Risk-Adjustment System for the Medicare Capitated ESRD Program

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Medicare is the principal payer for medical services for those in the U.S. population suffering from end-stage renal disease (ESRD). By law, beneficiaries diagnosed with ESRD may not subsequently enroll in Medicare Advantage (MA) plans, however, the potential benefits of managed care for this population have stimulated interest in changing the law and developing demonstration plans. We describe a new risk-adjustment system developed for Medicare to pay for ESRD beneficiaries in managed care plans. The model improves on current payment methodology by adjusting payments for treatment status and comorbidities.

INTRODUCTION

Medicare is the principal payer for medical services for those in the U.S. population suffering from ESRD. Currently, most ESRD beneficiaries are served by fee-for-service (FFS) Medicare. A small portion is enrolled in managed care plans now known as MA plans, and ESRD demonstration plans. Capitated payments for ESRD patients in health maintenance organizations (HMOs) and other plans were geographically adjusted at the State level until 2002, when they were adjusted also for age and sex. In 2005, CMS implemented diagnosis-based risk adjustment for ESRD beneficiaries enrolled in managed care plans. This article describes the diagnosis-based ESRD risk-adjustment system developed for Medicare.

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BACKGROUND

The Medicare ESRD program began with the enactment of the 1972 Social Security Amendments. The program provides Medicare entitlement, irrespective of age, to all who meet limited Medicare work requirements and medically qualify as having permanent renal failure requiring dialysis or a kidney transplant. The disease-specific coverage was established to cover the extremely high cost of dialysis and kidney transplants. The Medicare ESRD program has grown rapidly since 1972, increasing from 7,000 enrollees to over 300,000. Due to the high per patient cost and the growing number of enrollees, the ESRD program now accounts for 9 percent of Medicare expenditures though serving less than 1 percent of Medicare beneficiaries.

By law, Medicare beneficiaries who develop ESRD or individuals eligible for Medicare due to ESRD may not subsequently enroll in MA plans. Beneficiaries may remain in the MA program if they were enrolled in an MA plan prior to developing ESRD. ESRD capitated rates for MA plans are required since costs increase about tenfold. Payments for non-ESRD enrollees in capitated plans have been subject to diagnosis-based risk adjustment since 2000 (Ingber, 2000). But such payments for ESRD patients have been subject only to demographic risk adjustment. With demographic risk adjustment, payments are adjusted for age and sex. Without incorporating diagnoses, demographic adjustment does not differentiate more costly from less costly patients within age/sex payment cells.

The potential benefits of managed care for the ESRD population have stimulated the development of demonstration plans. The first demonstration of a sophisticated full capitation for ESRD managed care was implemented in 1998. Payments to plans were based on 100 percent of average FFS expenditures for ESRD beneficiaries in a State, differentiating people in dialysis status (with and without diabetes as the cause of ESRD), transplant status (3 months) and functioning graft status (Cooper, Eggers, and Eddington, 1997; Dykstra et al., 2002). The first and last groups were also divided into three age categories. A capitated payment system similar to that used in this demonstration was mandated in the Medicare, Medicaid, and SCHIP Benefits Improvement and Protection Act of 2000 to be applied to risk plans then called Medicare+Choice plans.

More recently, the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (MMA) introduced specialized MA plans to exclusively serve beneficiaries with special needs. ESRD may be a chronic condition that meets the criteria for a specialized plan. By statute, special needs plans will be paid the same way as other MA plans, through the use of diagnosis-based risk adjustment. But it is unclear whether the MA risk adjuster, the CMS-hierarchical condition category (HCC) model, is appropriate for ESRD beneficiaries. Average program costs for ESRD beneficiaries, regardless of disease profile, are substantially different from costs for those who are not ESRD beneficiaries.

There are additional reasons to calibrate a model specific to ESRD. Whereas payment to demonstration plans differentiated among dialysis, transplant, and functioning graft status, the demographic model and general CMS-HCC model do not make such distinctions. Not incorporating treatment status into an ESRD payment system would create problematic incentives in specialty MA plans solely for ESRD patients. Given that demographic adjustment does not adjust for treatment status within age/sex payment cells, plans would have incentives to enroll lower cost functioning graft patients and avoid the relatively high-cost dialysis patients. Plans would also be hesitant to provide a transplant since there is no explicit payment for a transplant. The plan recoups their investment only if the individual remains enrolled in the plan as a functioning graft patient. Paying appropriately based on treatment status removes these incentives.

This is not the first attempt to examine how ESRD costs vary with patient characteristics. Farley et al. (1996) developed a model to examine how expenditures vary with patient age, sex, years since renal failure, whether a transplant previously failed, and whether the patient has diabetes. They suggested using risk-adjusted capitated payments for individuals receiving dialysis or with functioning grafts. Lump sum payments would be made for kidney transplants, graft failures, and extremely high-cost individuals.

Beddhu et al. (2000) determined whether the Charleson Comorbidity Index predicts costs for ESRD patients. The Index assigns points based on patient age and condition severity. Average inpatient costs were $5,400 in the lowest quartile of scores compared to $40,700 in the highest quartile. Both studies suggest that diagnosis-based models can predict variation in costs for dialysis patients.

The CMS ESRD model developed here is based on the CMS-HCC model developed by Health Economics Research, Inc. (now part of RTI International) (Pope et al., 2004). The CMS-HCC model predicts payment year costs based on demographics and prior year diseases. The *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes (Centers for Disease Control and Prevention, 2006) are aggregated into disease groups. Hierarchies are imposed on related diseases so that, within a set of related conditions a person is assigned only the most costly of the coded conditions.

DATA

Data for model estimation were for FFS Medicare beneficiaries. The sample of ESRD beneficiaries in 2000 were derived from the Renal Beneficiary and Utilization System (REBUS). REBUS has been CMS' primary data system for information on ESRD beneficiaries. It is used to monitor the Medicare status, transplant activities, dialysis activities, and Medicare utilization of ESRD patients and their Medicare providers. It is also used to determine the Medicare-covered period of ESRD.

Next, we obtained information for these beneficiaries from the Enrollment Database (EDB). The EDB is the primary repository for Medicare current and historical enrollment data. Critical data in the EDB used in these analyses includes Parts A and B coverage periods, managed care coverage periods, dialysis and transplant periods, Medicaid coverage periods and Medicare secondary payer (MSP) periods. We added claims data for calendar year (CY) 2000 and diagnostic information from the Medicare Provider Analysis and Review (MEDPAR) inpatient stay records, hospital outpatient, and physician claims from the prior year, 1999.

