85 and older	1.55	1.94	2.05	2.00
Aged Beneficiaries--Original Entitlement Due to Age				
65 to 69	0.47	0.86	0.97	0.92
70 to 74	0.58	0.97	1.08	1.03
75 to 79	0.74	1.12	1.24	1.18
80 to 84	0.87	1.26	1.37	1.32
85 and older	1.05	1.44	1.55	1.50

NOTE: Calculated as the predicted 1993 cost for each cell, based on a regression model, divided by the mean costs over all individuals. The factors shown are for non-Medicaid beneficiaries. For Medicaid beneficiaries, add 0.12 to the rate shown for any cell.

[a] Cells include those with hypertension as a comorbidity.

TABLE IV.6

PAYMENT RATES FOR BENEFICIARIES WITH MULTIPLE CHRONIC CONDITIONS[a]

Age Group	Diabetes and COPD	Diabetes and Heart Condition	COPD and Heart Condition	Diabetes, COPD, and Heart Condition
Males				
Disabled Medicare Beneficiaries				
Younger than 35	2.18	2.29	2.46	2.86
35 to 44	1.97	2.08	2.25	2.65
45 to 54	1.77	1.88	2.05	2.45
55 to 59	1.80	1.91	2.08	2.48
60 to 64	1.85	1.95	2.13	2.52
Aged Beneficiaries--Original Entitlement Due to Disability				
65 to 69	1.85	1.95	2.13	2.52
70 to 74	1.95	2.06	2.23	2.63
75 to 79	2.11	2.22	2.39	2.79
80 to 84	2.25	2.35	2.53	2.93
85 and older	2.43	2.53	2.71	3.11
Aged Beneficiaries--Original Entitlement Due to Age				
65 to 69	1.51	1.62	1.79	2.19
70 to 74	1.62	1.73	1.90	2.30
75 to 79	1.78	1.88	2.06	2.46
80 to 84	1.92	2.02	2.20	2.59
85 and older	2.10	2.20	2.38	2.78
Females				
Disabled Medicare Beneficiaries				
Younger than 35	2.19	2.29	2.47	2.87
35 to 44	1.98	2.08	2.26	2.66
45 to 54	1.78	1.88	2.06	2.46
55 to 59	1.81	1.91	2.09	2.49
60 to 64	1.85	1.96	2.13	2.53
Aged Beneficiaries--Original Entitlement Due to Disability				
65 to 69	1.85	1.96	2.13	2.53
70 to 74	1.96	2.07	2.24	2.64
75 to 79	2.12	2.22	2.40	2.80
80 to 84	2.26	2.36	2.54	2.93
85 and older	2.44	2.54	2.72	3.12
Aged Beneficiaries--Original Entitlement Due to Age				
65 to 69	1.35	1.46	1.63	2.03
70 to 74	1.46	1.57	1.74	2.14
75 to 79	1.62	1.72	1.90	2.30
80 to 84	1.76	1.86	2.04	2.44
85 and older	1.94	2.04	2.22	2.62

[a] Calculated as the predicted cells costs in 1993 divided by the mean costs over all individuals. The factors shown are for non-Medicaid beneficiaries. For Medicaid beneficiaries, add 0.12 to the rate shown for any cell. Conditions listed may include hypertension as a comorbidity.

as disabled at a relatively young age. Above age 64, the rates increase uniformly, as we would expect. Disability (rather than age) as the original reason for entitlement adds about 0.33 to the rate factor for males of a given age and 0.50 to the rate factor for females. Finally, Medicaid coverage adds 0.12 to the rates shown in the two tables.

2. Rates for the No-Condition Group

As expected, the rates for beneficiaries with no conditions are low (Table IV.7). The rate factors range from 0.50 to 1.19 for males, and 0.40 to 1.15 for females, with each factor substantially below an equivalent beneficiary with a chronic condition. The lowest rate (0.40) is for females, age 65 to 69, without Medicaid, and whose original reason for entitlement is age. (Coincidentally, this is also the largest single payment cell, comprising about 17 percent of those with no conditions.) This is less than half the rate for females of this age who have diabetes, COPD, or heart problems. Differences by Medicaid status are more pronounced among those with no conditions, particularly for beneficiaries whose original reason for entitlement is age. For those age 65 to 69, for example, Medicaid coverage adds 51 percent to the rate factor for females whose original reason for entitlement is age and 81 percent for males. The U-shaped pattern for age groups under 65 found in the chronic-condition group also exists in the no-condition group, but only for males without Medicaid. Above age 65, the rates increase or remain constant with age, with a number of rate factors exceeding 1.0 for those age 75 and above.

