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.

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
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.

### Table 1

**Statistics for Selected Characteristics of the Estimation Samples**

| Characteristic                      | Dialysis-Continuing Enrollees | Dialysis-New Enrollees | Transplant | Functioning Graft |
|-------------------------------------|-------------------------------|------------------------|------------|------------------|
| Mean Annualized Payments            | $59,003                       | $59,727                | —          | $20,092          |
| Mean Actual Payments                | —                             | —                      | $43,532    | —                |
| Mean Age (In Years)                 | 62.9                          | 64.0                   | 46.0       | 47.3             |
| Observations                        | 199,505                       | 136,538                | 7,214      | 16,769           |

| Characteristic                      | Percent |
|-------------------------------------|---------|
| Male                                | 51.5    |
| Medicaid                            | 43.0    |
| Under Age 65                        | 45.9    |
| Originally Disabled                 | 13.6    |
| Originally Disabled (Non-ESRD)      | 8.0     |
| Originally ESRD                     | 5.6     |
| Diabetes                            | 50.0    |
| Congestive Heart Failure            | 46.0    |
| Vascular Disease                   | 41.2    |
| Major Complications of Medical Care | 40.3    |

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.
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 Estimation¹ Dependent Variable = Annualized Year 2000 Expenditures

| Characteristic | Label | Coefficients³ | 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 Infections² | 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 Manifestation | 5,628 b | 22.99 |
| HCC19 | Diabetes without Complication | 5,628 b | 22.99 |
| HCC21 | Protein-Calorie Malnutrition² | 3,818 | NA |
| HCC25 | End-Stage Liver Disease | 6,188 | 5.14 |
| HCC26 | Cirrhosis of Liver | 5,543 | 4.76 |
| HCC27 | Chronic Hepatitis² | 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 Disorders² | 5,055 | NA |
| HCC45 | Disorders of immunity | 3,256 | 3.98 |
| HCC51 | Drug/Alcohol Psychosis² | 1,571 c | NA |
| HCC52 | Drug/Alcohol Dependence² | 1,571 c | NA |

See footnotes at the end of the table.
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-

| Characteristic | Label | Coefficients | t-stat |
|----------------|-------|--------------|--------|
| HCC54          | Schizophrenia, Bipolar, and Paranoid Disorders | 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 | 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 | 10,417 | NA |
| HCC78          | Respiratory Arrest | 9,658 | 8.03 |
| HCC79          | Cardio-Respiratory Failure and Shock | 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 |
| HCC89          | 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 | 6.57 |
| HCC112         | Pneumococcal Pneumonia, Emphysema, Lung Abscess | 2,280 | 2.58 |
| HCC119         | Proliferative Diabetic Retinopathy and Vitreous Hemorrhage | 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 | 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 | 2,462 | 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 | 1,438 | NA |
| HCC174         | Major Organ Transplant Status | 10,333 | 9.02 |
| HCC176         | Artificial Openings for Feeding or Elimination | 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 | 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.
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.

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Table 3
**CMS New Enrollee Dialysis Model Estimation**
**Dependent Variable = Annualized Calendar Year 2000 Expenditures**

| Characteristic                                      | Coefficients<sup>2</sup> | 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                                        | 64,865a                  | 137.71 |
| FEMALE 80-84                                        | 64,865a                  | 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): 11,468b 19.34
- Female 65+, originally entitled due to disability (non-ESRD): 11,468b 19.34
- Male <65, originally entitled due to disability (non-ESRD): 10,988c 20.62
- Male 65+, originally entitled due to disability (non-ESRD): 10,988c 20.62

<sup>1</sup> 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.

<sup>2</sup> Coefficients with the same letter are constrained to be equal.

NOTES: Mean calendar year 2000 annualized expenditures is $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.
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 Estimation¹ for Community and Institutional Status Dependent Variable = Annualized Calendar Year 2000 Expenditures

| Characteristic | Label | Community² | Institutional² |
|----------------|-------|------------|----------------|
| **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 | 944 | — |
| Medicaid Male Aged | — | — |
| 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 | 2,299 |
| 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 |
| HCC89          | 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\(^3\)**

- 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**

| Disease Group | Coefficients | t-stat |
|---------------|--------------|--------|
| 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 Model   | Dialysis 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.
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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