The ESRD population is placed into three groups by treatment status (dialysis, transplant, and functioning graft). The ESRD status of the beneficiary is determined concurrently (i.e., in the payment year)—a person is switched to the appropriate group on the occurrence of a triggering event. For example, dialysis patients remain in that group until a transplant triggers a switch to the transplant group. The person is in the transplant group for 3 months starting with the month of transplant. The fourth month triggers a switch to the functioning graft group where the person remains until either a new dialysis period or another transplant occurs. A person may be in multiple records in the data, reflecting periods of treatment status.

We calculated total Medicare payments from all claims sources except hospice (because it is not an MA benefit) for CY 2000. Total costs are computed separately for each treatment group. For example, if a person was on dialysis for 4 months, then received a transplant which functioned for the remainder of the year, the person is represented in each treatment group. Costs are summed separately for the 4 months in the dialysis group, the 3 months in the transplant group, and the 5 months in functioning graft status. At the conclusion of the data compilation, for each beneficiary we had all existing demographic, programmatic, and diagnostic information for the base year 1999 along with demographic, programmatic, and cost information for payment year 2000.

Calibration Sample

Further stratification of the dialysis and functioning graft samples was necessary due to data considerations. The first group comprised those who could be included in the diagnosis-based risk-adjustment estimation based on their diagnostic, cost, and demographic information. For the purpose of calibrating an ESRD risk-adjustment model, we began with individuals enrolled in the Parts A and B FFS ESRD program while not residing in a hospice, for at least

1 day in 2000. This allowed us at least 1 month of ESRD cost information for these beneficiaries and assured inclusion of decedents. We further required Medicare FFS coverage under Medicare Parts A and B for the entire 1999 CY. This allowed us a complete year of diagnostic information for these beneficiaries. We categorize these individuals as continuing enrollees.

As is typical in work on risk adjustment, additional restrictions are placed on the sample. We excluded individuals with no inpatient, outpatient, or physician claims in 2000. Given the severity of illness, such individuals were likely classified as ESRD in error, or were improperly coded as an FFS enrollee. We removed observations when Medicare was not the primary payer in 1999 because Medicare is unlikely to have a complete claims history when secondary payer. We also removed observations when Medicare was not the primary payer in 2000 because Medicare payment would not reflect the total medical costs. If Medicare was the primary payer for part of 2000, we only excluded the months when Medicare was secondary. Including costs for months where Medicare is not the primary payer biases Medicare costs downward.

The second group comprised those for whom we did not have diagnostic information from 1999, but for whom we had Medicare FFS costs from 2000. Diagnostic data can be incomplete if the individual did not have 12 months of Medicare Parts A and B eligibility in the base year, or was in a MA plan during the base year. Diagnostic risk adjustment is not possible for such beneficiaries, thus we estimate a demographic risk-adjustment model based on age and sex. Because this is the situation for beneficiaries new to Medicare, these enrollees were categorized as new enrollees.

The analysis dependent variable, payment for each beneficiary, was annualized by dividing by the fraction of months in 2000 the cost data represent. In the analyses, the observations are weighted by this eligibility fraction. Thus, a beneficiary who has $1,000 of costs in 2000, but is only in the sample for 1 month has their costs inflated to $12,000, therefore, the weight for this observation in the analyses is 1/12. If the enrollee was enrolled in Medicare for all of 2000, but Medicare was the primary payer for only 3 months of 2000, we only included those 3 months in the estimation and the weight was 3/12.

Descriptive statistics for the dialysis, transplant, and functioning graft samples are provided in Table 1. Annualized expenditures were $59,003 for the 199,505 continuing enrollees receiving dialysis, compared to $20,092 for beneficiaries with functioning grafts. The extremely high cost for dialysis patients reflects the expense of receiving dialysis treatments on a regular basis for a year. The cost for functioning graft enrollees is much lower, but still well above the $5,352 average for non-ESRD enrollees (Pope et al., 2004). The higher cost for functioning graft enrollees reflects immunosuppressive drugs and a greater intensity of services. There were 7,214 transplants in the REBUS data that had associated claims in MEDPAR. The total 3-month cost for a kidney transplant was $43,532. Much of the cost reflects the inpatient cost associated with the transplant itself. The statistics for the new enrollee estimation sample include continuing enrollees as they are needed to estimate a demographic model. There are too few actual new enrollees to estimate all the cells in the demographic model.

It should be noted that the functioning graft sample of 16,769 beneficiaries is not the entire population of those with functioning grafts. Prior to the year 2000, Medicare only covered immunosuppressive drugs for 3 years after a transplant. Starting in 2001, immunosuppressive drugs were

Table 1

Statistics for Selected Characteristics of the Estimation Samples[1]

Characteristic	ESRD Sub-Populations: Dialysis-Continuing Enrollees	Dialysis-New Enrollees[2]	Transplant	Functioning Graft
Mean Annualized Payments[3]	$59,003	$59,727	—	$20,092
Mean Actual Payments[4]	—	—	$43,532	—
Mean Age (In Years)	62.9	64.0	46.0	47.3
Observations	199,505	136,538	7,214	16,769
		Percent		
Male	51.5	52.3	59.8	59.0
Medicaid	43.0	42.8	45.4	47.2
Under Age 65	45.3	42.7	88.1	87.1
Originally Disabled[5]	13.6	—	—	3.3
Originally Disabled (Non-ESRD)[6]	8.0	8.7	1.5	—
Originally ESRD[7]	5.6	—	2.8	—
Diabetes	50.0	—	—	48.0
Congestive Heart Failure	46.0	—	—	21.3
Vascular Disease	41.2	—	—	25.9
Major Complications of Medical Care	40.3	—	—	25.2

[1] Disease statistics are from calendar year 1999. All other characteristics are from calendar year 2000.

[2] The sample for this regression comprises new enrollees and continuing enrollees who were in dialysis less than 3 years. Statistics for actual new enrollees differ.

[3] Annualized payments equal actual payments divided by the proportion of year in fee-for-service Medicare parts A and B.

[4] Actual payments equal total Medicare payments for all services with the exception of hospice during the 3-month transplant payment period.

[5] Age greater than 64, but originally entitled to Medicare due to disability.

[6] Age greater than 64, but originally entitled to Medicare due to non-ESRD related disability.

[7] Age greater than 64, but originally entitled to Medicare due to ESRD.

NOTE: ESRD is end stage renal disease.

