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Evaluation of the CMS-HCC Risk Adjustment Model

Final Report

Prepared for

Melissa A. Evans, PhD
Centers for Medicare & Medicaid Services
Medicare Plan Payment Group
Division of Risk Adjustment and Payment Policy
Mail Stop C1-13-07
7500 Security Boulevard
Baltimore, MD 21244-1850

Prepared by

Gregory C. Pope, MS
John Kautter, PhD
Melvin J. Ingber, PhD
Sara Freeman, MS
Rishi Sekar, BA
Cordon Newhart, MA
RTI International
3040 Cornwallis Road
Research Triangle Park, NC 27709

RTI Project Number 0209853.006

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Authors: Gregory C. Pope, MS
John Kautter, PhD
Melvin J. Ingber, PhD
Sara Freeman, MS
Rishi Sekar, BA
Cordon Newhart, MA

Federal Project Officer: Melissa A. Evans, PhD

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ACRONYMS

AAPCC	adjusted average per capita cost
ADLs	activities of daily living
AMI	acute myocardial infarction
CAD	coronary artery disease
CC	condition category
CHF	congestive heart failure
CMS	Centers for Medicare & Medicaid Services
COPD	chronic obstructive pulmonary disease
C-SNP	chronic condition special needs plans
CVD	cerebrovascular disease
DME	durable medical equipment
DRGs	diagnosis-related groups
DXG	diagnostic group
ESRD	end stage renal disease
FFS	fee for service
HCC	hierarchical condition category
HOS	Health Outcomes Survey
ICD-9-CM	*International Classification of Diseases, Ninth Revision, Clinical Modification*
M+C	Medicare+Choice
MA	Medicare Advantage
MMA	Medicare Modernization Act of 2003
PACE	Program of All-Inclusive Care for the Elderly
PIP-DCG	Principal Inpatient Diagnostic Cost Group
SNP	Special Needs Plan

SECTION 1
ACA-MANDATED EVALUATION OF CMS-HCC MODEL

1.1 Introduction

The 2010 Patient Protection and Affordable Care Act (Public Law No: 111-148) includes several sections affecting the Medicare Program. Specifically, Sec. 3205 focuses on Medicare Advantage (MA) plans for special needs individuals. Within that section of the legislation, "item (f) Risk Adjustment" contains revisions to the Social Security Act, including a new clause that mandates 1) an evaluation of the Centers for Medicare & Medicaid Services (CMS) risk adjustment system used to account for medical expenditures and care coordination costs for specified subsets of beneficiaries; and 2) a publication of that evaluation and any changes occurring as a result of the evaluation:

> ... ``(III) Evaluation.—For 2011 and periodically thereafter, the Secretary shall evaluate and revise the risk adjustment system under this subparagraph in order to, as accurately as possible, account for higher medical and care coordination costs associated with frailty, individuals with multiple, comorbid chronic conditions, and individuals with a diagnosis of mental illness, and also to account for costs that may be associated with higher concentrations of beneficiaries with those conditions.
>
> ``(IV) Publication of evaluation and revisions.—The Secretary shall publish, as part of an announcement under subsection (b), a description of any evaluation conducted under subclause (III) during the preceding year and any revisions made under such subclause as a result of such evaluation."

The CMS hierarchical condition categories (CMS-HCC) model, implemented in 2004, adjusts Medicare capitation payments to Medicare Advantage health care plans for the health expenditure risk of their enrollees. Its intended use is to pay plans appropriately for their expected relative costs. For example, MA plans that disproportionately enroll the healthy are paid less than they would have been if they had enrolled beneficiaries with the average risk profile, while MA plans that care for the sickest patients are paid proportionately more than if they had enrolled beneficiaries with the average risk profile.

Although this Affordable Care Act legislative mandate for an evaluation of the CMS-HCC risk adjustment model is new, the evaluation process is well established. CMS conducts comprehensive evaluations of its CMS-HCC model on a regular basis, including evaluating the model on the dimensions specified in the Affordable Care Act.

This report is a record of the 2011 evaluation of the CMS-HCC model. It contains three major sections: a primer on the CMS-HCC model and more generally the use of risk adjustment within a health insurance market; an evaluation of the CMS-HCC model, including an evaluation of the predictive accuracy of the CMS-HCC model for individuals and groups; and an analysis to determine if there are integral differences between the individuals in MA Chronic Condition

Special Needs Plans (C-SNPs) and fee-for-service (FFS) beneficiaries with similar diagnostic profiles on whom the CMS-HCC model is calibrated.

For information on how the risk adjustment model addresses frailty, please refer to Section 2, where extensive research on the frailty model and potential methods for more effectively capturing these costs are summarized. For information on how the risk adjustment model performs in capturing the costs of individuals with multiple, comorbid chronic conditions, and individuals with a diagnosis of mental illness, please refer to Section 3 and the extensive discussion of model performance over a wide range of diagnoses, combinations of diagnoses, and range of risk given a number of serious conditions. Finally, for discussion of an assessment of the ability of the risk adjustment model to capture the scale of morbidity among beneficiaries enrolled in C-SNPs, please refer to Section 4.

SECTION 2
PRIMER ON THE CMS-HCC MODEL

In this section we present an introduction and overview on the CMS-HCC risk adjustment system. Risk adjustment is a method of adjusting capitation payments to health plans, either higher or lower, to account for the differences in expected health costs of individuals. Insurers determine their revenue needs based on a variety of factors, including trends in medical expenditures and anticipated enrollment, and determine how much to vary the premium charged to individuals or small groups of enrollees using population characteristics such as age, smoking habits, and past history of illness.. The risk adjustment models used in the MA program function as more comprehensive methods of underwriting in which diagnoses and demographic information are used to set each enrollee's monthly capitation rate. As with any insurance product, the system is intended to be accurate at the group level. At the individual level, predicted medical costs can be lower or higher than actual medical costs, but at the group level, below-average predicted costs balance out above-average predicted costs. Below, we first present relevant background on key characteristics of health insurance and then we describe the main components of the CMS-HCC models.

2.1 Health Insurance

In general, insurance is a form of risk management primarily used to hedge against the risk of a contingent, uncertain loss. Insurance can be defined as the equitable transfer of the risk of a loss, from one entity to another, in exchange for payment. Health insurance is an agreement between an organization and an individual to provide or pay for at least part of the costs of medical services for the individual and to protect that person against the risk of high-cost medical care in the case of a serious accident or illness. Not everyone will experience high-cost medical events; but for those who do, the financial impact could be devastating.

The concept of pooling risk is fundamental for all types of insurance because a large risk pool is needed to produce stable and measurable characteristics that can be used to accurately estimate future costs (AAA, 2006). Health insurance is designed to pool the financial risk of a high cost medical event across a large group of people. The majority of individuals in the risk pool pay more than their actual health services cost—they are willing to accept a small loss to guard against the risk of a major loss. The excess payments are pooled to cover the cost of individuals who do experience high-cost events.

Medicare is one of the world's largest health insurance programs, providing insurance to approximately 47 million beneficiaries. About one-fourth of Medicare beneficiaries receive their Medicare health benefits through private health care plans, a program known as Medicare Advantage (MA). Medicare pays these participating health plans a monthly capitation rate to provide health care services for their enrollees.

Medicare beneficiaries vary greatly in terms of their health status, which in turn affects their utilization and costs. Those with serious illnesses, multiple chronic conditions, or who are frail will require more care and will have higher medical costs than their healthier counterparts. If a MA health plan selected only the highest-cost beneficiaries (high risk), it would have difficulty remaining viable with unadjusted capitation rates. In contrast, if it selected a healthier-than-average pool in its enrollment (low risk), it would make excess profits at the expense of the

MA program if capitation rates were unadjusted. Risk selection can occur by chance or by practices implemented by health plans (AARP, 2009). For example, if a health plan were to set high copayment rates for office visits to specialists, beneficiaries needing care from specialists might select not to enroll in that plan. To address this issue of risk selection and accurately compensate MA health plans for accepting the risk of enrolling beneficiaries of varying health statuses, the MA program uses risk adjustment and administrative policies.[1]

2.2 Risk Adjustment

The Medicare risk adjustment models use data from a large pool of beneficiaries (full sample sizes over 1 million for the CMS-HCC models) to estimate predicted costs on average for each of the component factors (e.g., age-sex, low income status, individual disease groups). This method of risk assessment is in accordance with the Actuarial Standard Board's Actuarial Standard of Practice for risk classification—the risk characteristics are related to expected outcomes and the risk classes are large enough to allow credible statistical inferences (ASB, 2005). The predicted costs from the risk adjustment models are then converted to relative risk factors so that payment adjustments can be made relative to the average Medicare beneficiary. It is important to understand that the underlying risk assessment is designed to accurately explain the variation at the group level, not at the individual level, because risk adjustment is applied to large groups (AAA, 2010). As the American Academy of Actuaries notes:

> "... Determining average experience for a particular class of risk is not the same as predicting the experience for an individual risk in the class. It is both impossible and unnecessary to predict expenditures for individual risks. If the occurrence, timing, and magnitude of an event were known in advance, there would be no economic uncertainty and therefore no reason for insurance." (AAA, 1980)

By risk adjusting the payments to MA plans—beneficiaries with lower-than-average predicted costs have their payments decreased incrementally based on their risk profile and beneficiaries with higher-than-average predicted costs have their payments increased incrementally based on their risk profile—CMS reduces the incentives for these plans to risk select only the healthiest beneficiaries and avoids indirectly penalizing plans that provide care for the most seriously ill beneficiaries.

The suitability of a risk adjuster depends on the nature of the groups to be paid using the adjuster. The MA program now allows not only general population health plans to participate, but specialty plans as well, in particular plans enrolling beneficiaries with a specified subset of chronic diseases. Sections 2.3 to 2.8 describe that characteristics and ability of the CMS-HCC risk adjustment model to account for the costs of these conditions as well as the comorbidities

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[1] Risk adjustment is one of a set of techniques CMS implements to compensate MA plans and to protect beneficiary access to these plans. Other techniques include these: a Total Beneficiary Cost metric, which beginning in CY2011 evaluates changes from year to year in a plan's cost-sharing or benefits and denies bids that propose significant increases in cost-sharing or decreases in benefits; and Discriminatory Cost-Sharing Assessments, which beginning in CY2012 provide three benefit discrimination assessments—Per Member Per Month Actuarially Equivalent Cost Sharing Maximums, Service Category Cost Sharing Standards, and Discriminatory Pattern Analysis. (Advance Notice, CY2012)

and complications related to these conditions. The evaluation of its ability to predict risk for enrollee groups that have concentrations with particular medical conditions, as well as other atypical profiles, are in Section 3.

2.3 History of Risk Adjustment Models for Medicare Managed Care

CMS has developed its risk adjustment methodology over time, modifying it to better account for differences in expected health expenditures. **Table 2-1** presents a summary of the Medicare managed care risk adjustment models and their explanatory power as measured by R^2. It is followed by a description of each of the models.

Table 2-1
Medicare Managed Care historic risk adjustment model R^2 statistics[1]

Risk adjustment model	Payment years	R^2
Adjusted Average Per Capita Cost (AAPCC)[2]	pre-2000	0.0077
PIP-DCG[2]	2000-2003	0.0550
CMS-HCC[2,4]	2004-2008	0.0997
Version 12 CMS-HCC (2005 recalibration)[3,4]	2009-current	0.1091
Version 21 CMS-HCC (2007 recalibration; 2009 clinical revision)[3,4]	proposed	0.1246

NOTES:

1. The R^2 statistic refers to the percentage of variation in individual expenditures predicted.
2. The R^2 statistics for the three earliest models are based on the 1999-2000 calibration sample which included both community and institutional beneficiaries.
3. These models are estimated on the recalibration samples and include community continuing enrollees only, no months of institutional status are included.
4. The CMS-HCC models include payment model HCCs only.

SOURCE: RTI analysis of Medicare claims and enrollment data—1999-2000, 2004-2005, and 2006-2007 5% sample.

Historically, capitation payments to Medicare managed care plans were linked to FFS expenditures by geographic area, with payments set at 95 percent of an enrollee's county's Adjusted Average Per Capita Cost (AAPCC). The AAPCC actuarial rate cells were defined by age, sex, Medicaid enrollment (indicating poverty), institutional status (for nursing home residents), and working aged status (for beneficiaries with employer-based insurance where Medicare is a secondary payer). Separate county factors were calculated for the aged and nonaged (under 65 years) disabled. Due to small numbers, only state-level factors were calculated for end-stage renal disease (ESRD)-entitled beneficiaries.

The AAPCC payment methodology explained only about 1 percent of the individual variation in expenditures for Medicare beneficiaries and, for beneficiaries with similar

demographic profiles, did not pay more for sicker people. Research showed that the managed care program was increasing total Medicare expenditures because its enrollees were healthier than FFS enrollees and the AAPCC did not account for this favorable risk selection (Brown et al., 1993; Riley et al., 1996; Mello et al., 2003). Also, this payment methodology was not appropriately compensating plans enrolling sicker beneficiaries or plans specializing in treating high-cost populations, such as beneficiaries with particular chronic diseases or high levels of functional impairment.

The 1997 Balanced Budget Act (BBA) modified the Medicare managed care and other capitated programs, then collectively known as Medicare+Choice (M+C). The BBA included a mandate for health-based Medicare capitation payments by 2000. In 2000, CMS implemented the Principal Inpatient Diagnostic Cost Group (PIP-DCG) model as its health-based payment risk adjuster (Pope et al., 2000a). This model estimated beneficiary health status (the expected cost) from AAPCC-like demographics and the most serious principal inpatient diagnosis (principal reason for inpatient stay) associated with any hospital admission from the prior year.