E. PREDICTIVE ACCURACY

In Chapter III, we showed that the CHSF-I adjuster performs only slightly better than the AAPCC adjuster in predicting the costs of various groups of Medicare beneficiaries, most

TABLE IV.7

PAYMENT RATES FOR BENEFICIARIES WITH NO CONDITIONS[a]

	Non-Medicaid		Medicaid	
Age Group	Males	Females	Males	Females
Disabled Medicare Beneficiaries				
Younger than 35	0.69	0.63	0.84	0.83
35 to 44	0.64	0.75	0.84	0.83
45 to 54	0.64	0.75	0.84	0.83
55 to 59	0.64	0.75	0.84	0.83
60 to 64	0.74	0.81	0.92	0.90
Aged Beneficiaries--Original Entitlement Due to Disability				
65 to 69	0.74	0.86	0.92	0.90
70 to 74	0.82	1.02	0.92	1.02
75 to 79	0.99	1.07	1.05	1.15
80 and older	1.14	1.07	1.05	1.15
Aged Beneficiaries--Original Entitlement Due to Age				
65 to 69	0.50	0.40	0.75	0.72
70 to 74	0.57	0.47	0.75	0.72
75 to 79	0.73	0.61	0.99	0.87
80 to 84	0.88	0.78	1.08	0.95
85 and older	1.11	1.01	1.19	1.09

[a]Calculated as the mean cells costs in 1993 divided by the mean costs among all individuals. When cell sizes are very small, adjacent age groups have been combined to smooth the results and avoid anomalous estimates.

importantly those associated with favorable selection by Medicare MCOs. In this section, we now compare the predictive accuracy of the CHSF-CC adjuster to the AAPCC-CC and CHSF-I adjusters.

We set payment rates for a given beneficiary equal to the product of the beneficiary cost factor from Tables IV.5 through IV.7 and the county AAPCC rate. This approach fails to adjust the county rates for differences across counties in the incidence of our CHSF-CC conditions. However, making such changes would have little effect on most county rates or on our overall results.

1. Accuracy of the CHSF-CC Adjuster for Biased Subgroups: CMHS Data

We first assess the accuracy of the CHSF-CC adjuster by comparing mean payments to actual mean costs for various biased subgroups defined from the CMHS (Medicare's five percent sample). These comparisons are displayed in Table IV.8. The predicted rates for the three adjusters are normalized so that each accurately predicts overall mean reimbursement, since they should do so on average for a representative set of beneficiaries.

Not surprisingly, the CHSF-CC (like the CHSF-I adjuster) performs well when the sample is split by categories on which the rates are explicitly defined, but it performs poorly (though better than the AAPCC) for categories defined by actual 1993 expenditure levels. For those with chronic conditions (but no history of CHSF), the CHSF-CC predicts average costs accurately, while the AAPCC adjuster underpredicts only slightly. Among those with no conditions, the CHSF-CC adjuster again predicts costs well, while the AAPCC overpredicts by 46 percent. As expected, the CHSF-I adjuster also overpredicts costs of those with no conditions (by 21 percent), and it underpredicts costs for those with chronic conditions (by 21 percent). For groups defined by Medicaid status or original reason for entitlement, the payment rates under the CHSF-CC (and CHSF-I) are accurate, while the AAPCC performs nearly as well for the former but poorly for the

TABLE IV.8

PREDICTIVE ACCURACY, FIVE PERCENT SAMPLE (CMHS)
(1993 Costs)