SOURCES: Medicare Enrollment Database, 1999/2000 Standard Analytical Files and National Claims History, and the Renal Beneficiary and Utilization System.

covered indefinitely as long as the person was eligible for Medicare. The year 2000 was a transition year. It was decided to limit the sample only to those with grafts for less than 3 years to avoid including people who did not receive immunosuppressive drugs through Medicare. In part, this explains why the vast majority of the functioning graft sample is young, with 87 percent being under age 65.

Estimation of the ESRD Models

There are a number of models that were estimated. We estimated separate models for those in dialysis status and those in post-graft status. Those on dialysis have the large base cost of dialysis treatments, complications from the treatments and disease, and a high rate of hospitalization that modifies the incremental costs of comorbidities. The person with a functioning graft is typically similar to a non-ESRD beneficiary in the incremental costs of disease. There is a need to add payment, however, to reflect immunosuppressive drug therapy and increased service levels and monitoring due to the transplant. Because the transplant is both expensive and temporally well defined, the costs are carved out and paid over 3 months. This practice neutralizes any incentives not to do a transplant because the recovery of costs to a plan would be in doubt. The transplant payment is not adjusted for demographics or comorbidities.

As previously discussed, diagnosis-based risk adjustment is not possible for new enrollees. These new enrollees could fall into any of the three categories. The transplant payment is not contingent on diagnosis information and does not vary for new enrollees. For the other categories demographic risk-adjustment models were developed. A description of the estimation of each model follows.

The risk-adjustment models were estimated by weighted least squares regression. Observations were weighted by the fraction of the payment year the person was in the status being modeled. As described in the article by Pope et al. (2004) the explanatory variables consist of demographic variables, information about program eligibility, and diagnosis groups.

Some of the system design choices were driven by operational considerations for both the industry and CMS. The underlying risk model and mapping of ICD-9-CM codes (Centers for Disease Control and Prevention, 2006) to condition categories is already in use for MA. Thus, diagnostic data collection and transmission is the same as currently exists for the program. The new data system replacing REBUS, Consolidated Renal Operations in a Web-Enabled Network (CROWN) reports triggering events such as a transplant or a return to dialysis status. The transition to functioning graft status will happen automatically after the 3-month transplant period.

Continuing Enrollee Dialysis Model

Although the ESRD continuing enrollee dialysis model is patterned on the CMS-HCC model, there are some significant differences between this model and the model that is used for the general population:

- All of the kidney-disease related HCCs (i.e., dialysis status, renal failure, nephritis) are omitted from the model because all of these enrollees would fall into the most severe kidney disease category: they have ESRD and are in dialysis status.
- Any disease interactive HCCs that include the renal failure HCC as a component are unnecessary and omitted from the model.
- Whereas the general population model was estimated separately for those living in community status and those in long-term institutional settings, that distinction was not made here. There are not enough observations in institutional settings to estimate a stable model.
- Whereas the general population model had indicators for males and females age 65 or over, who were originally entitled to Medicare due to disability, in the ESRD model we differentiate those who are age 65 or over who were originally entitled to Medicare due to ESRD from those who were originally entitled due to disability.

The model was estimated using data for 199,505 persons with months meeting the dialysis criteria. We estimated the dialysis model twice. When we first estimated the model, we found that for several of the HCCs the coefficients were higher in the general population sample than in the dialysis sample. This was inconsistent with our presumption, based on consultations with nephrologists, that the marginal costs of diseases should not be smaller in the dialysis population than in the general population. Further ex post discussion with these nephrologists offered no clinical justification to support the lower coefficients. Therefore, we re-estimated the dialysis model under the constraint that the coefficients that were initially estimated less in the dialysis model were set equal to the values in the general population community model. This constraint was imposed on 15 HCC coefficients and one disabled HCC interaction term. We also imposed several constraints due to hierarchy violations. For example, the CMS-HCC model has five payment cells for diabetes; all have been constrained to be equal in the dialysis model. The results of this second estimation are presented in Table 2.

The age-sex coefficients are very large due to the high cost of dialysis. Seventy percent of payments are accounted for by the age/sex coefficients. Thirty percent of payments, which are not trivial given the high cost of dialysis, are accounted for by the disease groups. This is different than the CMS-HCC model where approximately 60 percent of payments are accounted for by the disease groups.

Consistent with our results in the general population, it is typical for aged enrollees originally entitled by disability to be more costly than similar enrollees originally entitled due to age. However, we find lower costs for aged enrollees originally entitled due to ESRD than for similar enrollees originally entitled due to age. At first, this seems counterintuitive since dialysis is physically debilitating and leads to greater costs in the long run. Dialysis patients also develop comorbidity in the long run. Indeed, the presence of so much comorbidity in an additive model actually leads the model to overpredict for these individuals.

New Enrollee Dialysis Model

The demographic risk model is applied to those ESRD beneficiaries for whom we do not have a full year of diagnostic information. However, there are not enough new enrollees to provide an adequate sample size to calibrate the model. Thus, the estimation sample includes those who are new enrollees in 2000 as well as those who are continuing enrollees in 2000 (i.e., those who were included in the prior regression). Continuing enrollees were included only if they had been on dialysis for less than 36 months at the end of 2000. As previously mentioned, dialysis is likely to have greater cost implications in the long run than in the short run. In general, the new enrollees with dialysis are those who have become entitled to coverage relatively recently. Had we included long-term dialysis beneficiaries in the new enrollee estimation we would have likely overestimated their costs. The final sample used in the estimation of this model is 136,538.

The estimation is based solely on demographic characteristics and not on HCCs. The results of the new enrollee dialysis regression are shown in Table 3. The coefficients for both sexes increase monotonically with age. Coefficients for females are consistently higher than for the males, and the Medicaid interactions with sex and age are higher for the disabled than for the aged.

ESRD Transplant Payment

Whereas dialysis costs are high, they are incurred incrementally through the year. The cost of a kidney transplant usually occurs only once but is the same order of magnitude as a year of dialysis. We calculated the cost of a transplant as the sum of the average Medicare costs for the month of the transplant discharge plus the two subsequent months (Table 4). For calibration, the reference date for the transplant was the discharge date so as to capture the costs of the inpatient stay and the two post-discharge months. In application of the model, the transplant date, rather than a discharge date, will trigger the transplant payment.