The PIP-DCG model was an improvement over the AAPCC payment methodology, increasing explanatory power of individual variation in beneficiaries' expenditures from about 1 percent to about 5.5 percent. The PIP-DCG model was intended as a transition model, a feasible way to implement risk adjustment based on the readily available: already adjudicated inpatient diagnostic data. However, relying on inpatient diagnoses was the PIP-DCG model's major shortcoming because only illnesses that result in hospital admissions were counted. Therefore, managed care organizations that reduced admissions (e.g., through good ambulatory care) could end up with apparently healthier patients and be penalized through lower payments. Congress's Benefits Improvement Protection Act (BIPA 2000) addressed the PIP-DCG limitations by requiring the use of ambulatory diagnoses in Medicare risk-adjustment, to be phased in from 2004 to 2007.

CMS evaluated several risk-adjustment models that use both ambulatory and inpatient diagnoses and ultimately chose the DCG-HCC model for Medicare risk-adjustment partly because it "…would lend itself most easily to necessary modifications that would be clear to analysts and physicians" (CMS, 2003). The model, part of the same DCG family of models as the PIP-DCG, was developed with CMS funding by researchers at RTI International and Boston University, with clinical input from physicians at Harvard Medical School (Pope, Kautter, Ingber, et al., 2004). Prior to its 2004 implementation, the model was modified to fit Medicare subpopulations and CMS' data collection system and became the CMS-HCC risk adjustment model. (The structure of the current model is described thoroughly in the next sections.) The CMS-HCC model was again an improvement over previous methodology, increasing explanatory power of individual variation in beneficiaries' expenditures to about 10 percent (compared to 5.5 percent in the PIP-DCG model).

One of the CMS-HCC model's strengths is its facility to be modified for improvements. CMS updates the software annually to account for changes in ICD-9-CM diagnosis codes. It recalibrates the model regularly on more recent diagnosis and expenditure data. Additionally, the CMS-HCC model underwent a major clinical revision in 2009 to adjust for changes in disease patterns, treatment methods, and coding practices, as well as compositional changes within the Medicare population. These modifications have again increased the CMS-HCC

model's explanatory power, raising it to 11 percent for the version of the model used in payment from 2009-current (Version 12 model) and then to 12.5 percent for the version of the model that will be implemented for PACE starting in 2012 (Version 21 model).[2]

2.4 Principles for Risk Adjustment Model Development

The CMS-HCC risk adjustment model is prospective—it uses demographic information (age, sex, Medicaid dual eligibility, disability status) and a profile of major medical conditions in the base year to predict Medicare expenditures in the next year. It is calibrated on the FFS population because this population, unlike the MA population, submits complete Medicare claims data, including both diagnoses and expenditures. Determining which diagnosis codes should be included, how they should be grouped, and how the diagnostic groupings should interact for risk adjustment purposes was a critical step in the development of the model. The following 10 principles guided the creation of the CMS-HCC diagnostic classification system:

> ***Principle 1*—Diagnostic categories should be clinically meaningful**. Each diagnostic category is a set of ICD-9-CM codes (Centers for Disease Control and Prevention [CDC], 2010). These codes should all relate to a reasonably well-specified disease or medical condition that defines the category. Conditions must be sufficiently clinically specific to minimize opportunities for gaming or discretionary coding. Clinical meaningfulness improves the face validity of the classification system to clinicians, its interpretability, and its utility for disease management and quality monitoring.
>
> ***Principle 2*—Diagnostic categories should predict medical expenditures**. Diagnoses in the same HCC should be reasonably homogeneous with respect to their effect on both current (this year's) and future (next year's) costs.
>
> ***Principle 3*—Diagnostic categories that will affect payments should have adequate sample sizes to permit accurate and stable estimates of expenditures**. Diagnostic categories used in establishing payments should have adequate sample sizes in available data sets. Given the extreme skewness of medical expenditure data, the data cannot reliably determine the expected cost of extremely rare diagnostic categories.
>
> ***Principle 4*—In creating an individual's clinical profile, hierarchies should be used to characterize the person's illness level within each disease process, while the effects of unrelated disease processes accumulate**. Because each new medical problem adds to an individual's total disease burden, unrelated disease processes should increase predicted costs of care. However, the most severe manifestation of a given disease process principally defines its impact on costs. Therefore, related conditions should be treated hierarchically, with more severe manifestations of a condition dominating (and zeroing out the effect of) less serious ones.

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[2] Throughout this report, we refer to V12 and V21 of the CMS-HCC risk adjustment model. These shorthand names refer to the versions of the model. Model versions are updated for a variety of reasons, including changes in valid diagnoses mapping to the HCCs, updates to accommodate more recent years of data, as recalibrations to incorporate clinical and other updates. Not all model versions are used for payment

***Principle 5*—The diagnostic classification should encourage specific coding**. Vague diagnostic codes should be grouped with less severe and lower-paying diagnostic categories to provide incentives for more specific diagnostic coding.

***Principle 6*—The diagnostic classification should not reward coding proliferation**. The classification should not measure greater disease burden simply because more ICD-9-CM codes are present. Hence, neither the number of times that a particular code appears, nor the presence of additional, closely related codes that indicate the same condition should increase predicted costs.

***Principle 7*—Providers should not be penalized for recording additional diagnoses (monotonicity)**. This principle has two consequences for modeling: (1) no condition category (CC) should carry a negative payment weight, and (2) a condition that is higher-ranked in a disease hierarchy (causing lower-rank diagnoses to be ignored) should have at least as large a payment weight as lower-ranked conditions in the same hierarchy.

***Principle 8*—The classification system should be internally consistent (transitive)**. If diagnostic category A is higher-ranked than category B in a disease hierarchy, and category B is higher-ranked than category C, then category A should be higher-ranked than category C. Transitivity improves the internal consistency of the classification system and ensures that the assignment of diagnostic categories is independent of the order in which hierarchical exclusion rules are applied.

***Principle 9*—The diagnostic classification should assign all ICD-9-CM codes (exhaustive classification)**. Because each diagnostic code potentially contains relevant clinical information, the classification should categorize all ICD-9-CM codes.

***Principle 10*—Discretionary diagnostic categories should be excluded from payment models**. Diagnoses that are particularly subject to intentional or unintentional discretionary coding variation or inappropriate coding by health plans/providers, or that are not clinically or empirically credible as cost predictors, should not increase cost predictions. Excluding these diagnoses reduces the sensitivity of the model to coding variation, coding proliferation, gaming, and upcoding.

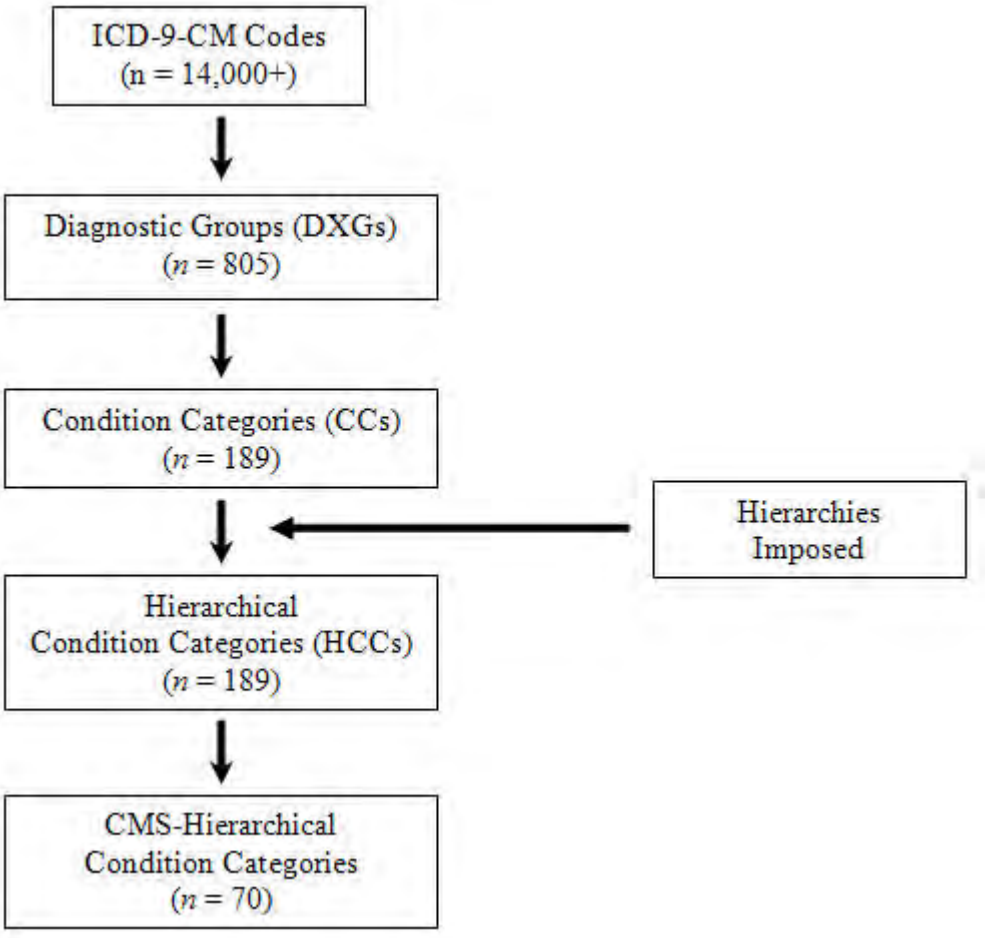
In designing the diagnostic classification, principles 7 (monotonicity), 8 (transitivity), and 9 (exhaustive classification) were followed absolutely. For example, if the expenditure weights for the models did not originally satisfy monotonicity, constraints were imposed to create models that did. Judgment was used to make tradeoffs among other principles. For example, clinical meaningfulness (principle 1) is often best served by creating a very large number of detailed clinical groupings. But a large number of groupings conflicts with adequate sample sizes for each category (principle 3). Another tradeoff is encouraging specific coding (principle 5) versus predictive power (principle 2). In current coding practice, nonspecific codes are common. If these codes are excluded from the classification system, predictive power may be sacrificed. Similarly, excluding discretionary codes (principle 10) can also lower predictive power (principle 2). The model developers approached the inherent tradeoffs involved in designing a classification system using empirical evidence on frequencies and predictive power; clinical judgment on relatedness, specificity, and severity of diagnoses; and their own professional judgment on incentives and likely provider responses to the classification system. The CMS-HCC model balances these competing goals to achieve a feasible, health-based payment system.

2.5 Elements and Organization of the CMS-HCC Model

2.5.1 Diagnostic Classification System

The HCC diagnostic classification system begins by classifying over 14,000 ICD-9-CM diagnosis codes into 805 diagnostic groups, or DXGs (see **Figure 2-1**). Each ICD-9-CM code maps to exactly one DXG, which represents a well-specified medical condition, such as *DXG 96.01 precerebral or cerebral arterial occlusion with infarction*. DXGs are further aggregated into 189 Condition Categories, or CCs. CCs describe a broader set of similar diseases. Although they are not as homogeneous as DXGs, diseases within a CC are related clinically and with respect to cost. An example is *CC 96 Ischemic or Unspecified Stroke*, which includes DXGs 96.01 precerebral or cerebral arterial occlusion with infarction and 96.02 acute but ill-defined cerebrovascular disease.

Figure 2-1
Hierarchical Condition Categories aggregations of ICD-9-CM codes, version 12 CMS-HCC model



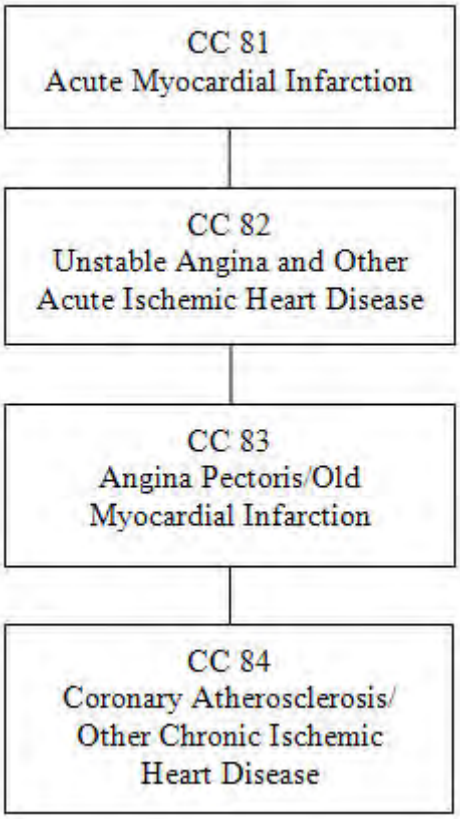
NOTE: ICD-9-CM is International Classification of Diseases, Ninth Revision, Clinical Modification.

SOURCE: RTI International.