	Number of Cases	Percentage of FFS Population	Predictive Ratio			Mean Absolute Deviation			Mean Squared Error		
			CHSF-CC	CHSF-I	AAPCC	CHSF-CC	CHSF-I	AAPCC	CHSF-CC	CHSF-I	AAPCC
Overall	1,484,932	100.0	100	100	100	396	402	421	802,568	808,963	842,050
Subgroups											
Type of Conditions											
CHSF	218,126	14.7	101	101	54	728	728	652	1,892,153	1,892,206	2,089,794
Chronic	490,326	33.0	100	79	97	425	392	425	843,304	858,074	856,379
None	776,480	52.3	99	122	146	285	317	353	471,013	473,644	483,731
Died in 1993											
Yes	71,796	4.8	26	25	18	1,790	1,802	1895	13,279,108	13,364,884	14,051,550
No	1,413,136	95.2	116	116	118	358	363	380	455,759	459,947	474,867
Medicaid											
Yes	182,485	12.3	101	101	97	462	468	478	709,714	717,163	743,767
No	1,302,447	87.7	100	100	101	387	392	413	815,833	822,077	856,091
Original Reason for Entitlement											
Disabled	230,795	15.5	100	100	75	477	485	458	1,174,016	1,184,175	1,245,911
Aged	1,254,137	84.5	100	100	106	382	387	414	735,096	740,807	768,690
Actual 1993 Reimbursement											
Lowest quintile	308,413	20.8	43,526	49,380	57,055	224	255	294	65,429	78,823	98,302
Second quintile	288,817	19.5	1,949	1,996	2,224	252	258	289	88,969	87,380	95,635
Third quintile	287,969	19.4	694	684	720	269	264	281	111,416	102,344	92,402
Fourth quintile	289,617	19.5	216	208	204	218	202	186	100,331	88,131	51,266
Highest quintile	310,116	20.9	33	32	26	1,018	1,029	,1053	3,647,166	3,688,562	3,873,037

NOTE: The predictive ratio is the ratio of average payment under the adjuster to average Medicare cost, multiplied by 100, for the subgroup of interest. MAD is the mean absolute deviation of payment from the actual cost. MSE is the mean squared error, the mean of the squared difference between predicted and actual cost.

latter. Finally, the CHSF-CC adjuster performs poorly, though considerably better than the AAPCC, for subgroups defined by 1993 expenditure quintiles and by whether the individual died in 1993.

While the AAPCC adjuster does predict well for the chronic-condition group, this result is largely accidental and does not suggest that the adjuster would predict well overall. The principal reason for the success of the AAPCC with this group is that the mean cost for beneficiaries with chronic conditions ($349) happens to be only slightly more than the mean overall ($327).[18] Thus, when the AAPCC combines beneficiaries with no conditions, chronic conditions, and CHSF into single rate cells, its ends up paying about the right amount (on average) for the chronic-condition beneficiaries. At the same time, however, the AAPCC substantially overpays on average for the no-condition beneficiaries within each cell, and it substantially underpays on average for the beneficiaries with CHSF. Therefore, while the AAPCC may pay about the right amount for chronic-condition beneficiaries, its overall accuracy will depend crucially on the ratio of no-condition enrollees to enrollees with a CHSF history remaining roughly equal to their ratio in FFS (3.56:1). Prior studies of biased selection suggest this is unlikely to occur.

Two other measures of predictive power, the mean square error (MSE) and mean absolute deviation (MAD), are consistent with the inferences from the predictive ratios. Among the various subgroups, the MSE and MAD under the CHSF-CC are often considerably lower (by 5 to 20 percent) than under the AAPCC. One noticeable exception is the MSE for those in the CHSF group, which is actually lowest under the AAPCC. This result, however, is misleading, because the predictive ratio of 54 for the AAPCC (versus 100 for the CHSF-I and CHSF-CC) clearly indicates that it performs very poorly for this group. Overall, the MAD and MSE for the CHSF-CC are about five to six percent lower than for the AAPCC, and they are about one percent lower than for the CHSF-I adjuster.

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[18]Recall that this group excludes anyone in the CHSF group.