The total 3-month cost for a kidney transplant was $43,532 with the overwhelming majority of the costs in the month of the transplant. While this represents the average costs for an individual receiving a kidney transplant, costs vary considerably between individuals receiving solely a kidney transplant and those receiving a

Table 2

CMS Hierarchical Condition Category Dialysis Model Estimation[1] Dependent Variable = Annualized Year 2000 Expenditures

Characteristic	Label	Coefficients[3]	*t*-stat
Age/Sex Groups			
	MALE 0-34	34,583	47.31
	MALE 35-44	34,783	61.14
	MALE 45-54	35,954	76.37
	MALE 55-59	38,504	66.43
	MALE 60-64	38,189	66.60
	MALE 65-69	41,081	69.58
	MALE 70-74	41,723	89.28
	MALE 75-79	42,690	90.48
	MALE 80-84	44,116	74.89
	MALE ≥85	46,343	55.83
	FEMALE 0-34	38,537	46.36
	FEMALE 35-44	38,562	55.46
	FEMALE 45-54	39,492	67.70
	FEMALE 55-59	39,049	58.81
	FEMALE 60-64	40,143	65.07
	FEMALE 65-69	43,892	77.37
	FEMALE 70-74	45,002	97.09
	FEMALE 75-79	45,822	95.67
	FEMALE 80-84	46,090	76.24
	FEMALE ≥85	48,789	58.98
Medicaid Interactions With Age and Sex			
	Medicaid Female Disabled	2,751	5.31
	Medicaid Female Aged	1,777	4.18
	Medicaid Male Disabled	2,218	4.91
	Medicaid Male Aged	2,527	4.52
Originally Disabled Interactions With Sex			
	Female, 65+, Originally Entitled Due to ESRD/with or without Disability	-3,604	-4.87
	Male, 65+, Originally Entitled Due to ESRD/with or without Disability	-2,611	-3.14
	Female, 65+, Originally Entitled Due to Disability (non-ESRD)	2,779	4.39
	Male, 65+, Originally Entitled Due to Disability (non-ESRD)	1,220	2.00
Disease Groups			
HCC1	HIV/AIDS	9,936	9.81
HCC2	Septicemia/Shock	4,118	12.70
HCC5	Opportunistic Infections[2]	3,643	NA
HCC7	Metastatic Cancer and Acute Leukemia	8,968 a	12.03
HCC8	Lung, Upper Digestive Tract, and Other Severe Cancers	8,968 a	12.03
HCC9	Lymphatic, Head and Neck, Brain and Other Major Cancers	8,084	5.84
HCC10	Breast, Prostate, Colorectal and Other Cancers and Tumors	2,627	22.99
HCC15	Diabetes with Renal or Peripheral Circulatory Manifestation	5,628 b	22.99
HCC16	Diabetes with Neurologic or Other Specified Manifestation	5,628 b	22.99
HCC17	Diabetes with Acute Complications	5,628 b	22.99
HCC18	Diabetes with Ophthalmologic or Unspecified Manisfestation	5,628 b	22.99
HCC19	Diabetes without Complication	5,628 b	22.99
HCC21	Protein-Calorie Malnutrition[2]	3,818	NA
HCC25	End-Stage Liver Disease	6,188	5.14
HCC26	Cirrhosis of Liver	5,543	4.76
HCC27	Chronic Hepatitis[2]	1,837	n/a
HCC31	Intestinal Obstruction/Perforation	3,478	8.81
HCC32	Pancreatic Disease	4,230	7.60
HCC33	Inflammatory Bowel Disease	5,526	4.82
HCC37	Bone/Joint/Muscle Infections/Necrosis	7,373	14.16
HCC38	Rheumatoid Arthritis and Inflammatory Connective Tissue Disease	4,964	10.01
HCC44	Severe Hematological Disorders[2]	5,055	NA
HCC45	Disorders of Immunity	3,256	3.98
HCC51	Drug/Alcohol Psychosis[2]	1,571 c	NA
HCC52	Drug/Alcohol Dependence[2]	1,571 c	NA

See footnotes at the end of the table.

Table 2—Continued

CMS Hierarchical Condition Category Dialysis Model Estimation[1] Dependent Variable = Annualized Year 2000 Expenditures

Characteristic	Label	Coefficients[3]	*t*-stat
HCC54	Schizophrenia	6,220 d	12.60
HCC55	Major Depressive, Bipolar, and Paranoid Disorders	6,220 d	12.60
HCC67	Quadriplegia, Other Extensive Paralysis	13,939 e	9.67
HCC68	Paraplegia	13,939 e	9.67
HCC69	Spinal Cord Disorders/Injuries	4,880	4.76
HCC70	Muscular Dystrophy	4,020	0.64
HCC71	Polyneuropathy	2,600	7.78
HCC72	Multiple Sclerosis	4,380	1.92
HCC73	Parkinson's and Huntington's Diseases[2]	1,954	NA
HCC74	Seizure Disorders and Convulsions	3,673	7.98
HCC75	Coma, Brain Compression/Anoxic Damage	3,875	2.91
HCC77	Respirator Dependence/Tracheostomy Status[2]	10,417	NA
HCC78	Respiratory Arrest	9,658	8.03
HCC79	Cardio-Respiratory Failure and Shock[2]	3,451	NA
HCC80	Congestive Heart Failure	4,440	17.96
HCC81	Acute Myocardial Infarction	5,168 f	15.47
HCC82	Unstable Angina and Other Acute Ischemic Heart Disease	5,168 f	15.47
HCC83	Angina Pectoris/Old Myocardial Infarction	1,940	5.22
HCC92	Specified Heart Arrhythmias	3,565	11.75
HCC95	Cerebral Hemorrhage	3,145 g	7.88
HCC96	Ischemic or Unspecified Stroke	3,145 g	7.88
HCC100	Hemiplegia/Hemiparesis	4,476	6.42
HCC101	Cerebral Palsy and Other Paralytic Syndromes	3,416	1.95
HCC104	Vascular Disease with Complications	7,747	22.38
HCC105	Vascular Disease	3,189	11.92
HCC107	Cystic Fibrosis	3,839 h	12.64
HCC108	Chronic Obstructive Pulmonary Disease	3,839 h	12.64
HCC111	Aspiration and Specified Bacterial Pneumonias	6,474	8.67
HCC112	Pneumococcal Pneumonia, Emphysema, Lung Abscess	2,280	2.58
HCC119	Proliferative Diabetic Retinopathy and Vitreous Hemorrhage[2]	1,975	NA
HCC148	Decubitus Ulcer of Skin	9,461	16.61
HCC149	Chronic Ulcer of Skin, Except Decubitus	6,039	12.03
HCC150	Extensive Third-Degree Burns[2]	4,427	NA
HCC154	Severe Head Injury	3,875	2.91
HCC155	Major Head Injury	2,123	2.28
HCC157	Vertebral Fractures without Spinal Cord Injury[2]	2,462	NA
HCC158	Hip Fracture/Dislocation	2,731	3.92
HCC161	Traumatic Amputation	4,953 i	9.35
HCC164	Major Complications of Medical Care and Trauma[2]	1,438	NA
HCC174	Major Organ Transplant Status	10,333	9.02
HCC176	Artificial Openings for Feeding or Elimination[2]	3,810	NA
HCC177	Amputation Status, Lower Limb/Amputation Complications	4,953 i	9.35
Disabled/Disease Interactions			
DIS*HCC5	<65*Opportunistic Infections	4,912	3.38
DIS* HCC44	<65*Severe Hematological Disorders	3,762	4.84
DIS*HCC51	<65*Drug/Alcohol Psychosis	5,081 j	5.20
DIS*HCC52	<65*Drug/Alcohol Dependence	5,081 j	5.20
DIS*HCC107	<65*Cystic Fibrosis[2]	9,691	NA