2.5.2 Hierarchies

Hierarchies are imposed among related CCs, so that a person is coded for only the most severe manifestation among related diseases. For example (**Figure 2-2**), ICD-9-CM Ischemic Heart Disease codes are organized in the Coronary Artery Disease hierarchy, consisting of four CCs arranged in descending order of clinical severity and cost, from *CC 81 Acute Myocardial Infarction* to *CC 84 Coronary Atherosclerosis/Other Chronic Ischemic Heart Disease*. A person with an ICD-9-CM code in CC 81 is excluded from being coded in CCs 82, 83, or 84 even if codes that group into those categories were also present. Similarly, a person with ICD-9-CM codes that group into both *CC 82 Unstable Angina and Other Acute Ischemic Heart Disease* and *CC 83 Angina Pectoris/Old Myocardial Infarction* is coded for CC 82, but not CC 83. After imposing hierarchies, CCs become Hierarchical Condition Categories, or HCCs.

Figure 2-2
Hierarchical Condition Categories for coronary artery disease, created from ICD-9-CM ischemic heart diseases codes, version 12 CMS-HCC model



SOURCE: RTI International.

Although HCCs reflect hierarchies among related disease categories, for unrelated diseases, HCCs accumulate. For example, a male with heart disease, stroke, and cancer has (at least) three separate HCCs coded, and his predicted cost will reflect increments for all three problems.

In addition to the additive terms in the model, the CMS-HCC model also incorporates some interaction terms for conditions where the costs are more than additive. For example, the presence of both diabetes and congestive heart failure (CHF) leads to higher expected costs than would be calculated by adding the separate increments for diabetes and CHF alone. Therefore, the model includes a set of two-way interactions between pairs of disease groups, those which together have clinical validity and most strongly predict higher additional costs. Many interactions among diseases are tested during model development and the model reflects those that have significant effects on costs.

Because a single beneficiary may be coded for none, one, or more than one DXG or HCC, the CMS-HCC model can individually price tens of thousands of distinct clinical profiles using fewer than 200 disease parameters. The model's structure thus provides, and predicts from, a detailed comprehensive clinical profile for each individual.

HCCs are assigned using hospital and physician diagnoses from any of five sources: (1) hospital inpatient–principal diagnoses, (2) hospital inpatient–secondary diagnoses, (3) hospital outpatient, (4) physician, and (5) clinically-trained nonphysician (e.g., psychologist, podiatrist). These sources were found to be the most reliable and to provide the greatest predictive power. The CMS-HCC model does not distinguish among sources; in particular, it places no premium on diagnoses from inpatient care.

2.5.3 CMS-HCCs

The CMS-HCC V12 model includes the 70 HCCs (out of a total of 189 HCCs) that best predict Part A and Part B medical expenditures. The CMS-HCC V21 model includes 87 HCCs. Consistent with principle 10 (section 2.4), the CMS-HCC payment model excludes discretionary diagnostic categories (HCCs), containing diagnoses that are vague/nonspecific (e.g., symptoms), discretionary in medical treatment or coding (e.g., osteoarthritis), not medically significant (e.g., muscle strain), or transitory or definitively treated (e.g., appendicitis). The payment model also excludes HCCs that do not (empirically) add to costs, as well as HCCs that are fully defined by the presence of procedures or DME, in order to have payments based on medical problems that were present rather than services that were offered.

For some payment HCCs, the predicted costs of the disease are significantly different for the subpopulation entitled to Medicare by disability as opposed to the aged subpopulation. Thus, in addition to disease group interactions described earlier, the CMS-HCC model also includes a set of disease-disabled status interactions. For example, a female who has cystic fibrosis and is disabled receives an incremental payment to account for her higher expected costs.

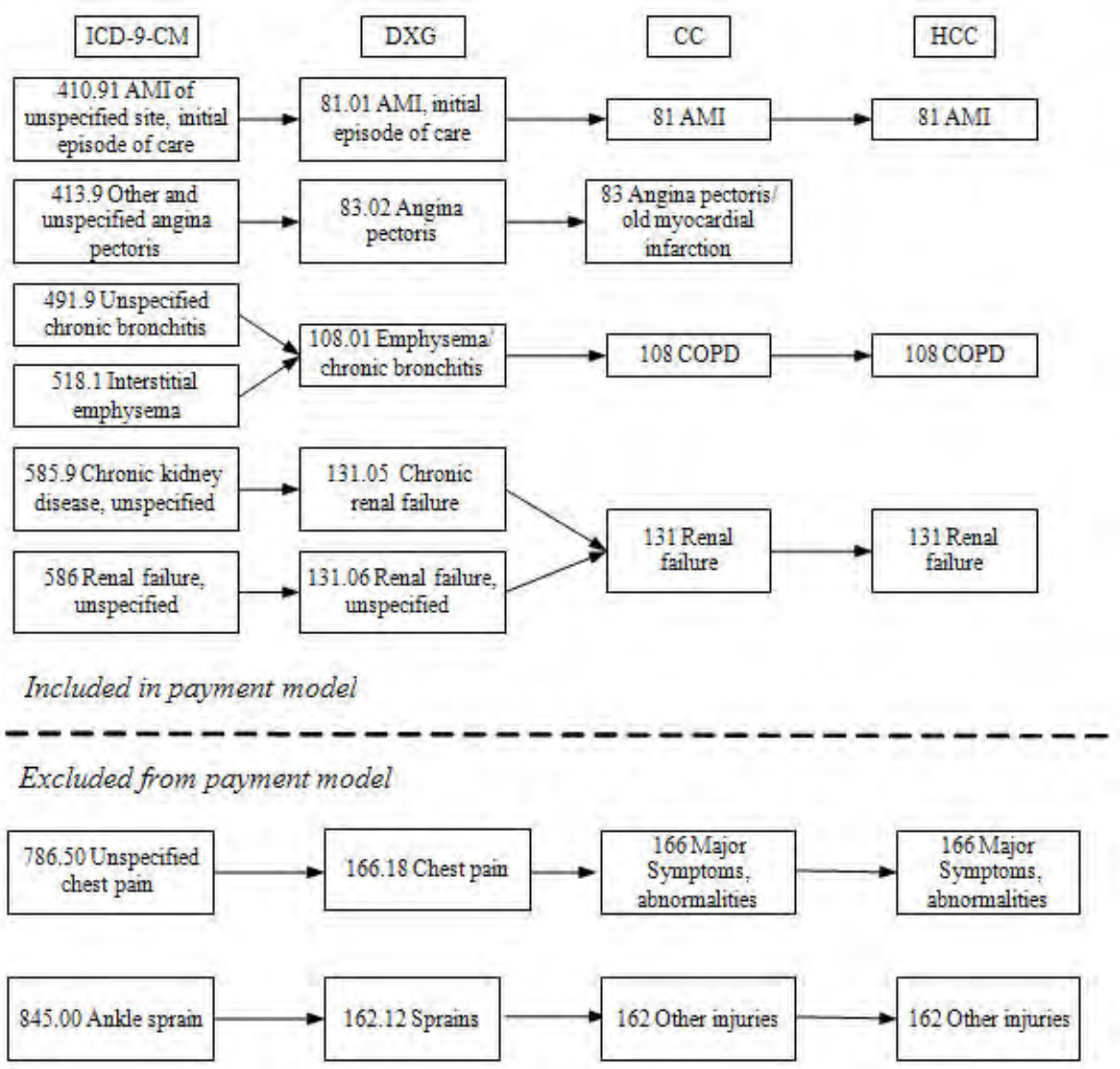
The CMS-HCC model also relies on demographics. Demographic adjusters included in the model are 24 mutually exclusive Age-Sex cells (e.g., female, age 65–69), an indicator for at least 1 month of Medicaid enrollment in the base year (a poverty indicator), and an indicator of originally disabled status. The Medicaid indicator is interacted with sex and either aged or

disabled status to differentiate predicted costs. The originally disabled indicator, interacted with sex, distinguishes beneficiaries who are currently age 65 or over, but were first entitled to Medicare before age 65 because of disability. These demographic adjusters pick up the costs of diseases not in the model and differences in spending associated with each demographic factor. The Age-Sex, Medicaid, and originally disabled categories add to each other and to the HCC diagnostic categories.

2.5.4 Clinical Vignette

To illustrate the CMS-HCC model, we have created a hypothetical clinical vignette. **Figure 2-3** displays a hypothetical clinical vignette of a female, age 76, who lives in the community and has several chronic conditions. She received eight ICD-9-CM diagnosis codes from visits to hospitals and physicians, which are grouped into seven DXGs: acute myocardial infarction (AMI); angina pectoris; emphysema/chronic bronchitis; chronic renal failure; renal failure, unspecified; chest pain; and sprains. These seven DXGs in turn group into six CCs, with the chronic renal failure and unspecified renal failure DXGs mapping to a single CC of renal failure. Finally, the six CCs result in three payment HCCs—AMI, Chronic obstructive pulmonary disease (COPD), and Renal failure—that are used in risk adjusting Medicare capitation payments. Although this female receives CCs for both AMI and angina, she receives no payment HCC for angina because AMI is a more severe manifestation of coronary artery disease, and thus excludes angina in the coronary artery disease hierarchy. The HCCs for major symptoms and other injuries are also excluded from the payment calculation. Chest pain is a symptom associated with a variety of medical conditions ranging from minor to serious, and sprains are typically transitory, with minimal implications for next year's cost.

Figure 2-3
Clinical vignette for CMS-HCC (version 12) classification community-residing, 76-year-old woman with AMI, angina pectoris, COPD, renal failure, chest pain, and ankle sprain



NOTE: AMI, acute myocardial infarction; CC, condition category; COPD, chronic obstructive pulmonary disease; DXG, diagnostic group; HCC, hierarchical condition category; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification.

SOURCE: RTI International

The predicted expenditures and risk score for the woman in this hypothetical example are presented in **Table 2-2.** (Predicted dollar values are from the Version 12 Aged-Disabled, Community Continuing Enrollee CMS-HCC model, as estimated using 2004 diagnostic data and 2005 spending data, and are used here for illustrative purposes.) Along with the demographic factors of age 76 and female ($3,409), each of the three payment HCCs identified in the clinical vignette contributes additively to this person's risk profile (AMI $2,681; COPD $2,975; Renal failure $2,745). Her total predicted expenditures are the sum of the individual increments, or $11,810. Her total risk score is the sum of the individual relative factors, or 1.583.

Table 2-2
Hypothetical example of CMS-HCC (version 12) expenditure predictions and risk score community-residing, 76-year-old woman with AMI, angina pectoris, COPD, renal failure, chest pain, and ankle sprain

Risk marker	Incremental prediction	Relative risk factor
Female, age 75–79	$3,409	0.457
Acute myocardial infarction (HCC 81)	$2,681	0.359
Angina pectoris (HCC 83)[1]	$0	—
Chronic obstructive pulmonary disease (HCC 108)	$2,975	0.399
Renal failure (HCC 131)	$2,745	0.368
Chest pain (HCC 166)[2]	$0	—
Ankle sprain (HCC 162)[2]	$0	—
Total	**$11,810**	**1.583**

NOTES:

[1] HCC 83 Angina Pectoris has an incremental prediction, but the amount is not added because HCC 81 Acute Myocardial Infarction is within the same hierarchy and is the more severe manifestation of cardiovascular disease.

[2] Chest pain (symptom associated with a variety of medical conditions from minor to serious) and ankle sprain (typically transitory) are excluded from the payment model.

SOURCE: RTI International.

2.6 CMS-HCC Model Versions

In 2009, CMS undertook a clinical revision of the CMS-HCC risk adjustment model in which we revisited the assignment of each ICD-9 diagnoses code to a DXG, and the assignment of each DXG to an HCC. We reassessed each interaction term for inclusion in the model.

2.7 CMS-HCC Model Segments

Predicting expenditures accurately for subgroups of Medicare beneficiaries is a fundamental goal of risk adjustment. This is why the CMS-HCC model differentiates between aged or disabled versus ESRD (end-stage renal disease), community-residing versus long-term institutional (nursing home), and continuing enrollees versus new Medicare enrollees. Additionally, there are important subgroups of beneficiaries for which the risk adjustment model does not fully predict expenditures for (e.g., frail elderly). In these cases, an additional risk adjustment factor is applied to the payment of beneficiaries in the subpopulation.

2.7.1 Aged-Disabled Models — Community versus Institutional

Medicare beneficiaries differ along characteristics that are important for risk-adjustment. One such characteristic is community versus institutional residence. About 5 percent of Medicare beneficiaries are long-term residents in institutions, primarily nursing facilities. Institutionalized beneficiaries are allowed to enroll, or remain enrolled, in MA plans.

Among the aged or disabled population, institutional residents are 89 percent more expensive than community residents, $15,256 in mean annual expenditures compared to $8,074 (2007 FFS expenditure data). The main reason that people in facilities cost more is that they have more medical problems, a distinction that is accounted for by their diagnostic profile of HCCs. Although institutionalized beneficiaries are more costly to the Medicare Program than community residents on average, their expenditures are overpredicted by the CMS-HCC model. This overprediction occurs for a combination of reasons, such as substitution of non-Medicare (e.g., Medicaid) for Medicare-reimbursed services at nursing homes, greater monitoring of patients within facilities to prevent problems leading to hospitalization, and limiting aggressive care for very old residents in nursing homes.

Because of the overprediction of expenditures for nursing home residents and their different cost patterns, separate CMS–HCC models are estimated for aged-or-disabled community and institutional residents.

The Version 12 CMS-HCC institutional model uses the same 70 payment HCCs and interaction terms as the Version 12 community model. However, to better recognize the medical characteristics of the institutional population the revised Version 21 institutional model contains different sets of two-disease interactions and disease-disabled status interactions than the Version 21 community model. For example, the Version 21 institutional model contains a sepsis-pressure ulcer interaction term, indicating the presence of both conditions predicts higher spending than the sum of the individual increments among those residing in institutions. Similarly, the disabled-pressure ulcer interaction is unique to the institutional sample and new to the revised version.