2. Accuracy for Biased Subgroups: CBS Sample

The CBS sample provides a number of further categorizations on which to examine the effectiveness of the CHSF-CC adjuster (Table IV.9). For most of these categories, the CHSF-CC performs far better than the AAPCC, and it often noticeably outperforms the CHSF-I. Perhaps the best relative performance of the adjuster is in predicting the costs for beneficiaries categorized by expenditure quintiles in 1992. Not surprisingly, the CHSF-CC considerably underpredicts average costs for the highest expenditure quintile (75) and overpredicts costs for the lowest quintile (138); however, these predictions are considerably better than under the AAPCC (51 and 168, respectively) or the CHSF-I (73 and 152, respectively). The CHSF-CC also predicts costs better than the AAPCC for groups defined by self-reported health status, but not by much more than the CHSF-I.

For groups defined by types or counts of (self-reported) conditions, the CHSF-CC again outperforms the AAPCC and often the CHSF-I as well. Not surprisingly, the greatest improvement over the CHSF-I adjuster is for subgroups defined by chronic conditions. For example, while the CHSF-CC underpredicts the costs of those who say they have diabetes by 16 percent, the AAPCC and CHSF-I underpredict by far more (37 and 25 percent, respectively). For subgroups defined by counts of conditions, the relative performance of the CHSF-CC is even more noticeable. In particular, for those reporting no chronic conditions, the CHSF-CC overpredicts costs by 38 percent, but not by nearly as much as the AAPCC (81 percent) or the CHSF (55 percent).[19]

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[19]The CHSF-CC adjuster might be expected to be even more accurate than this, since chronic conditions are used to develop the rates. However, the chronic-condition measures used in this table are those self-reported by CBS respondents. Thus, they include individuals who had no claims for their chronic condition in 1992 and no hospital stay for it in the past four years. Only 13 percent report no chronic conditions on the CBS.

TABLE IV.9

PREDICTIVE ACCURACY, MCBS
(1993 Costs)

	Number of Cases	Percentage of FFS Population	Predictive Ratio			Mean Absolute Deviation			Mean Squared Error		
			CHSF-CC	CHSF-I	AAPCC	CHSF-CC	CHSF-I	AAPCC	CHSF-CC	CHSF-I	AAPCC
Overall	10,090	100.0	99	99	96	394	399	411	786,306	794,454	818,562
Subgroups											
Functional Impairments											
No impairments	5,766	63.2	113	114	117	334	340	354	658,340	665,795	674,386
IADL, no ADL impairments	2,441	21.6	95	93	80	445	449	441	807,797	815,650	854,247
One ADL impairment	540	4.8	89	86	73	486	494	516	734,265	744,260	846,646
Multiple ADL impairments	1,336	10.3	73	71	72	626	627	661	1,536,582	1,546,433	1600,728
Self-Rating of Health											
Excellent	3,916	41.3	134	140	149	298	309	326	461,196	464,065	463,354
Good	3,023	30.1	91	90	89	409	413	426	864,252	878,028	903,841
Fair/Poor	3,127	28.4	83	80	68	522	522	521	1,182,915	1,193,050	1,251,477
Serious and Chronic Conditions											
Cancer	1,753	17.7	106	106	86	419	424	408	783,438	786,723	803,480
No cancer	8,337	82.3	97	97	98	388	394	411	786,909	796,078	821,738
Heart problem	4,233	41.4	89	86	75	489	491	488	1,222,212	1,236,709	1,271,910
No heart problem	5,857	58.6	110	114	121	328	336	357	485,791	489,562	506,184
Stroke	1,202	11.1	93	92	79	506	509	511	827,965	830,230	890,119
No stroke	8,888	88.9	100	100	99	380	386	399	781,291	790,147	809,954
Hip Fracture	603	4.9	107	107	99	493	496	495	696,800	703,484	727,406
No hip fracture	9,487	95.1	98	98	95	389	395	406	790,772	798,993	823,108
Hypertension	4,946	50.1	94	92	86	422	423	429	878,518	885,730	918,317
No hypertension	5,144	49.9	104	107	107	365	376	392	694,005	703,090	718,643
Diabetes	1,526	15.5	84	75	63	540	524	529	1,350,978	1,370,925	1,435,621
No diabetes	8,564	84.5	103	106	106	367	377	389	684,539	690,560	707,284
COPD	1,355	13.4	86	78	69	480	473	486	1,190,075	1,205,029	1,275,162
No COPD	8,735	86.6	102	103	102	381	388	399	724,362	731,465	748,315
Arthritis	5,454	55.0	95	94	89	403	406	415	746,013	751,511	781,967
No arthritis	4,636	45.0	104	105	106	383	391	405	835,797	847,199	863,485