[1] This model is used for those enrollees who have a full year of base year claims data. Observations are weighted by the fraction of the payment year the person was in dialysis.

[2] The coefficient is restricted to the CMS-HCC model coefficient. As such, there is no standard error or *t*-statistic.

[3] Coefficients with the same letter are constrained to be equal.

NOTES: For mean year 2000 total annualized expenditures=$59,003. Observations = 199,505. R^2 = 0.0767. NA is not available.

SOURCES: Medicare Enrollment Database, 1999/2000 Standard Analytical Files and National Claims History, and the Renal Beneficiary and Utilization System.

simultaneous kidney-pancreas transplant. Unfortunately, there was no distinguishing diagnosis related group (DRG) for simultaneous kidney-pancreas transplants in 2000. Beginning in 2002, however, there was a separate DRG for simultaneous kidney-pancreas transplants (DRG 512). By examining 2002 costs, we determined that total costs for the 5 percent of kidney transplants that were simultaneous kid-

Table 3

CMS New Enrollee Dialysis Model Estimation[1] Dependent Variable = Annualized Calendar Year 2000 Expenditures

Characteristic	Coefficients[2]	*t*-stat
Age/Sex Groups		
MALE 0-34	36,658	36.26
MALE 35-44	40,837	50.62
MALE 45-54	42,968	67.45
MALE 55-59	46,153	61.43
MALE 60-64	47,808	64.25
MALE 65-69	54,421	97.52
MALE 70-74	58,312	108.96
MALE 75-79	59,922	111.11
MALE 80-84	62,403	89.67
MALE ≥85	64,279	64.15
FEMALE 0-34	42,173	36.41
FEMALE 35-44	43,725	43.07
FEMALE 45-54	48,032	60.83
FEMALE 55-59	48,529	56.06
FEMALE 60-64	50,189	62.26
FEMALE 65-69	58,847	106.58
FEMALE 70-74	63,484	115.54
FEMALE 75-79	64,865 a	137.71
FEMALE 80-84	64,865 a	137.71
FEMALE ≥85	67,067	65.54
Medicaid Interactions With Age and Sex		
Medicaid Female Disabled	9,751	14.02
Medicaid Female Aged	5,541	10.17
Medicaid Male Disabled	9,836	16.14
Medicaid Male Aged	7,679	11.12
Originally Disabled Interactions With Sex		
Female <65, originally entitled due to disability (non-ESRD)	11,468 b	19.34
Female 65+, originally entitled due to disability (non-ESRD)	11,468 b	19.34
Male <65, originally entitled due to disability (non-ESRD)	10,988 c	20.62
Male 65+, originally entitled due to disability (non-ESRD)	10,988 c	20.62

[1] New enrollees are those enrollees who do not have a full year of base year claims data. Observations are weighted by the fraction of the payment year the person was in dialysis status.

[2] Coefficients with the same letter are constrained to be equal.

NOTES: Mean calendar year 2000 annualized expenditures=$59,727. R^2 =0.0249. Observations = 136,538. Estimations based on demographic characteristics only.

SOURCES: Medicare Enrollment Database, 1999/2000 Standard Analytical Files and National Claims History, and the Renal Beneficiary and Utilization System.

ney-pancreas transplants cost were 1.5 times as much as kidney-only transplants. By using the 2002 cost ratio and distribution of transplants, we estimated monthly costs for kidney-only and kidney-pancreas transplants in the year 2000. Payment varies by transplant month; about 80 percent of the transplant total is paid in the first month. Costs are still high in months two and three at $4,523 per month for kidney transplants and $6,785 per month for simultaneous kidney and pancreas transplants (Table 4).

Although it should not happen very often, there could be new enrollees who obtain transplants which will be paid under this model. We see no reason why the costs of a transplant should differ between continuing and new enrollees. Because the payment has no determining factors requiring prior year information, the payment is the same regardless of enrollee status.

ESRD CONTINUING AND NEW ENROLLEE FUNCTIONING GRAFT MODELS

Payments for those with functioning grafts were estimated using a variant of the general population CMS-HCC model. Discussions with clinicians supported the case that these beneficiaries are quite

Table 4

Costs of Kidney Transplants

Month	Kidney Transplant	Simultaneous Kidney-Pancreas Transplant
Total	$42,470	$63,705
One	33,424	50,136
Two	4,523	6,785
Three	4,523	6,785

NOTES: Month one denotes the month of transplant. The average for all transplants is $43,532.
SOURCES: Medicare Enrollment Database, 1999/2000 Standard Analytical Files and National Claims History, and the Renal Beneficiary and Utilization System.

similar in their disease-related incremental costs to non-ESRD beneficiaries. However, in addition to the usual Medicare-covered services, the program pays for immunosuppressive drugs and increased intensity of services related to monitoring. Services including immunosuppressive drugs are covered by the program for 36 months if a beneficiary is entitled to Medicare due solely to ESRD. The Beneficiary Improvement and Protection Act (BIPA) of 2000 removed the time limit on the immunosuppressive drug benefit for beneficiaries entitled due to age or disability.

A model was estimated that retained almost all of the coefficient values in the CMS-HCC model, but added variables to capture the additional costs of this population. Functioning graft status was identified using four distinct substatuses: (1) those who were aged (age 65 or over), with a graft less than 10 months old; (2) those who were aged with a graft 10 months old or more; (3) those who were under age 65, with a graft less than 10 months old; and (4) those under age 65 with a graft 10 months old or more. The four classes were arrived at through discussions with clinicians and empirical study. The age distinction is related to the greater costs associated with aged ESRD beneficiaries. The second distinction was made because those who have a more recent graft tend to have the greatest treatment intensity and a more expensive drug regimen.