2.7.2 Aged-Disabled Model for New Enrollees

The CMS-HCC model is a prospective model (year 1 [base year] diagnoses are used to predict the year 2 [payment year] expenditures), and requires a complete 12-month base year diagnostic profile. For purposes of calibrating the model, beneficiaries without 12 months of Part A and Part B base year Medicare enrollment, but at least one month of payment year enrollment, are defined for MA payment purposes as "new enrollees." This new enrollee definition includes new entrants to the Medicare program as well as beneficiaries without a full year of prior diagnosis information. The majority of new enrollees are newly eligible for Medicare by age, having reached the qualifying age of 65. New enrollees may be under age 65 if they become eligible for Medicare by disability or ESRD status. They may be over age 65 if they delay Medicare enrollment or are not enrolled in both Parts A and B until a later age. This latter group provides an example of new enrollees who are not new entrants. For example, a beneficiary might be entitled by age to Part A (hospital insurance) at age 65, but might not enroll in Part B, or enroll and pay the Part B (physician insurance) premium at an older age.[3]

Because new enrollees do not have a full year of diagnostic information, CMS developed a demographic model to predict expenditures for new enrollees. New enrollee scores are the same for both community and institutional beneficiaries. The new enrollee model is used for risk adjustment of aged or disabled beneficiaries enrolling in MA plans for which the CMS-HCC model is not applicable. The demographic factors from the CMS-HCC model—age, sex, Medicaid, and originally disabled—are used to predict expenditures in the new enrollee model. Because of small sample sizes in some age-sex cells for the new enrollee population, the model is estimated on a combined sample of new and continuing enrollees who are aged or disabled. Both community and institutional residents are included in the sample. The age-sex breakouts for the new enrollee model include individual years for ages 65, 66, 67, 68, and 69, rather than the five-year grouping that occurs in the continuing enrollee models, to allow the cost weights for these ages (where most new enrollees are concentrated) to be as accurate as possible. Unlike the continuing enrollee models, Medicaid status for the new enrollee model is measured in the payment year, rather than the base year, because CMS does not look at data prior to a beneficiary's entitlement to Medicare and, since most new enrollees are new to Medicare, we look to the payment year for Medicaid status.

2.7.3 End Stage Renal Disease (ESRD) Models

People of all ages with ESRD (permanent kidney failure requiring dialysis or kidney transplant) are eligible for Medicare. Although the ESRD population is small—less than 1 percent of all Medicare enrollees—these Medicare beneficiaries have extensive health needs and high medical expenditures that distinguish them from those who are eligible for Medicare by age or disabled status. For example, continuing enrollee dialysis beneficiaries have mean annual medical expenditures of $76,034 (2007 FFS expenditure data). For this reason, separate risk adjustment models are applied to the ESRD population.

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[3] This distinction between Part A and Part B enrollment applies to the FFS calibration sample. Enrollment in Medicare Advantage requires both Part A and Part B coverage.

ESRD beneficiaries can be categorized into three groups, based on treatment status — dialysis, transplant (3 months), and functioning graft (from 4 months post-graft). By law, persons in dialysis status may not join an MA plan, except under certain circumstances, such as when it is a Special Needs Plan specific to ESRD. However, beneficiaries who are already enrolled in an MA plan who develop ESRD may remain in their plan. Risk adjusting payment by ESRD treatment status avoids problematic incentives in specialty MA plans for ESRD beneficiaries. Without adequate risk adjustment, plans might enroll lower-cost functioning graft patients and avoid higher-cost dialysis patients.

2.8 Adjustments to the CMS-HCC models

2.8.1 Frailty Adjustment

The CMS-HCC aged-disabled model does not fully predict expenditures for the community-residing frail elderly. Absent a frailty adjustment, plans enrolling a highly disproportionate number of frail beneficiaries residing in the community would be underpaid. Program of All-Inclusive Care for the Elderly (PACE) organizations focus on providing care to the frail elderly. As required by law, CMS has applied a frailty adjustment to payments for enrollees in PACE organizations since 2004 (Kautter and Pope, 2005). CMS has also applied the frailty adjustment to specific demonstrations that are ending in 2011. CMS is working to develop a methodology to pay certain dual eligible special needs plans (SNPs), as permitted by the Affordable Care Act.

For this frailty adjustment, functional status is used to measure frailty, defined by difficulty in performing activities of daily living (ADLs): bathing, dressing, eating, getting in or out of chairs, walking, and using the toilet. Specifically, the CMS-HCC frailty adjuster uses a scale based on the number of ADL difficulties—5-6, 3-4, 1-2, and no difficulties. Because ADLs are not available from Medicare administrative claims data, CMS uses ADL counts from the Consumer Assessment of Health Plans Survey (CAHPS) data to calibrate the frailty factors. To estimate the frailty factors, CMS regresses residual expenditures (actual Medicare expenditures minus expenditures predicted by the CMS-HCC model) on counts of ADLs in the previous year. Separate estimations are done for the Medicaid and non-Medicaid subpopulations.

The frailty adjustment applies to aged or disabled community beneficiaries age 55 or older enrolled in PACE organizations. The adjustment is made at a contract level, based on the proportion of beneficiaries in each ADL-count category as identified through the Health Outcomes Survey (HOS), stratified by Medicaid status. The frailty factors are negative for the lowest count category, 0 ADLs, because the CMS-HCC model overpredicts for this subset. The remaining frailty factors are positive and increase as the level of frailty increases, as measured by ADL counts. Unlike most MA plans, PACE organizations typically will have a greater proportion of enrollees with non-zero ADL counts, with an expected net effect of a positive factor and an overall increase in monthly capitation payments.

CMS conducted research to determine whether or not to apply the frailty adjustment to all MA plans. CMS concluded that applying the frailty adjuster would not improve payment accuracy primarily because of methodological concerns. First, to date, the HOS data currently

used to determine frailty scores is sampled only at the contract level, and therefore does not allow CMS to calculate accurate frailty scores at the plan benefit package (PBP) level. Because bids and plan benefit designs are made at the PBP level, applying a contract-level frailty score would lead to inconsistent payments across plans and beneficiaries. Second, if frailty were applied program wide, MA organizations would need to project a frailty score in their plan bids. However, CMS pays plans using frailty scores calculated after the bid is submitted. Due to the changing nature of the marketplace and the different enrollment profiles of plans from year to year, this creates a risk that the level of frailty assumed by a plan in its bid would not reflect its actual frailty score in the payment year. PACE plans do not bid on Part C benefits and are not affected by this issue. Third, the County ratebook would need to be standardized with risk scores that include the appropriate frailty adjustment, which would require that CMS obtain adequate ADLs at the county level. Between the need to sample at the PBP level to calculate the frailty scores, as well as at the county level in order to appropriately standardize the ratebook, the cost of obtaining adequate data appears prohibitive.

2.8.2 Chronic Condition Special Needs Plans with New Enrollees

Under the Medicare Modernization Act of 2003 (MMA), Congress created a new type of MA plan focused on coordinating care for beneficiaries with special needs, called a Special Needs Plan (SNP). These plans are allowed to target one of three types of beneficiaries: 1) institutionalized (nursing home or nursing home certifiable); 2) dually eligible to both Medicaid and Medicare; and 3) individuals with severe or disabling chronic conditions. Further legislation, the Medicare Improvements for Patients and Providers Act (MIPPA) of 2008, restricted enrollment in chronic condition SNPs (C-SNPs) and mandated that CMS convene a panel of clinical advisors to determine the SNP-specific chronic conditions that meet the definition of severe or disabling. That panel identified 15 SNP-specific chronic conditions, shown in **Table 2-3** (CMS, 2008).

As was discussed previously, enrollees who are new to Medicare lack the full base-year diagnosis data needed for the CMS-HCC model to predict their expenditures in the next year and therefore are risk adjusted using a demographic-only new enrollee model. New enrollees who enroll in a C-SNP are likely to have more diseases than the average Medicare new enrollee, or at least one of the targeted chronic condition diseases, and thus pose a greater risk of higher expenditures to these C-SNPs. To account for these differences, CMS implemented in 2011 an adjustment for new enrollees in MA C-SNPs.

To create the adjustment, CMS regressed the risk scores of continuing enrollees enrolled in C-SNPs on new enrollee demographic variables—age-sex categories, Medicaid status, and originally disabled status. Only continuing enrollees were used in the sample because they had risk scores reflecting their morbidity. The factors derived from that regression were added to those of the Aged-Disabled New Enrollee model to create the C-SNP new enrollee adjustment.

Table 2-3
Chronic conditions covered by special needs plans

Chronic Condition Special Needs Plan (C-SNP) Conditions
1. Chronic alcohol and other drug dependence
2. Autoimmune disorders
3. Cancer, excluding pre-cancer conditions or in situ status
4. Cardiovascular disorders
5. Chronic heart failure
6. Dementia
7. Diabetes mellitus
8. End-stage liver disease
9. End-stage renal disease requiring dialysis (any mode of dialysis)
10. Severe hematological disorders
11. HIV/AIDS
12. Chronic lung disorders
13. Chronic and disabling mental health conditions
14. Neurologic disorders
15. Stroke

SOURCE: 2008 Special Needs Plan Chronic Condition Panel Final Report.

2.9 Ongoing CMS-HCC Risk Adjustment Research

The adoption of the CMS-HCC prospective risk adjustment payment model (Pope, Kautter, Ingber, et al., 2004) starting in 2004 allowed for substantially more accurate predictions of medical costs for MA enrollees than was previously possible. Its use is intended to redirect money away from MA plans that disproportionately enroll the healthy, while providing the MA plans that care for the sickest patients the resources to do so. The ultimate purpose of the CMS-HCC model is to promote fair payments to MA plans that reward efficiency and encourage high quality care for the chronically ill.

CMS is continually conducting research on refining the CMS-HCC risk adjustment model. A major focus of this research is the incorporation of variables that increase the predictive accuracy of the CMS-HCC model for high-cost beneficiaries for whom \the model doesn't fully predict expenditures. These are beneficiaries for whom actual expenditures during the year are significantly higher than predicted expenditures at the beginning of the year. In other words, these beneficiaries have high "residual" expenditures. A number of factors may

contribute to high residual expenditure cases, including comorbidities, frailty, use of hospice or home health, and other factors. CMS is continually examining methodologies to better predict high residual expenditure cases, preferably without including utilization factors, which, as is well known, may create incentives for inappropriate utilization. Below we present selected research analyses, along with their limitations (Pope, Kautter, and Ingber, 2009).

2.9.1 Profiling Beneficiary Groups Defined by Functional Impairments

One goal of CMS' research is to investigate ways to improve expenditure prediction using administrative data of average expenditures for groups of beneficiaries distinguished by their number of limitations in activities of daily living (ADL). A first step in this direction is through profiling the characteristics of beneficiaries by ADL group. Examining the characteristics of the ADL groups may lead to insights about how to better predict their associated expenditures. We describe some of the results here.

The most frequent 10 Diagnosis-Related Groups (DRGs)[4] and Hierarchical Condition Categories (HCCs) were examined for a random sample of Medicare beneficiaries by ADL groups, defined as number of difficulties with ADLs (0, 1-2, 3-4, 5-6). Overall, the analysis of the most common DRGs and HCCs provides little information that could be used to improve predictions of expenditures by ADL group. DRGs and HCCs are more common among the functionally impaired population, but the mix of DRGs and HCCs differs little.

In addition, selected characteristics by beneficiaries with 5-6 ADLs whose expenditures were under- or overpredicted by the CMS-HCC model were examined. The 5-6 ADL group was focused on because this is the most underpredicted group on average, and the most functionally impaired. Overall, these statistics indicate that the underpredicted subgroup within the 5-6 ADL group has higher prior year expenditures, utilization, and number of diagnoses than the overpredicted subgroup, but the differences are not dramatic. The death rate in the current year is much higher for the underpredicted subgroup. The implications are that modest improvements in underpredictions might be attainable through greater use of prior year expenditure and utilization information. Greater gains might be achievable if it were possible to find prior year characteristics that predicted the much higher current year mortality of the underpredicted group. Current year mortality itself could be used as an ex post risk adjuster to improve underpredictions, although this is usually avoided because of the obvious negative quality of care incentives.

2.9.2 Adding New Sources of Information

In earlier work, CMS evaluated inclusion of new sources of information into the CMS-HCC risk adjustment model, including diagnoses from home health agencies and from durable medical equipment (DME) vendors, as well as indicators of DME use, such as oxygen therapy and wheelchairs (Pope et al., 2000b). In general, these new sources of information improved prediction of expenditures modestly, with the greatest improvement in the frail elderly subgroup. But risk adjustment models, or sources of information incorporated into such models, should not

[4] The current DRG patient classification system, effective October 1, 2007, uses Medicare-Severity DRGs, or MS-DRGs. The analyses described were conducted on pre-2007 data and thus used the DRGs.

be selected solely on the basis of predictive accuracy. Other equally or more important criteria for evaluating risk adjusters include incentives for appropriate and high quality care, and resistance to provider manipulation. For example, payment credit for wheelchair use could provide an incentive for the purchase of wheelchairs in cases when their use could be considered discretionary or inappropriate, rather than necessary. This would contribute to Medicare's costs both through unnecessary wheelchair purchases and, if wheelchair use were included in the risk adjustment model, the corresponding higher risk-adjusted payments to plans.