TABLE IV.9 *(continued)*

	Number of Cases	Percentage of FFS Population	Predictive Ratio			Mean Absolute Deviation			Mean Squared Error		
			CHSF-CC	CHSF-I	AAPCC	CHSF-CC	CHSF-I	AAPCC	CHSF-CC	CHSF-I	AAPCC
Number of Conditions											
None	1,422	13.3	138	155	181	268	289	327	390,350	395,935	421,772
One	2,256	22.9	109	114	122	328	339	356	589,754	595,382	604,833
Two	2,636	26.7	101	102	100	382	387	399	609,075	616,828	630,781
Three or more	3,776	37.1	89	85	73	491	488	485	1,186,707	1,197,657	1,238,022
Number of Problems with Activities of Daily Living											
None	8,208	84.9	106	107	104	362	368	377	700,419	708,291	724,362
One	540	4.8	89	86	73	486	494	516	734,265	744,260	846,646
Two	357	2.9	79	77	69	568	575	590	1,212,653	1,231,079	1,252,731
Three or more	979	7.4	70	69	73	650	649	690	1,670,347	1,676,657	1,744,962
Number of Problems with Instrumental Activities of Daily Living											
None	5,903	64.3	112	114	116	336	342	357	658,717	666,224	676,255
One	1,523	14.5	90	88	80	424	429	432	825,278	829,692	879,676
Two	929	7.4	97	94	89	497	499	501	803,730	812,198	839,898
Three or more	1,730	13.8	79	77	67	584	587	595	1,303,095	1,316,414	1,377,756
Nursing Home Resident											
Yes	864	6.1	94	93	124	505	510	589	734,785	739,078	744,276
No	9,226	93.9	99	99	93	387	393	400	789,379	797,757	823,000
Prior Reimbursement (1992)[a]											
Lowest quintile	1,975	20.0	138	152	168	301	322	345	555,967	560,754	568,881
Second quintile	1,898	19.6	124	127	144	305	312	335	752,926	761,228	764,256
Third quintile	1,981	19.7	127	125	136	323	322	340	371,875	371,058	375,682
Fourth quintile	2,036	20.0	94	91	95	385	384	399	594,984	603,978	606,267
Highest quintile	2,200	20.7	75	73	51	655	658	634	1,656,548	1,676,030	1,778,334

[a] Heart problems include myocardial infarction, arteriosclerocis, congestive heart failure, or other heart condition.

[b] Number of observations is weighted, so numbers differ slightly across quintiles, which were defined on unweighted data.

One disappointing result is that the predictive accuracy of the CHSF-CC is only slightly better than the CHSF or AAPCC for subgroups defined by numbers of ADLs or IADLs. For those reporting no impairments of any kind, for example, the three adjusters have predictive ratios of 113 to 117. Similarly, for those reporting multiple impairments, the predictive ratios across the adjusters (71 to 73) reflect large and consistent underpredictions. For counts of ADLs or IADLs, the CHSF-CC is sometimes more accurate than the AAPCC, but rarely by a wide margin, and it does little better than the CHSF. Among those with three or more IADLs, for example, both the CHSF-CC and the CHSF-I underpredict average costs substantially (by 21 and 23 percent, respectively), though by less than the AAPCC (33 percent).

The MAD and MSE for the three adjusters are again consistent with the results from the predictive ratios. For various subgroups, the CHSF-CC typically has a lower MAD and MSE than the AAPCC (often by 5 to 10 percent) and, to a lesser extent, the CHSF-I as well. Overall, the MAD and MSE for the CHSF-CC are four to five percent lower than for the AAPCC, and about one percent lower than for the CHSF-I.

F. EFFECTS ON PAYMENTS TO PLANS

Results from Table IV.8 show that the AAPCC substantially overpays plans for beneficiaries with no conditions, slightly underpays for those with chronic conditions, and substantially underpays for those with a history of CHSF. This suggests that, when plans enroll a disproportionate number of beneficiaries without a CHSF or chronic condition, they will likely receive large overpayments per beneficiary.