With the exception of the dialysis and renal failure HCCs that were set to zero and HCC174 (Major Organ Transplant Status), which was estimated in the model, all coefficients were restricted to be equal to the coefficients for the non-ESRD combined coefficient model. The marginal cost of maintaining a second major transplant is expected to be much less for this population since individuals with functioning grafts are already on immunosuppressive drug regimens. The only other coefficients that were free to vary in the regressions were the four functioning graft add-on coefficients, which captured the cost differentials for the four classes of persons with functioning grafts.

For payment purposes, the general population CMS-HCC model differentiates between institutional and community status. We used a combined community-institutional model to set the restricted coefficients since the number of institutionalized persons is too small to estimate a separate model for this population. This common set of coefficients is applied to both the community and institutional models. We present the results in Table 5, making the distinction.

As expected, the costs for HCC174 (Major Organ Transplant Status) are much lower than in the CMS-HCC model ($1,402 versus $3,790). The add-on graft factors are substantial, between 4 and 9 months after the transplant; $15,853 for the disabled and $17,569 for the aged. Patients are monitored very closely after a transplant for signs of rejection. After 9 months, costs fall to $8,310 for the disabled and $8,671 for the aged.

Table 5

CMS Hierarchical Condition Category Functioning Graft Model Estimation[1] for Community and Institutional Status Dependent Variable = Annualized Calendar Year 2000 Expenditures

Characteristic	Label	Community[2]	Institutional[2]
Age/Sex Groups			
	MALE 0-34	$346	$5,664
	MALE 35-44	617	5,664
	MALE 45-54	973	5,664
	MALE 55-59	1,386	5,664
	MALE 60-64	1,755	5,664
	MALE 65-69	1,774	7,435
	MALE 70-74	2,323	6,350
	MALE 75-79	2,960	6,210
	MALE 80-84	3,372	6,201
	MALE 85-89	4,050	6,366
	MALE 90-94	4,620	5,378
	MALE ≥95	5,307	4,287
	FEMALE 0-34	598	5,457
	FEMALE 35-44	1,012	5,457
	FEMALE 45-54	1,096	5,457
	FEMALE 55-59	1,360	5,457
	FEMALE 60-64	1,924	5,457
	FEMALE 65-69	1,572	5,970
	FEMALE 70-74	1,970	6,049
	FEMALE 75-79	2,475	5,089
	FEMALE 80-84	2,936	4,813
	FEMALE 85-89	3,408	4,515
	FEMALE 90-94	4,077	4,048
	FEMALE ≥95	4,130	2,980
Medicaid and Originally Disabled Interactions With Age and Sex			
	Medicaid Female Disabled	1,133	—
	Medicaid Female Aged	940	—
	Medicaid Male Disabled	592	—
	Medicaid Male Aged	944	—
	Female, 65+, Originally Entitled due to Disability	1,213	—
	Male, 65+, Originally Entitled due to Disability	757	—
Disease Groups			
HCC1	HIV/AIDS	3,514	6,893
HCC2	Septicemia/Shock	4,563	4,854
HCC5	Opportunistic Infections	3,346	6,893
HCC7	Metastatic Cancer and Acute Leukemia	7,510 a	2,771
HCC8	Lung, Upper Digestive Tract, and Other Severe Cancers	7,510 a	2,771
HCC9	Lymphatic, Head and Neck, Brain and Other Cancers	3,539	2,319
HCC10	Breast, Prostate, Colorectal and Other Cancers and Tumors	1,194	1,330
HCC15	Diabetes with Renal or Peripheral Circulatory Manifestation	3,921	3,137
HCC16	Diabetes with Neurologic or Other Specified Manifestation	2,833	3,137
HCC17	Diabetes with Acute Complications	2,008	3,137
HCC18	Diabetes with Ophthalmologic or Unspecified Manifestation	1,760	3,137
HCC19	Diabetes without Complication	1,024	1,308
HCC21	Protein-Calorie Malnutrition	4,727	2,193
HCC25	End-Stage Liver Disease	4,616	1,375
HCC26	Cirrhosis of Liver	2,645	1,375
HCC27	Chronic Hepatitis	1,841	1,375
HCC31	Intestinal Obstruction/Perforation	2,094	1,375
HCC32	Pancreatic Disease	2,281	1,375
HCC33	Inflammatory Bowel Disease	1,575	1,375
HCC37	Bone/Joint/Muscle Infections/Necrosis	2,546	2,539
HCC38	Rheumatoid Arthritis and Inflammatory Connective Tissue Disease	1,653	1,463
HCC44	Severe Hematological Disorders	5,188	2,29
HCC45	Disorders of Immunity	4,260	2,299
HCC51	Drug/Alcohol Psychosis	1,810	1,131
HCC52	Drug/Alcohol Dependence	1,361	1,131
HCC54	Schizophrenia	2,786	1,131
HCC55	Major Depressive, Bipolar, and Paranoid Disorders	2,209	1,131
HCC67	Quadriplegia, Other Extensive Paralysis	6,059 b	504
HCC68	Paraplegia	6,059 b	504
HCC69	Spinal Cord Disorders/Injuries	2,526	504
HCC70	Muscular Dystrophy	1,981	504

See footnotes at the end of the table.

Table 5—Continued

CMS Hierarchical Condition Category Functioning Graft Model Estimation[1] for Community and Institutional Status Dependent Variable = Annualized Calendar Year 2000 Expenditures