Diagnostic-related groups.[5] Because hospital expenditures comprise a significant proportion of the spending of high-cost beneficiaries, more recent analyses have explored incorporating data from DRGs, the unit of payment for Medicare inpatient acute-care hospitals. CMS identified for which DRGs the CMS-HCC model overpredicts, predicts accurately, and underpredicts and then examined adding a set of "mispredicted" clusters of DRGs to the model. The addition of these DRG clusters slightly improved the model's predictive power, although less than a percentage point. However, it did not improve the average predictive accuracy across subgroups, especially the highest-cost beneficiaries. In short, some additional power to explain future expenditures is available in extra diagnoses, in knowledge of whether beneficiaries are hospitalized, and in the diagnoses and procedures associated with these hospitalizations. But modest gains in explanatory power from incorporating this additional information must be balanced against other criteria for risk adjustment such as incentives, gaming, simplicity, and minimizing data collection and processing burden.

Home health. CMS also examined incorporating Medicare home health Outcome and Assessment Information Set (OASIS) data, which contains ADL and other information useful for frailty adjustment. It is known that there is a positive correlation between home health utilization and frailty (Kautter, Ingber, and Pope, 2008). The analyses compared adding a home health utilization marker as well as a functional score for home health utilizers. Adding the home health markers improves predictions for home health users, but does not address the majority of functionally impaired beneficiaries, who do not receive home health services. In addition, there is a concern about the incentives created by including utilization markers in the risk adjustment methodology. Including a utilization marker provides an incentive for Medicare private plans to provide some utilization to more people, in order to get the increase in payment from the risk adjustment methodology. Moreover, utilization risk markers increase the sensitivity of the model's predictions—and payments—to geographic or other practice pattern variations such as greater or lesser reliance on home health services.

2.9.3 Model Specification

The specification of the CMS-HCC model is a linear regression in which expenditures are predicted by diagnoses (CMS-HCCs) and demographics. CMS is exploring variations on this model specification. It has been speculated that beneficiaries with many comorbidities tend to be underpredicted by the CMS-HCC payment model and that this group may be correlated with beneficiaries with ADL deficits and beneficiaries disproportionately enrolled by Special Needs Plans (The SNP Alliance, 2009). To address this issue, CMS is exploring a *nonlinear model*

5 Ibid.

approach, which essentially interacts all diseases in the payment model, but not through explicit interaction terms between individual diseases.

Initial model results indicate that there is some interactivity among the HCCs, that a pure linear model is not ideal. The nonlinear model has both advantages and disadvantages. The nonlinear form does not improve predictive accuracy for individuals (R-squared rose only very slightly). It is slightly biased in predicting mean expenditures overall and by age, sex and other variables. The nonlinear model significantly improves predictive ratios for low predicted expenditure deciles, and predicts quite accurately across the range of predicted expenditures. It does not significantly improve predictions by functional limitation count (frailty).

An alternative method of capturing nonlinearities in the risk adjustment model is to use interaction terms (e.g., between two or more HCCs). Specifying specific interaction effects has greater clinical transparency and theoretically could be more accurate than the nonlinear functional form, which constrains interactive relationships among HCCs. The CMS-HCC V12 model includes the HCC interaction terms that contributed significantly to model predictive power when it was originally calibrated, and ongoing work is being conducted to assess what additional interaction terms might be added in order to improve the predictive power of the model. In the Version 21 clinical revision and recalibration of the CMS-HCC model, new interaction terms were evaluated and added (e.g., Cancer interacted with Immune disorders). Additional analysis requires estimating a much larger number of parameters, and hence requires large sample sizes and more clinical review in development. Current exploratory research, using 100 percent samples rather than 5 percent samples, will help in identifying and evaluating other potential interaction terms. Testing the proposed interaction terms on different subsamples of adequate size will aid in discerning whether or not the interaction terms are stable.

Another disadvantage of a nonlinear model compared to the standard linear model is that it is less intuitive and more difficult to explain. It is also more cumbersome to estimate—it requires greater computational resources, and convergence in estimation is not guaranteed. Finally, it may create greater incentives for "upcoding" because the marginal increase in predicted expenditures with more HCCs is greater, at least among individuals with a large number of diagnoses. Interaction terms would have the same effect, but they could be targeted to HCCs with diagnoses that are less likely to involve discretionary coding variation. For example, morbid obesity is resistant to "upcoding" since it can be defined by a specific range of BMI (body mass index) values.

The summaries of selected ongoing research illustrate CMS' commitment to improving its risk adjustment models as well as the complexity of issues and factors that interact with regards to these improvements.

SECTION 3
MODEL EVALUATION

This Section presents a quantitative evaluation of the CMS-HCC risk adjustment models. Risk adjustment models are typically evaluated with two key statistics—the R^2, which measures the extent to which the model can explain individual differences, and predictive ratios, which measure the ability of the model to predict average costs over the entire group or subgroups. Predictive ratios should be assessed with individual explanatory power (R^2) also in mind.

A predictive ratio—the ratio of a group's predicted cost to its actual cost—measures the accuracy of the model in predicting the average cost of a group. When predictive ratios are close to 1.0, this indicates that the variance around the average within the group has an average close to zero. A simple model may be quite good at predicting the average cost for a large group of beneficiaries because these errors of prediction average out. However, the ability of the simple model to differentiate beneficiaries within the group may be poor. This is the case with the demographic risk adjustment model, where the predictive ratios can be 1.0, or close to 1.0, for some subgroups, but the model R^2 is very low, indicating that there is much unexplained variation among the beneficiaries within the group. Each version of the CMS-HCC model, which has a considerably greater R^2 than the demographic model, may have predictive ratios that are not quite as close to 1.0, but this model is superior in its ability to distinguish high and low cost individuals.

While prediction is expected to be accurate for diseases and characteristics included in the model, calculating these predictive ratios serves as a useful check on model performance. Model accuracy for characteristics not included in the model is less certain, and provides information on how accurate the model is for characteristics of interest, but that may not be appropriate to include in the model (e.g., because they establish poor incentives, or are gameable). The ratios presented in this report are mostly based on grouping by demographic characteristics, clinical characteristics and prior or current utilization or expenditures.

Section 3.1 covers predictive ratios for the CMS-HCC model, Version 12 (V12). Section 3.2 compares the performance of CMS-HCC V12 with the clinically-revised V21 of the CMS-HCC model. Predictive ratios from a demographic risk adjustment model are presented for comparison in each section. The demographic risk adjustment model includes the same age-sex cells, Medicaid, and originally disabled variables as are included in the V12 CMS-HCC model.

3.1 CMS-HCC Model V12 Predictive Ratios

This section presents predictive ratios that are used to evaluate the performance of the V12 CMS-HCC model. Predictive ratios evaluate the average predictive performance of the model for subgroups of beneficiaries. Predictive ratios are calculated as the ratio of mean predicted to mean actual expenditures for a group of beneficiaries. A predictive ratio of 1.0 indicates accurate prediction. A ratio greater than 1.0 indicates overprediction and a ratio less than 1.0 indicates underprediction.

This section reports predictive ratios for the different subpopulations to which the CMS HCC model is applied. In each table, sample sizes for each subgroup, along with mean actual and predicted expenditures, are shown with the predictive ratios. We begin in Section 3.1.1 with

by far the largest subpopulation, aged-disabled, community continuing enrollees. Section 3.1.2 addresses institutionalized beneficiaries. Section 3.1.3 discusses new Medicare enrollees.

3.1.1 Aged-Disabled Community Continuing Enrollees

All predictive ratios discussed in this section were calculated on the Medicare 2004-2005 5 percent sample of aged-disabled community continuing enrollees used for calibration of the V12 CMS-HCC model. This sample was also used for calibration of the demographic model.

Demographic groups

Table 3-1 shows predictive ratios for the entire calibration sample in various demographic subgroups. All of the characteristics in the table are included in the CMS-HCC model, and the predictive ratios confirm accurate prediction for them on the calibration sample.

Predicted expenditure deciles and percentiles

Table 3-2 shows predictive ratios by deciles of 2005 predicted expenditures and the top 5 and 1 percent of predicted beneficiary expenditures. Predictive ratios are shown for deciles and percentiles defined by expenditures predicted by the CMS-HCC model and by the demographic models. The CMS-HCC model predicts 2005 expenditures using 2004 diagnoses and demographic information. The demographic model predicts 2005 expenditures using demographic information only. The predictive ratios by deciles from a model's own predicted expenditures test model "calibration," that is, to what extent groups of beneficiaries predicted to have certain levels of expenditures actually have those levels on average.

For deciles and percentiles formed by CMS-HCC model predicted expenditures, CMS-HCC model prediction is quite accurate for the middle and high-expenditure deciles, and even for the top 5 and 1 percent of highest-predicted cost beneficiaries. There is some underprediction for the first two deciles. Underprediction for the lowest predicted groups is related to the dominance in the Medicare population of people with medical conditions captured by the model. The lowest predicted groups are quite healthy; most have no HCCs included in the model. The predictions for healthy people are determined by CMS-HCC model demographic factors only, and the values for these demographic factors are the same for both beneficiaries without HCCs and those with model HCCs. For those beneficiaries with HCCs, the age-sex factors have modest importance in explaining costs. The coefficient of an included HCC reflects the costs of not only that condition, but some of the costs of conditions not in the model if they occur frequently in people with the included HCC. The actual effect in dollars of the underprediction in the low deciles is quite small, as it is a percentage of a relatively small expenditure level.

CMS-HCC model predictions for the deciles and percentiles sorted on demographic model predicted expenditures are also quite good, except for a modest underprediction for the top 1th percentile. This good performance is not surprising because the CMS-HCC model includes demographic factors. The CMS-HCC model is well calibrated for demographic predicted expenditures.

Demographic model predictions for the deciles and percentiles sorted by demographic model predicted expenditures show that the predictive ratios of the demographic model in Table 3-2 are all close to 1.0, indicating that the demographic model is well-calibrated for its own

predictions. But the range of predicted expenditures of the demographic model is much narrower than the range of predicted expenditures of the CMS-HCC model. Demographic factors alone do not distinguish well between beneficiaries who will be costly in the next year versus beneficiaries who will not be costly. The tenth to first decile predicted expenditure range of the demographic model is only 2.7 to 1 ($11,620 versus $4,372) versus a 9.7 to 1 range of the CMS-HCC model ($23,306 versus $2,392). When deciles and percentiles are sorted on the CMS-HCC model predictions, the predictive ratios of the demographic model are poor, and differ substantially from 1.0 (top panel I. of Table 3-2, right hand side). The demographic model does not predict well the range of expenditures that have been ordered by a more powerful model, the CMS-HCC model.

Although predictive ratios grouped by actual cost have been published, we are not presenting these predictive ratios here since this grouping makes little analytic sense and interpreting such predictive ratios is not always meaningful. The reason that predictive ratios grouped by actual cost are not meaningful is that modeling of future medical spending can never exactly predict costs, and sorting by actual cost is essentially testing to see if all people with high actual costs were predicted high and all those with low actual costs were predicted low. Insurance models are developed using information known prior to the insurance period and future medical events have both predictable and unpredictable, essentially random, components. An insurance model captures the predictable component and seeks to balance the over and under-prediction errors so the average actual spending for a group equals the average predicted spending.

Instead of testing to see if a group organized by actual cost (a group influenced by random outcomes) had their costs predicted accurately, we test to see if a group organized by risk (predicted cost), had average actual costs that were equivalent to their predicted costs. In other words, grouping predictive ratios based on risk allows us to assess whether the over-predictions and under-predictions balance out, so that the average predicted costs over a large enough group equal the actual costs. This test is shown in Table 3-2. This evaluative measure sorts an insured population into premium classes related to risk and evaluates whether each class has revenue equal to payouts. To make an analogy with life insurance, the insured are sorted into their underwriting classes and the premiums for each class are compared to the payouts, which are related to the mortality rates.

When sorting on **actual** expenditures one is sorting from low actual spending to high actual spending. The analogy in life insurance would be to sort the insured by whether they lived (low payout) or died (high payout) and compare the premiums for each group to the payout for each group. Clearly there would be premium overpayment for the survivors and underpayment for the decedents. This pattern of over and under-prediction is not confined to insurance, but occurs with regression models of any type of data when the observations are sorted in this way, by actual rather than predicted values. In the risk adjustment model a low actual spending group is biased to be below the predicted because it contains people predictably low and additional people who randomly fell below their predicted level. There may even be a group of people who unpredictably have 0 spending in this group. A high actual spending group contains both people predictably high and a set of people who were randomly higher than predicted. There may even be extreme random outliers driving this group. The actual spending at the low end will average lower than the predicted, and the actual will average higher than the predicted at the high end.

The pattern of predicted ratios by actual cost groups is hard to interpret because it occurs as a matter of the mathematics rather than biases in the model. Since only a perfect model would not exhibit this behavior, we do not find such tables useful in judging the performance of the CMS-HCC model.

Number of HCCs

Table 3-3 shows predictive ratios by number of HCCs assigned to each beneficiary. Because the CMS-HCC is an additive model, a larger count of HCCs means a greater burden of disease. Table 3-3 restricts the HCC count to HCCs included in the payment model, which are serious, high-cost diseases. The CMS-HCC predictive ratios show that model prediction is accurate across a range of number of HCCs, from none (where prediction is entirely by demographic factors) to 10 or more (which indicates a high burden of serious disease co-existing conditions).