Not surprisingly, the overpayment is likely to be greatest when plans enroll proportionately few beneficiaries with a CHSF history (Table IV.10). When the percentage of those with CHSF falls just one point below the "neutral" rate found in FFS (roughly 15 percent), the plans are overpaid by about

TABLE IV.10

EFFECTS ON MONTHLY PAYMENTS TO PLANS
(Per Enrollee)

	Total		
	Average Payment (in Dollars)	Average FFS Cost (in Dollars)	Difference (Percentage)
AAPCC			
Has CHSF Condition (14.7 percent)	372	691	-46.1
Has Chronic Condition (CC) (33.0 percent)	337	349	-3.4
Has No Condition (52.3 percent)	306	209	46.4
Total	326	326	0.0
CHSF-CC Adjuster			
Has CHSF Condition	699	691	1.2
Has Chronic Condition (CC)	350	349	0.4
Has No Condition	206	209	-1.3
Total	326	326	0.0
AAPCC Payment to Plan With:			
14.7 percent CHSF (neutral)	326	326	0.0
14 percent CHSF	325	322	1.2
13 percent CHSF	325	318	2.3
12 percent CHSF	324	313	3.6
11 percent CHSF	324	309	4.8
10 percent CHSF	323	305	6.1
AAPCC Payment to Plan with 14.7 Percent CHSF (Neutral) and			
33 percent CC (neutral)	326	326	0.0
32 percent CC	326	325	0.3
31 percent CC	325	323	0.7
30 percent CC	325	322	1.0
29 percent CC	325	320	1.4
28 percent CC	324	319	1.7

[a]For non-neutral levels of CHSF, "additional" non-CHSF beneficiaries are assigned to the no-condition and chronic-condition groups based on their relative proportions in the population (.523:330).

[b]For non-neutral levels of CC, "additional" non-CC beneficiaries are assigned to the no-condition group.

1.2 percent per beneficiary.[20] At four percentage points below the FFS rate of CHSF, the plans are overpaid by nearly five percent.

The rate of overpayment is smaller when plans enroll disproportionately few beneficiaries with chronic conditions. When the percentage of those with a chronic condition falls by one percentage point from the "neutral" rate (about 33 percent), the plans are overpaid by 0.3 percent under the AAPCC.[21] When this percentage is five points below the neutral rate, the overpayment is close to two percent.

The results in Table IV.10 understate to some degree the likely overpayment under the AAPCC, because they assume that enrollees and nonenrollees with CHSF and CC have the same distribution on comorbidities and timing of prior admissions. To the extent that CHSF enrollees are less likely than nonenrollees to have comorbidities or to have recent admissions for CHSF, their costs will be lower than those shown. Thus, the amount by which plans are underpaid by the AAPCC for those with conditions is less than our calculations show, leading to greater overall overpayment.[22]

G. SUMMARY

The addition of chronic conditions to the CHSF-I adjuster substantially improves its predictive accuracy for biased samples. Perhaps most important, for the average beneficiary with no

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[20]These calculations assume that the share of beneficiaries enrolled in lieu of those with CHSF have chronic conditions in proportion to their prevalence in the non-CHSF group (about two out of five beneficiaries without CHSF). We ignore the possibility that plans may gain further favorable selection by enrolling lower-cost beneficiaries among those with chronic (or no) conditions, a result found by the GAO (1997).

[21]Assumes that the beneficiaries enrolled in lieu of those with chronic conditions have no conditions.

[22]AAPCC underpayments for those with CHSF offset to some extent the overpayments for those without CHSF. Thus, if enrollees with these diseases have less-severe cases than nonenrollees, there will be less underpayment offsetting the overpayment.

conditions, the CHSF-CC adjuster pays plans accurately, while the CHSF-I and AAPCC substantially overpay. This revision to the CHSF adjuster would essentially eliminate a major source of overpayment that the GAO (1997) found to be highly prevalent among Medicare managed care plans in California. In addition, while the CHSF-CC still is not accurate for some subgroups, it performs far better than the AAPCC for groups defined by expenditure quintiles (the best predictor of future costs) and most medical conditions.