Characteristic	Label	Community[2]	Institutional[2]
HCC71	Polyneuropathy	1,377	504
HCC72	Multiple Sclerosis	2,654	504
HCC73	Parkinson's and Huntington's Diseases	2,436	504
HCC74	Seizure Disorders and Convulsions	1,381	504
HCC75	Coma, Brain Compression/Anoxic Damage	2,912	504
HCC77	Respirator Dependence/Tracheostomy Status	10,783	7,259
HCC78	Respiratory Arrest	7,327	7,259
HCC79	Cardio-Respiratory Failure and Shock	3,550	1,481
HCC80	Congestive Heart Failure	2,141	903
HCC81	Acute Myocardial Infarction	1,785 c	1,476
HCC82	Unstable Angina and Other Acute Ischemic Heart Disease	1,785 c	1,476
HCC83	Angina Pectoris/Old Myocardial Infarction	1,205	1,476
HCC92	Specified Heart Arrhythmias	1,363	961
HCC95	Cerebral Hemorrhage	2,011	774
HCC96	Ischemic or Unspecified Stroke	1,569	774
HCC100	Hemiplegia/Hemiparesis	2,241	504
HCC101	Cerebral Palsy and Other Paralytic Syndromes	840	504
HCC104	Vascular Disease with Complications	3,473	2,612
HCC105	Vascular Disease	1,832	583
HCC107	Cystic Fibrosis	1,929 d	1,180
HCC108	Chronic Obstructive Pulmonary Disease	1,929 d	1,180
HCC111	Aspiration and Specified Bacterial Pneumonias	3,556	2,377
HCC112	Pneumococcal Pneumonia, Emphysema, Lung Abscess	1,034	2,377
HCC119	Proliferative Diabetic Retinopathy and Vitreous Hemorrhage	1,791	5,102
HCC130	Dialysis Status[3]	0	0
HCC131	Renal Failure[3]	0	0
HCC132	Nephritis	1,401	2,152
HCC148	Decubitus Ulcer of Skin	5,285	1,628
HCC149	Chronic Ulcer of Skin, Except Decubitus	2,485	1,346
HCC150	Extensive Third-Degree Burns	4,935	1,274
HCC154	Severe Head Injury	2,912	1,274
HCC155	Major Head Injury	1,239	1,274
HCC157	Vertebral Fractures without Spinal Cord Injury	2,514	504
HCC158	Hip Fracture/Dislocation[4]	2,010	—
HCC161	Traumatic Amputation	4,322	1,274
HCC164	Major Complications of Medical Care and Trauma	1,346	1,347
HCC176	Artificial Openings for Feeding or Elimination	4,054	4,523
HCC177	Amputation Status, Lower Limb/Amputation Complications	4,322	1,274
Disabled/Disease Interaction			
	<65 with Opportunistic Infections[4]	4,047	—
	<65 with Severe Hematological Disorders[4]	4,580	—
	<65 with Drug/Alcohol Psychosis[4]	2,608	—
	<65 with Drug/Alcohol Dependence[4]	2,122	—
	<65 with Cystic Fibrosis[4]	9,547	—
Disease Interactions[2]			
	Diabetes (DM) and Congestive Heart Failure (CHF)	1,296	1,064
	DM and Cerebrovascular Disease (CVD)[4]	639	—
	CHF and Chronic Obstructive Pulm. Disease (COPD)	1,238	1,906
	COPD and CVD and Coronary Artery Disease (HCC81-HCC83)[4]	406	—
Coefficients Common to Community and Institutional Models			
		Coefficients	*t*-stat
Disease Group			
HCC174	Major Organ Transplant Status	1,402	1.82
Graft Factors			
	<65, with duration since transplant of 4-9 months	15,853	22.25
	≥65, with duration since transplant of 4-9 months	17,569	9.85
	<65, with duration since transplant of 10 months or more	8,310	24.14
	≥65, with duration since transplant of 10 months or more	8,671	10.33

[1] All coefficients except for the graft factors and HCC174 are restricted to the values estimated for the CMS-HCC model. Observations are weighted by the by the fraction of the payment year the person was in functioning graft status.

[2] Coefficients with the same letter are constrained to be equal.

[3] These HCCs are not in the model for those in functioning graft status.

[4] Variable is not in model for the institutionalized.

NOTES: Mean calendar year 2000 annualized expenditures=$20,092. R^2 = 0.2745. Observations = 16,769.

SOURCES: Medicare Enrollment Database, 1999/2000 Standard Analytical Files and National Claims History, and the Renal Beneficiary and Utilization System.

To determine payment for new enrollees in functioning graft status, the add-on factors estimated previously are added to the general population new-enrollee model (Pope et al., 2004). Such a payment model simply pays according to demographic factors to which are added the amount for the appropriate functioning graft group.

Validation of the system

The ESRD risk-adjustment system performs well compared to a demographic based method consistent with the traditional Medicare model for paying for ESRD beneficiaries. A regression that only accounts for age and sex was estimated on the combined sample of people in dialysis, transplant, and functioning graft status. The R^2 for the age-sex model was only 0.0047. Each of the CMS ESRD diagnosis-based risk-adjustment regressions have far greater explanatory power.

In Table 6, we compare predictive ratios (mean predicted divided by the mean actual dollars) from the age-sex and diagnosis-based risk-adjustment models for the three status groups. Given that an age-sex model does not differentiate more costly from less costly patients within age-sex payment cells, the age-sex model overpredicts severely for people in functioning graft status, but underpredicts substantially for individuals receiving transplants. In essence, an age-sex model requires plans that invest in a transplant to recover the costs in future years. The new ESRD system aligns payments with current costs and enables plans to avoid the uncertainty associated with future enrollment.

We also computed the predictive ratios for the dialysis model when sorting the population into deciles based on predicted spending. These results are in Table 7 and show the dialysis model is able to distinguish between relatively low- and high-cost dialysis patients.

Medicare as Secondary Payer

When the beneficiary has other insurance coverage, Medicare is a secondary payer (MSP) during the first 30 months of eligibility or entitlement to Part A benefits because of ESRD. Medicare becomes primary after 30 months, regardless of whether the individual has other coverage. But it is conceivable that plans will have enrollees develop ESRD who have other insurance coverage. The cost ramifications of MSP status are quite large and for this reason MSP status will be tracked monthly by CMS from its standard sources of information on coordination of benefits. In our work we have separated persons with MSP and treated MSP months in a separate analysis. We computed their average Medicare costs to be about 21.5 percent of the costs that the model predicts for Medicare as the primary payer. Thus, payments will be 21.5 percent of the risk-adjusted capitated rate when Medicare (i.e., the MA plan) is secondary.