Chronic Disease HCC Groups: Individual and Multiple Chronic Diseases

Table 3-4 shows predictive ratios for selected groups of HCCs that together comprise a single serious chronic condition that is common in the Medicare population. For Table 3-4, the individual HCCs in a HCC clinical hierarchy that distinguish severity are grouped together to indicate presence of the disease. For example, the diabetes HCC group contains 5 HCCs, each of which indicates diabetes, and the coronary artery disease group contains 4 HCCs, each of which indicates coronary artery disease. The predictive ratios are exactly 1.0 for all but three of the HCC groups. The three groups with predictive ratios less than 1.0 contain some HCCs that are not included in the payment model. These predictive ratios show that the CMS-HCC model predicts accurately, although not perfectly, for beneficiaries with some individual major chronic conditions common in the Medicare population. Moreover, the CMS-HCC predictions are much more accurate than the demographic model predictions, even for beneficiaries with conditions not included in the CMS-HCC payment model.

Tables 3-5 and 3-6 show predictive ratios for beneficiaries with combinations of 2 or 3 of the HCC groups, for example, diabetes and cancer, or diabetes, cancer, and chronic obstructive pulmonary disease. Validation group beneficiaries have the specified 2 or 3 HCC groups and may have others in addition; the validation groups are not restricted to beneficiaries who have only the specified conditions. The predictive ratios for the 2- and 3-HCC groups are generally close to one, indicating accurate model prediction. These results indicate that the CMS-HCC model is predicting expenditures accurately for beneficiaries who have combinations of major chronic illnesses common in the Medicare population.

Predicted Expenditure Deciles and Percentiles for Chronic Disease HCC Groups

Tables 3-7 through 3-12 show predictive ratios for deciles of predicted expenditures for 5 HCC groups studied in Table 3-4, plus an additional condition, HCC 92, Heart Arrhythmias. These tables show several things. First, the HCC model predicts a wide range of expenditures for beneficiaries with specific chronic conditions. The expenditure predictions differ because the disease severity and burden of coexisting conditions, comorbidities, and complications varies widely, even among beneficiaries with a serious chronic illness. For example, if a beneficiary is diagnosed with uncomplicated diabetes only, his or her expenditure prediction will be relatively modest. But if a beneficiary has diagnoses for diabetes with chronic complications, congestive

heart failure, vascular disease, cancer, and chronic obstructive pulmonary disease, his or her predicted expenditures will be much higher.

Second, the CMS-HCC model is "well calibrated" across the wide range of predicted expenditures. That is, actual expenditures correspond well to predicted expenditures across the range of predictions, or, equivalently, the predictive ratios are fairly close to one. For example, the first decile of predicted expenditures for congestive heart failure (Table 3-8) is $6,938 and actual expenditures are $7,058. The top 1 percent of predicted expenditures is $59,805 and actual expenditures are $64,130. These numbers show that the model is doing well at distinguishing more expensive from less expensive beneficiaries with congestive heart failure, a predicted and actual cost range of 9 to 1.

Prior Year Hospitalizations

Table 3-13 shows predictive ratios by number of prior year (2004) beneficiary hospitalizations. Model prediction is good for beneficiaries with 0, 1, or 2 hospitalizations. But the model underpredicts expenditures by about 18 percent for the 2.8 percent of beneficiaries with 3 or more prior year hospitalizations.

Chronic Condition Special Needs Plan (C-SNP) Diagnoses

The next set of tables show predictive ratios for disease categories corresponding to the 15 SNP-specific chronic conditions that meet the definition of severe or disabling. Predictive ratios discussed in this subsection were calculated on the 2004-2005 Medicare fee-for-service 5 percent sample of aged-disabled community continuing enrollees calibration dataset.

1) C-SNPs: Definitions and Predictive Ratios

Table 3-14 identifies the 15 SNP-specific chronic conditions and lists the validation group definitions. While the 2008 SNP Chronic Condition Panel identified these chronic conditions and eligible subcategories within them, it did not provide ICD-9-CM code-specific definitions for each condition. The groupings for these predictive ratios are approximations based on an analysis of the Version 12 CMS-HCC structure. They are done at the HCC level, rather than the at the diagnostic group or individual code level, and include combinations of payment HCCs and non-payment HCCs. HCCs identified as “approximate mapping” include both the targeted diagnoses as well as a subset of diagnoses that were not specified by the panel.

Table 3-15 shows predictive ratios for 14 of the 15 C-SNP conditions. (*SNP 9 End-stage renal disease requiring dialysis* is excluded because it corresponds to the ESRD continuing enrollee dialysis model.) The results show the predictive accuracy is quite good for most of the C-SNP categories. For those conditions defined only by complete payment HCCs, the predictive ratios of 1.0 confirm accurate prediction. *SNP 6 Dementia* had the greatest underprediction, about 14 percent. It is defined by a single HCC which is not included in the V12 payment model. Other C-SNP categories with predictive ratios of less than 1.0 are defined by a mix of payment and non-payment HCCs.

With the possible exception of dementia, the results show that health plans concentrating on these chronic conditions or combinations of these conditions would have risk adjustment of

their rates that is appropriate. A risk adjuster that accounts for both the conditions being focused on and a wide range of comorbidities works well for such atypical enrollee groups.

2) C-SNPs: Predicted expenditure deciles and percentiles

Table 3-16 shows predictive ratios for deciles of predicted expenditures for the 14 C-SNP categories presented in Table 3-15. These results are consistent with those presented in the earlier chronic disease discussion (Tables 3-7 through 3-12). The CMS-HCC model predicts a wide range of expenditures for beneficiaries with these C-SNP conditions. As was noted earlier, the expenditure predictions differ because the disease severity and burden of coexisting conditions, comorbidities, and complications varies widely, even among beneficiaries with these severe or disabling chronic conditions. For example, a beneficiary within *SNP 1 Chronic alcohol and other drug dependence* could be diagnosed with alcohol dependence only, and his or her expenditure prediction would be relatively low. Another beneficiary in that same SNP 1 category could have diagnoses for alcohol psychoses, drug psychoses, schizophrenia, hepatitis, and liver failure, and his or her predicted expenditures would be much higher.

For many of these C-SNP categories, the CMS-HCC model is "well calibrated" across the wide range of predicted expenditures. That is, actual expenditures correspond well to predicted expenditures across the range of predictions, or, equivalently, the predictive ratios are fairly close to 1.0. For example, for *SNP 1 Chronic alcohol and other drug dependence,* the first decile of predicted expenditures is $6,291 and actual expenditures are $6,172. The top 1 percent of predicted expenditures is $65,760 and actual expenditures are $66,041. These numbers show that the model is doing well distinguishing more expensive from less expensive beneficiaries within this C-SNP category. Several of the C-SNP categories, such as *SNP 4 Cardiovascular disorders* and *SNP 14 Neurologic disorders*, underpredict for the lowest deciles, which is logical based on how they are defined. These C-SNP categories include non-payment HCCs in their definitions—at the lowest deciles there would be fewer payment-HCC comorbidities to be included in their predicted expenditures. This pattern is evident in the predictive ratios for *SNP 6 Dementia*. Although the dementia HCC is not included in the payment model, at the higher deciles the underprediction decreases as the CMS-HCC model picks up the predicted expenditures of the comorbidities.

3.1.2 Institutionalized Continuing Enrollees

This section discusses selected predictive ratios for institutionalized continuing enrollees. The predictive ratios in this section were calculated on the Medicare 2004-2005 100 percent sample of long-term institutionalized calibration dataset. This sample was also used for calibration of the demographic model.

Predicted Expenditure Deciles and Percentiles

Table 3-17 shows predictive ratios for validation groups defined by deciles and the top 5 and 1 percent of 2005 predicted beneficiary expenditures. Predictive ratios are shown for deciles and percentiles defined by predicted expenditures from both the CMS-HCC model and the demographic model. As seen from the table, the CMS-HCC model performs well when deciles/percentiles are sorted by its own predicted expenditures, as well as by the demographic model predicted expenditures. When sorted by the CMS-HCC model deciles/percentiles, the

results show that predictive accuracy is good across all deciles, with very slight overprediction in the middle set of deciles and significant underprediction only in the first decile. This brings attention to the model's ability to predict annualized expenditure in the lower range of predicted 2005 expenditure. Beneficiaries with low predicted expenditures tend to have zero payment HCCs, placing much explanatory burden on demographic factors, thus impacting the accuracy of prediction. Predictive accuracy for the top 5 percent and 1 percent is very good, indicating strong model performance at higher predicted expenditure levels.

Comparatively, the demographic model only performs well on its own predictions, and poorly when deciles/percentiles are sorted on CMS-HCC predicted expenditures. It is reassuring that both models predict well for the demographic model-predicted deciles, though this is expected since both models include demographic factors. Only the CMS-HCC model performs well in both scenarios. Thus, the CMS-HCC model incorporates most of the information in the previous demographic model, while adding new predictive information not captured by the demographic model.

Number of HCCs

Table 3-18 shows predictive ratios based on the number of payment HCCs assigned to each beneficiary. Due to the fact that the CMS-HCC model is additive, a larger count of HCCs suggests a greater burden of disease. The results show that predictive accuracy is quite good across a range of number of payment HCCs, except for zero HCCs. This is due to the fact that when zero payment HCCs are present, the expenditure prediction is based solely on demographic factors, preventing an accurate prediction. Once HCCs are incorporated (any count above zero), predictive accuracy is near perfect.

Chronic Disease HCC Groups: Individual and Multiple Chronic Diseases

Table 3-19 shows predictive ratios for selected groups of HCCs that together comprise a single serious chronic condition that is common in the Medicare population. For example, Renal Disease (RENAL) would include HCCs 130-132: dialysis status, renal failure, and nephritis. As seen in the table, all predictive ratios are 1.0 except for a few that are just above or below 1.0. These slight digressions are due in large part to the presence of HCCs not included in the payment model within these groups. For example, with Coronary Artery Disease (CAD), 1 of the 4 included HCCs is not in the payment model, decreasing predictive accuracy. The results show that overall, the CMS-HCC model predicts accurately for beneficiaries with individual major chronic conditions common in the Medicare population. In the institutional population, in contrast to the community population, CMS-HCC model predictive ratios are close to 1.0 for beneficiaries with dementia, even though dementia is not included in the V12 CMS-HCC model. The V12 CMS-HCC model for the institutionalized predicts spending for beneficiaries with dementia well, even without explicitly including dementia, because a large proportion of institutionalized beneficiaries have dementia. These beneficiaries are typical for the institutionalized population, and the institutional CMS-HCC model predicts the average expenditures of the institutionalized well. In contrast, beneficiaries with dementia are rare in the community population, and without the inclusion of dementia, the community CMS-HCC model does not predict the extra spending associated with a diagnosis of dementia in the community setting particularly well.

3.1.3 New Medicare Enrollees

All predictive ratios discussed in this section were calculated on the Medicare 2004-2005 5 percent sample calibration dataset for new Medicare enrollees (V12). See Section 2.7.2 for information on the new enrollee segment of the CMS-HCC model. About 12 percent of the modeling sample comprises true new enrollees, meaning those who are new to Medicare and those who are entitled to Medicare but have not enrolled in Part B. The tables in this section present predictive ratios for only the true new enrollee subsample. These predictive ratios are limited in that the new enrollee model is a demographic model only. There is no expectation that the new enrollee demographic model will predict well for domains outside the demographic groups as there is no clinical content in the model.

True New Enrollee Subsample: Demographic Groups

Table 3-20 shows predictive ratios for the true new enrollee subsample's demographic characteristics. As would be expected when profiling a small proportion of the modeling sample, these predictive ratios differ from 1.0 for nearly all groups. The beneficiary counts demonstrate how the true new enrollee population is concentrated at age 65. Because many of the new enrollee groups are quite small, their predictive ratios may be randomly or systematically different from 1.0.

True New Enrollee Subsample: Predicted Expenditure Deciles

Table 3-21 shows predictive ratios for deciles and top percentiles of predicted expenditures for the true new enrollee subsample. The results show predictive accuracy is good at most levels, with slight underprediction at the lowest decile and slight overprediction in some of the mid-level deciles.

3.2 Comparison of CMS-HCC Model V12 and V21

This section compares the performance of the CMS-HCC model V12 to the clinically-revised V21 of the model. Two types of statistics are presented. Section 3.2.1 presents R-squared, or R^2, statistics, which are defined as the percentage of variance in individual expenditures explained by the model. The R-squared statistic summarizes the ability of the models to explain variation in annual expenditures (Medicare payments) among individual beneficiaries. Section 3.2.2 presents predictive ratios for the model, and the ratio of mean predicted to mean actual expenditures for subgroups of beneficiaries. Predictive ratios measure the mean accuracy of the model in predicting expenditures for groups of beneficiaries.

3.2.1 Percentage of Variation in Expenditures Explained (R^2)

Table 3-22 shows the R^2 statistic for revised (Version 21, or V21) versus the current (Version 12, or V12) CMS-HCC models, by model segment. The revised model R^2s are higher for all sub-models. The increase in R^2 could be due to two factors. The first is improvements in the model. Several HCC diagnostic categories were added to the V21 payment model, notably dementia. Distinguishing between beneficiaries with and without these conditions raises the model's explanatory power. Also, the diagnoses assigned to the existing payment HCCs were refined. The model's Medicaid indicator was improved through the use of the CME "MMA state files" (rather than the Denominator file "state buy-in indicator"), resulting in the identification of

additional Medicaid-enrolled beneficiaries, who have higher average expenditures. This change in the Medicaid variable presumably plays the major role in explaining the increase in the R^2 of the new enrollees model, which does not include diagnoses.