CONCLUSION

This article describes the diagnosis-based ESRD risk-adjustment system developed for Medicare. The model makes far more accurate payments than the demographic payment system. Making accurate payment is important to reduce the risk faced by insurers when providing transplants, and to pay fairly for the treatment provided to the beneficiary. Overall, the system has been designed to meet the needs of legislation, to minimize extra data collection, and to improve accuracy of

Table 6

Predictive Ratios for Demographic, Disease, and Utilization Characteristics, for ESRD Models Predictive Ratio = Predicted Expenditures/Actual Expenditures

Characteristic	Dialysis Sample		Transplant Sample		Functioning Graft Sample	
	Age-Sex[1] Model	Dialysis Model	Age-Sex Model	Transplant Model	Age-Sex Model	Functioning Graft Model
All Enrollees	1.040	1.000	0.549	1.033	2.846	1.000
Demographics						
AGED (Age ≥ 65)	1.022	1.000	0.609	1.042	2.838	1.000
DISABLED (Age < 65)	1.064	1.000	0.541	1.032	2.848	1.000
MALE 0-34	1.135	1.000	0.520	1.055	3.229	1.071
MALE 35-44	1.081	1.000	0.539	1.053	2.882	1.045
MALE 45-54	1.066	1.000	0.528	1.024	2.733	1.010
MALE 55-59	1.053	1.000	0.527	1.002	2.473	0.871
MALE 60-64	1.045	1.000	0.542	1.030	2.613	1.000
MALE 65-69	1.033	1.000	0.599	1.061	2.690	0.987
MALE 70-74	1.024	1.000	0.595	1.037	2.664	0.990
MALE 75-79	1.017	1.000	**	**	2.982	1.052
MALE 80-84	1.017	1.000	**	**	**	**
MALE 85-89	1.018	1.006	**	**	**	**
MALE 90-94	1.018	0.966	**	**	**	**
MALE ≥ 95	1.018	1.031	**	**	**	**
FEMALE 0-34	1.120	1.000	0.561	1.060	2.993	0.963
FEMALE 35-44	1.078	1.000	0.544	1.011	2.707	0.958
FEMALE 45-54	1.056	1.000	0.538	0.990	3.093	1.048
FEMALE 55-59	1.042	1.000	0.581	1.036	2.734	0.957
FEMALE 60-64	1.032	1.000	0.583	1.046	2.982	1.026
FEMALE 65-69	1.027	1.000	0.616	1.017	3.027	1.022
FEMALE 70-74	1.019	1.000	0.691	1.121	3.097	0.992
FEMALE 75-79	1.017	1.000	**	**	**	**
FEMALE 80-84	1.017	1.000	**	**	**	**
FEMALE 85-89	1.016	1.004	**	**	**	**
FEMALE 89-94	1.020	0.995	**	**	**	**
FEMALE ≥ 95	1.020	0.891	**	**	**	**
Originally Disabled	0.979	1.001	—	—	2.852	1.057
Medicaid	1.014	1.000	—	—	2.718	0.986
Diagnoses - Base Year						
Any Chronic Condition	1.013	0.998	—	—	2.767	0.998
Depression	0.868	0.976	—	—	2.075	0.923
Alcohol / Drug Dependence	0.843	0.990	—	—	1.678	0.866
Hypertensive Heart/Renal Disease	1.000	1.017	—	—	2.570	1.012
Benign/Unspecified Hypertension	0.978	0.987	—	—	2.729	0.999
Diabetes With Complications	0.929	1.004	—	—	2.234	0.997
Diabetes Without Complications	0.932	0.994	—	—	2.358	0.983
Heart Failure / Cardiomyopathy	0.919	0.998	—	—	2.015	0.980
Acute Myocardial Infarction	0.845	0.997	—	—	1.926	1.023
Other Heart Disease	0.927	0.989	—	—	2.165	0.947
Chronic Obstructive Pulmonary Disease	0.910	0.995	—	—	2.216	0.946
Colorectal Cancer	0.929	1.010	—	—	2.054	0.880
Breast Cancer	0.982	1.005	—	—	2.585	0.959
Lung/Pancreas Cancer	0.851	1.016	—	—	2.506	1.552
Other Stroke	0.863	0.995	—	—	2.113	1.067
Intracerebral Hemorrhage	0.832	1.003	—	—	1.736	0.980
Hip Fracture	0.876	0.997	—	—	1.499	0.719
Arthritis	0.920	0.949	—	—	2.366	0.902

See footnotes at the end of the table.

Table 6—Continued

Predictive Ratios for Demographic, Disease, and Utilization Characteristics, for ESRD Models Predictive Ratio = Predicted Expenditures/Actual Expenditures

	Dialysis Sample		Transplant Sample		Functioning Graft Sample	
Characteristic	Age-Sex[1] Model	Dialysis Model	Age-Sex Model	Transplant Model	Age-Sex Model	Functioning Graft Model
Multiple Diagnoses[1]						
DM*CAD	0.855	0.997	—	—	1.824	0.928
DM*CVD	0.829	0.997	—	—	1.776	0.981
CHF*COPD	0.853	0.998	—	—	1.586	0.873
CAD*VD	0.838	0.994	—	—	1.627	0.883
COPD*CAD	0.833	1.001	—	—	1.593	0.862
COPD*CVD*CAD	0.764	1.016	—	—	1.260	0.759
DM*CVD*VD	0.778	0.993	—	—	1.539	0.944
Hospitalizations						
0 Base Year Hosp Admissions	1.229	0.996	—	—	3.881	0.979
1 Base Year Hosp Admissions	1.111	1.036	—	—	3.229	1.078
2 Base Year Hosp Admissions	1.004	1.023	—	—	2.619	1.038
3+ Base Year Hosp Admissions	0.831	0.968	—	—	1.907	0.946
0 Pmt Year Hosp Admissions	2.015	1.783	—	—	6.834	2.127
1 Pmt Year Hosp Admissions	1.304	1.232	—	—	3.308	1.190
2 Pmt Year Hosp Admissions	0.998	0.977	—	—	2.115	0.820
3+ Pmt Year Hosp Admissions	0.651	0.677	—	—	1.004	0.445

** Denotes cell size less than 30.

[1] The Age-Sex model was calibrated across all the ERSD status groups, consistent with the original ESRD payment system.

NOTES: HHA is home health agency. DME is durable medical equipment. DM is diabetes mellitus. CAD is coronary artery disease. CVD is cerebrovascular disease. CHF is congestive heart failure. COPD is chronic obstructive pulmonary disease. VD is vascular disease.

SOURCES: Medicare Enrollment Database, 1999/2000 Standard Analytical Files and National Claims History, and the Renal Beneficiary and Utilization System.

Table 7

Predictive Ratios for Beneficiaries Grouped by Predicted Expenditures CMS Hierarchical Condition Category Dialysis Model

Deciles of Predicted Expenditures	Predictive Ratio
Lowest	0.985
2	1.031
3	1.008
4	1.016
5	1.001
6	0.992
7	0.996
8	0.985
9	0.992
Highest	1.002

SOURCES: Medicare Enrollment Database, 1999/2000 Standard Analytical Files and National Claims History, and the Renal Beneficiary and Utilization System.

payment so that both demonstrations and MA plans can succeed in improving care for this population. The ultimate purpose is to provide a payment system that will enable creation of specialty MA plans to serve ESRD beneficiaries and to allow the possibility of open enrollment into general MA plans.

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