The second factor raising the R^2s is the secular increase in the completeness of diagnostic coding, which has raised model R^2s over time, even when the same model is estimated on newer data. The revised model R^2s were estimated on 2006-2007 data, whereas the previous model R^2s were estimated on 2004-2005 data. Newer data may be particularly important in explaining the large increase in the R^2 of the ESRD dialysis model; the earlier version of that model was estimated on 2002-2003 data.

3.2.2 Predictive Ratios

Predictive ratios were compared between the V12 and V21 CMS-HCC models for the aged-disabled community continuing enrollee population. (Comparisons were made for the institutional or the new enrollee populations.) The predictive ratio comparisons are made between the V12 CMS-HCC models estimated on 2004-2005 data (the calibration dataset for the V12 CMS-HCC model), and the V21 CMS-HCC model estimated on 2006-2007 data (the calibration dataset for the V21 CMS-HCC model).

Demographic groups

Table 3-23 shows predictive ratios by demographic group. All the predictive ratios for demographic groups are 1.0 for both models, indicating exact prediction (on the calibration sample). This is expected because age, sex, Medicaid enrollment, and originally disabled status are included in all of these models.

Predicted expenditures deciles and percentiles

As shown in Table 3-24, the predictive ratios for predicted expenditure deciles and percentiles are similar between the V12 and V21 CMS-HCC models. The V12 model is slightly better calibrated for the low deciles of predicted expenditures, while the V21 model is slightly better calibrated for the highest deciles and percentiles of predicted expenditures.

Number of HCCs

Table 3-25 shows that the V21 CMS-HCC model predicts slightly more accurately by number of payment HCCs. The difference is greatest for 10 or more payment HCCs, where the V21 model's predicted costs are 95.2 percent of actual costs, whereas the V12 model's predicted costs are 92.8 percent of actual costs. This indicates some improvement in predictive accuracy among beneficiaries with the greatest burden of disease as measured by large numbers of HCCs.

Chronic Disease HCC Groups

Table 3-26 shows predictive ratios for HCC chronic disease groups, which are single or multiple HCCs that together define a single, major chronic disease such as diabetes or congestive heart failure. The predictive ratios are essentially the same for all conditions except for dementia. Spending for beneficiaries with dementia is significantly underpredicted by the V12 CMS-HCC model but is predicted accurately by the V21 CMS-HCC model. This reflects the addition of dementia to the payment HCCs of the V21 model.

Predicted Expenditure Deciles and Percentiles for Chronic Disease HCC Groups

Tables 3-27 through 3-32 show predictive ratios for deciles and percentiles for specific chronic disorders as represented by HCC groups. The V12 and V21 CMS-HCC model predictive ratios are generally quite similar. There are slight differences from disease to disease, but no strong patterns or differences between the models emerge across these tables.

Prior Year Hospitalizations

Table 3-33 shows predictive ratios by count of prior year hospital discharges. The V21 CMS-HCC model predictive ratios are slightly more accurate across these groups. For example, the V21 model's predicted costs are 83.1 percent of actual costs for beneficiaries with 3 or more prior year hospital discharges while the V12 model's predicted cost for these beneficiaries are 82.1 percent of actual costs. We note that beneficiaries with 3 or more hospitalizations comprise fewer than 3% of the population, while those with zero hospitalizations comprise 81% of the population. If MA plans enroll beneficiaries that experience anything close to the range of hospitalizations in the population, their risk will average out.

Body Systems/Disease Groups

The next set of comparison tables show predictive ratios for body system or disease group categories within the CMS-HCC payment models. These are clusters of related HCCs, as is shown in Table 3-34, which identifies the validation group definitions. These tables are designed to make comparisons by body system/disease group between the Version 12 model (2004-2005 data) and the clinically-revised and recalibrated Version 21 model (2006-2007 data). With the exception of the Version 12 Cognitive group, which relates to dementia, all groups are fully defined by payment HCCs only.

Table 3-35 presents the predictive ratios for the 26 categories. The predictive ratios for both sets, except V12 cognitive, are nearly identical to 1.0, as would be expected. The slight variations from perfect prediction are due to hierarchy structures within the individual categories. Significant differences in numbers of beneficiaries between the two versions help identify categories that were reconfigured in the clinically-revised model. For example, the Metabolic category, which in V12 is composed of a single payment HCC (HCC 21 Protein-Calorie Malnutrition), includes three HCCs in the V21 model (HCC 21 Protein-Calorie Malnutrition, HCC 22 Morbid Obesity, and HCC 23 Other Significant Endocrine and Metabolic Disorders).

Table 3-36 presents predictive ratios for deciles and top percentiles of predicted expenditures for the 26 categories. With the exception of the Cognitive category (dementia), which was previously discussed, there is no systematic pattern of differences between the two versions. Both the V12 and V21 versions of the CMS-HCC model predict a wide range of expenditures from the first to the tenth deciles. Most predictive ratios are relatively close to 1.0. In some cases, the categories with multiple deciles indicating over-prediction or under-prediction greater than 10 percent are those with small sample sizes.

Chronic Condition Special Needs Plan (C-SNP) Diagnoses

The next set of tables compares Version 12 (2004-2005 data) and Version 21 (2006-2007 data) predictive ratios for the C-SNP diagnoses described previously in section 3.1.1. Predictive

ratios discussed in this subsection were calculated on the Medicare fee-for-service 5 percent sample of aged-disabled community continuing enrollees calibration datasets, with the exception of *SNP 9 End-stage renal disease requiring dialysis*. For V21 only, SNP 9 was calculated on the 2006-2007 Medicare fee-for-service 100 percent sample of ESRD dialysis continuing enrollees calibration dataset. It is important to keep in mind these differences in samples when looking at the number of beneficiaries—only SNP 9 has 100 percent beneficiary counts, the other C-SNP categories have 5 percent counts.

Table 3-37 identifies the 15 C-SNP conditions and the validation group definitions for the V12 and V21 CMS-HCC models. The validation group definitions are comparable, but not exact matches. The V12 C-SNP set uses complete HCCs only, both payment and non-payment, and thus is broader in its definitions. The V12 validation group definitions were created for other analyses which permitted only complete HCCs. The V21 C-SNP set did not have the complete HCC restriction. It includes combinations of complete payment HCCs and non-payment HCCs, as well as subsets of HCCs when appropriate.

Table 3-38 presents V12 and V21 predictive ratios for the 15 C-SNP conditions. The results show the predictive accuracy is quite good for both versions of the CMS-HCC model. For those conditions defined by complete payment HCCs, the predictive ratios of 1.0 confirm accurate prediction. C-SNPs that are underpredicted, such as *SNP 14 Neurological disorders,* include diagnoses that are part of non-payment model HCCs.

Table 3-39 compares V12 and V21 predictive ratios for deciles of predicted expenditures for the 15 C-SNP categories. These results are consistent with those presented in the earlier chronic disease discussions. For most of these 15 C-SNP categories, the CMS-HCC model (or the ESRD Dialysis model) is "well calibrated" across the wide range of predicted expenditures. The V21 set of predicted ratios for *SNP 9 End-stage renal disease requiring dialysis* illustrate why a separate model is needed for dialysis (much higher expenditures) and that the ESRD dialysis continuing enrollee model does predict accurately, even for the top 1 percent. For the most part, comparisons across the two versions do not reveal systematic differences. As expected, *SNP 6 Dementia* has much better predictive ratios in V21 where it is defined by payment model HCCs. The C-SNP conditions that include diagnoses outside of the payment model, for example *SNP 4 Cardiovascular disorders* and *SNP 14 Neurologic disorders*, underpredict in both V12 and V21 for the lowest deciles. *SNP 8 End-stage liver disease* is the only C-SNP category with great variability in its predictive ratios and no logical pattern in that variability. Small sample size limits the model's predictive ability for this C-SNP in both V12 and V21. Presumably, no actual special needs plan would have a pool of potential enrollees large enough to support offering an "end-stage liver disease"-only C-SNP.

Table 3-1
Predictive ratios for aged-disabled community continuing enrollees: Demographics
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 Mean expenditures predicted ($)	Ratio predicted to actual
All enrollees	1,441,247	7,461	7,461	1.000
Aged (age 65+ Feb 2005)	1,234,070	7,543	7,543	1.000
Disabled (age < 65 Feb 2005)	207,177	6,975	6,975	1.000
Female, 0-34	8,040	5,502	5,502	1.000
Female, 35-44	16,498	6,307	6,307	1.000
Female, 45-54	28,914	7,471	7,471	1.000
Female, 55-59	19,286	8,175	8,175	1.000
Female, 60-64	22,415	8,912	8,912	1.000
Female, 65-69	151,934	5,379	5,379	1.000
Female, 70-74	170,401	6,246	6,246	1.000
Female, 75-79	160,440	7,481	7,481	1.000
Female, 80-84	128,755	8,614	8,614	1.000
Female, 85-89	73,209	9,704	9,704	1.000
Female, 89-94	30,888	10,785	10,785	1.000
Female, 95 or older	9,194	10,343	10,343	1.000
Male, 0-34	10,767	4,343	4,343	1.000
Male, 35-44	22,249	5,748	5,748	1.000
Male, 45-54	35,601	6,366	6,366	1.000
Male, 55-59	20,727	6,678	6,678	1.000
Male, 60-64	22,680	8,155	8,155	1.000
Male, 65-69	127,824	5,752	5,752	1.000
Male, 70-74	136,024	6,937	6,937	1.000
Male, 75-79	114,404	8,541	8,541	1.000
Male, 80-84	79,507	9,799	9,799	1.000
Male, 85-89	37,102	10,989	10,989	1.000
Male, 89-94	11,991	12,235	12,235	1.000
Male, 95 or older	2,397	12,687	12,687	1.000
Originally disabled 2005	97,450	10,738	10,738	1.000
Medicaid 2004	245,202	9,157	9,157	1.000

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-2
Predictive ratios for aged-disabled community continuing enrollees: Deciles and percentiles of predicted 2005 annualized expenditures
Version 12 CMS-HCC model and Demographic model

Validation groups	Number of beneficiaries	CMS-HCC model 2005 mean expenditures actual ($)	CMS-HCC model 2005 mean expenditures predicted ($)	CMS-HCC model ratio predicted to actual	Demographic model actual	Demographic model predicted	Demographic model ratio predicted to actual
Sorted by CMS-HCC model predicted expenditures							
First (lowest) decile	144,125	2,392	2,134	0.892	2,392	4,954	2.071
Second decile	144,125	2,989	2,776	0.929	2,989	5,899	1.974
Third decile	144,125	3,631	3,486	0.960	3,631	6,891	1.898
Fourth decile	144,125	4,300	4,190	0.974	4,300	7,598	1.767
Fifth decile	144,125	5,096	5,047	0.990	5,096	7,615	1.494
Sixth decile	144,125	6,068	6,055	0.998	6,068	8,089	1.333
Seventh decile	144,125	7,334	7,436	1.014	7,334	8,245	1.124
Eighth decile	144,124	9,152	9,441	1.032	9,152	8,313	0.908
Ninth decile	144,124	12,403	12,855	1.036	12,403	8,564	0.690
Tenth (highest)	144,124	23,306	23,274	0.999	23,306	8,658	0.372
Top 5%	72,063	29,482	28,971	0.983	29,482	8,666	0.294
Top 1%	14,413	45,560	42,851	0.941	45,560	8,590	0.189
Sorted by Demographic Model predicted expenditures							
First (lowest) decile	144,125	4,396	4,419	1.005	4,396	4,372	0.995
Second decile	144,125	5,188	5,044	0.972	5,188	5,127	0.988
Third decile	144,125	5,570	5,601	1.006	5,570	5,669	1.018
Fourth decile	144,125	6,361	6,397	1.006	6,361	6,386	1.004
Fifth decile	144,125	6,944	6,949	1.001	6,944	6,970	1.004
Sixth decile	144,125	7,935	8,003	1.008	7,935	7,898	0.995
Seventh decile	144,125	8,104	8,130	1.003	8,104	8,169	1.008
Eighth decile	144,124	9,105	9,088	0.998	9,105	9,010	0.990
Ninth decile	144,124	9,831	9,858	1.003	9,831	9,792	0.996
Tenth (highest)	144,124	11,580	11,524	0.995	11,580	11,620	1.003
Top 5%	72,063	12,345	12,259	0.993	12,345	12,516	1.014
Top 1%	14,413	13,335	13,489	1.012	13,335	13,959	1.047

NOTE: Demographic model includes age, sex, Medicaid enrollment, and originally disabled status.
SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data

Table 3-3
Predictive ratios for aged-disabled community continuing enrollees: Number of payment HCCs
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
Number of HCCs included in the payment model:				
0	567,906	3,468	3,297	0.951
1-3	713,671	7,834	7,990	1.020
4-6	128,624	18,396	18,575	1.010
7-9	25,166	31,615	30,815	0.975
10+	5,880	50,675	47,008	0.928

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-4
Predictive ratios for aged-disabled community continuing enrollees: HCC groups
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual	Demographic model actual	Demographic model predicted	Demographic model ratio predicted to actual
DIAB	300,593	11,103	11,103	1.000	11,103	7,768	0.700
CHF	171,566	16,898	16,898	1.000	16,898	8,494	0.503
CAD	338,239	12,412	11,653	0.939	12,412	8,076	0.651
CVD	150,009	13,074	12,376	0.947	13,074	8,163	0.624
VASC	174,696	14,529	14,529	1.000	14,529	8,286	0.570
COPD	185,895	14,437	14,437	1.000	14,437	8,066	0.559
RENAL	56,113	19,302	19,302	1.000	19,302	8,417	0.436
DEMENTIA	70,991	14,351	12,315	0.858	14,351	8,932	0.622
CANCER	155,871	12,608	12,608	1.000	12,608	7,784	0.617

NOTES
Version 12 CMS-HCC Model:
Diabetes (DIAB) = HCCs 15-19
Congestive Heart Failure (CHF) = HCC 80
Coronary Artery Disease (CAD) = HCCs 81-84
Cerebrovascular Disease (CVD) = HCCs 95-100, 102-103
Vascular Disease (VASC) = HCCs 104-105
Chronic Obstructive Pulmonary Disease (COPD) = HCCs 107-108
Renal Disease (RENAL) = HCCs 130-132
Dementia (DEMENTIA) = HCCs 49
Cancer (CANCER) = HCCs 7-10
Heart Arrhythmia: HCC 92
Demographic model includes age, sex, Medicaid enrollment, and originally disabled status.

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-5
Predictive ratios for aged-disabled community continuing enrollees: Two HCC groups
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
DIAB*CHF	65,303	20,286	20,286	1.000
DIAB*CAD	112,763	15,566	14,843	0.954
DIAB*CVD	46,304	16,830	16,213	0.963
DIAB*VASC	58,702	18,118	18,010	0.994
DIAB*COPD	50,944	19,384	18,954	0.978
DIAB*RENAL	27,479	22,226	22,024	0.991
DIAB*DEMENTIA	17,430	19,715	17,106	0.868
DIAB*CANCER	35,969	16,230	16,328	1.006
CHF*CAD	107,982	18,830	18,281	0.971
CHF*CVD	37,826	20,955	20,538	0.980
CHF*VASC	49,843	22,429	22,187	0.989
CHF*COPD	57,536	22,271	22,268	1.000
CHF*RENAL	25,859	26,445	26,393	0.998
CHF*DEMENTIA	17,119	23,228	21,122	0.909
CHF*CANCER	24,496	22,525	22,454	0.997
CAD*CVD	72,928	16,050	14,955	0.932
CAD*VASC	85,362	17,618	17,022	0.966
CAD*COPD	78,850	18,617	18,066	0.970
CAD*RENAL	30,196	23,653	22,927	0.969
CAD*DEMENTIA	24,540	19,414	16,739	0.862
CAD*CANCER	47,796	17,211	16,427	0.954
CVD*VASC	47,570	17,273	16,768	0.971
CVD*COPD	32,237	19,927	19,197	0.963
CVD*RENAL	13,402	24,733	23,847	0.964
CVD*DEMENTIA	21,650	18,641	16,053	0.861

(continued)

Table 3-5 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Two HCC groups
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
CVD*CANCER	20,685	17,763	17,163	0.966
VASC*COPD	45,268	20,830	20,463	0.982
VASC*RENAL	19,557	25,316	24,926	0.985
VASC*DEMENTIA	17,761	20,369	18,435	0.905
VASC*CANCER	26,619	19,487	19,564	1.004
COPD*RENAL	15,970	27,680	27,122	0.980
COPD*DEMENTIA	13,574	22,503	20,283	0.901
COPD*CANCER	28,797	20,102	20,181	1.004
RENAL*DEMENTIA	6,097	27,411	24,687	0.901
RENAL*CANCER	9,978	24,403	24,268	0.994
DEMENTIA*CANCER	8,568	18,481	17,552	0.950

NOTES
Version 12 CMS-HCC Model:
Diabetes (DIAB) = HCCs 15-19
Congestive Heart Failure (CHF) = HCC 80
Coronary Artery Disease (CAD) = HCCs 81-84
Cerebrovascular Disease (CVD) = HCCs 95-100, 102-103
Vascular Disease (VASC) = HCCs 104-105
Chronic Obstructive Pulmonary Disease (COPD) = HCCs 107-108
Renal Disease (RENAL) = HCCs 130-132
Dementia (DEMENTIA) = HCCs 49
Cancer (CANCER) = HCCs 7-10
Heart Arrhythmia: HCC 92
Validation group beneficiaries have the two indicated HCC groups, and may have other HCC groups, i.e., validation groups are not defined as having only the two indicated HCC groups.

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data

Table 3-6
Predictive ratios for aged-disabled community continuing enrollees: Three HCC groups
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
DIAB*CHF*CAD	45,754	21,989	21,446	0.975
DIAB*CHF*CVD	16,117	24,585	24,175	0.983
DIAB*CHF*VASC	22,140	25,858	25,464	0.985
DIAB*CHF*COPD	23,212	26,245	25,713	0.980
DIAB*CHF*RENAL	14,488	28,774	28,687	0.997
DIAB*CHF*DEMENTIA	6,156	28,172	25,699	0.912
DIAB*CHF*CANCER	9,058	25,934	26,124	1.007
DIAB*CAD*CVD	27,434	19,675	18,567	0.944
DIAB*CAD*VASC	34,242	21,143	20,374	0.964
DIAB*CAD*COPD	28,698	22,934	22,016	0.960
DIAB*CAD*RENAL	16,615	26,299	25,308	0.962
DIAB*CAD*DEMENTIA	8,347	24,459	21,107	0.863
DIAB*CAD*CANCER	15,286	20,746	20,093	0.969
DIAB*CVD*VASC	17,629	21,446	20,611	0.961
DIAB*CVD*COPD	11,188	25,065	23,903	0.954
DIAB*CVD*RENAL	6,995	27,941	26,845	0.961
DIAB*CVD*DEMENTIA	6,670	24,240	21,051	0.868
DIAB*CVD*CANCER	6,243	21,851	21,557	0.987
DIAB*VASC*COPD	16,172	25,810	24,844	0.963
DIAB*VASC*RENAL	10,555	28,427	27,598	0.971
DIAB*VASC*DEMENTIA	5,604	26,509	23,383	0.882
DIAB*VASC*CANCER	8,482	23,321	23,353	1.001
DIAB*COPD*RENAL	8,162	31,363	30,193	0.963
DIAB*COPD*DEMENTIA	4,196	29,353	25,772	0.878
DIAB*COPD*CANCER	7,907	25,220	24,895	0.987
DIAB*RENAL*DEMENTIA	2,835	31,793	28,254	0.889
DIAB*RENAL*CANCER	4,372	27,730	27,555	0.994
DIAB*DEMENTIA*CANCER	2,286	23,248	22,688	0.976
CHF*CAD*CVD	28,166	22,262	21,515	0.966
CHF*CAD*VASC	36,539	23,886	23,096	0.967
CHF*CAD*COPD	39,111	24,111	23,557	0.977
CHF*CAD*RENAL	19,384	28,108	27,367	0.974

(continued)

Table 3-6 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Three HCC groups
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
CHF*CAD*DEMENTIA	10,907	25,687	22,879	0.891
CHF*CAD*CANCER	16,072	24,320	23,648	0.972
CHF*CVD*VASC	16,536	24,504	24,204	0.988
CHF*CVD*COPD	13,825	26,776	26,126	0.976
CHF*CVD*RENAL	7,571	30,440	29,640	0.974
CHF*CVD*DEMENTIA	6,992	26,857	24,196	0.901
CHF*CVD*CANCER	5,798	26,232	25,766	0.982
CHF*VASC*COPD	20,464	27,539	26,892	0.977
CHF*VASC*RENAL	11,212	31,238	30,520	0.977
CHF*VASC*DEMENTIA	6,525	28,470	25,920	0.910
CHF*VASC*CANCER	8,012	27,967	27,752	0.992
CHF*COPD*RENAL	10,737	32,203	31,397	0.975
CHF*COPD*DEMENTIA	6,103	29,213	27,176	0.930
CHF*COPD*CANCER	9,494	28,090	28,085	1.000
CHF*RENAL*DEMENTIA	3,440	33,046	30,482	0.922
CHF*RENAL*CANCER	4,515	31,837	31,806	0.999
CHF*DEMENTIA*CANCER	2,415	27,590	26,856	0.973
CAD*CVD*VASC	29,859	19,420	18,534	0.954
CAD*CVD*COPD	20,258	22,523	21,459	0.953
CAD*CVD*RENAL	9,362	26,948	25,824	0.958
CAD*CVD*DEMENTIA	10,347	22,556	19,524	0.866
CAD*CVD*CANCER	10,785	20,761	19,649	0.946
CAD*VASC*COPD	27,871	23,411	22,569	0.964
CAD*VASC*RENAL	13,351	28,143	26,963	0.958
CAD*VASC*DEMENTIA	8,679	24,473	21,854	0.893
CAD*VASC*CANCER	13,648	22,207	21,906	0.986
CAD*COPD*RENAL	10,892	30,588	29,374	0.960
CAD*COPD*DEMENTIA	7,122	26,396	23,769	0.900
CAD*COPD*CANCER	13,298	24,087	23,548	0.978
CAD*RENAL*DEMENTIA	3,667	31,219	27,874	0.893
CAD*RENAL*CANCER	5,456	28,289	27,657	0.978
CAD*DEMENTIA*CANCER	3,505	22,885	21,722	0.949
CVD*VASC*COPD	14,354	23,169	22,546	0.973

(continued)

Table 3-6 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Three HCC groups
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
CVD*VASC*RENAL	6,798	28,361	27,004	0.952
CVD*VASC*DEMENTIA	7,407	24,319	21,441	0.882
CVD*VASC*CANCER	7,331	21,719	21,597	0.994
CVD*COPD*RENAL	4,645	32,235	30,946	0.960
CVD*COPD*DEMENTIA	5,297	26,665	23,820	0.893
CVD*COPD*CANCER	5,438	25,223	24,673	0.978
CVD*RENAL*DEMENTIA	2,672	31,218	27,870	0.893
CVD*RENAL*CANCER	2,357	30,090	29,108	0.967
CVD*DEMENTIA*CANCER	2,918	22,685	21,028	0.927
VASC*COPD*RENAL	7,319	31,964	31,233	0.977
VASC*COPD*DEMENTIA	4,941	27,991	25,693	0.918
VASC*COPD*CANCER	8,235	25,784	25,918	1.005
VASC*RENAL*DEMENTIA	2,587	32,922	29,624	0.900
VASC*RENAL*CANCER	3,714	29,793	29,893	1.003
VASC*DEMENTIA*CANCER	2,451	24,846	24,125	0.971
COPD*RENAL*DEMENTIA	2,125	34,649	31,838	0.919
COPD*RENAL*CANCER	3,224	32,300	32,106	0.994
COPD*DEMENTIA*CANCER	2,167	26,330	26,089	0.991
RENAL*DEMENTIA*CANCER	1,048	30,138	29,336	0.973

NOTES
Version 12 CMS-HCC Model:
Diabetes (DIAB) = HCCs 15-19
Congestive Heart Failure (CHF) = HCC 80
Coronary Artery Disease (CAD) = HCCs 81-84
Cerebrovascular Disease (CVD) = HCCs 95-100, 102-103
Vascular Disease (VASC) = HCCs 104-105
Chronic Obstructive Pulmonary Disease (COPD) = HCCs 107-108
Renal Disease (RENAL) = HCCs 130-132
Dementia (DEMENTIA) = HCCs 49
Cancer (CANCER) = HCCs 7-10
Heart Arrhythmia: HCC 92
Validation group beneficiaries have the three indicated HCC groups, and may have other HCC groups, i.e., validation groups are not defined as having only the three indicated HCC groups.

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-7
Predictive ratios for aged-disabled community continuing enrollees: Deciles and percentiles of predicted 2005 expenditures, diabetes
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
DIAB 2005 predicted:				
First (lowest) decile	30,060	3,960	3,651	0.922
Second decile	30,060	4,801	4,657	0.970
Third decile	30,060	5,796	5,655	0.976
Fourth decile	30,059	6,786	6,771	0.998
Fifth decile	30,059	8,027	8,050	1.003
Sixth decile	30,059	9,458	9,637	1.019
Seventh decile	30,059	11,296	11,661	1.032
Eighth decile	30,059	14,019	14,529	1.036
Ninth decile	30,059	18,915	19,166	1.013
Tenth (highest)	30,059	31,934	31,151	0.976
Top 5%	15,030	39,061	37,507	0.960
Top 1%	3,006	57,667	52,621	0.912

NOTES: Diabetes (DIAB) = HCCs 15-19

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-8
Predictive ratios for aged-disabled community continuing enrollees: Deciles and percentiles of predicted 2005 expenditures, congestive heart failure
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
CHF 2005 predicted:				
First (lowest) decile	17,157	7,058	6,938	0.983
Second decile	17,157	9,294	9,187	0.989
Third decile	17,157	10,738	10,849	1.010
Fourth decile	17,157	12,423	12,502	1.006
Fifth decile	17,157	13,856	14,235	1.027
Sixth decile	17,157	15,897	16,165	1.017
Seventh decile	17,156	18,222	18,480	1.014
Eighth decile	17,156	21,372	21,578	1.010
Ninth decile	17,156	26,273	26,314	1.002
Tenth (highest)	17,156	39,841	38,525	0.967
Top 5%	8,579	47,663	45,042	0.945
Top 1%	1,716	64,130	59,805	0.933

NOTES: Congestive Heart Failure (CHF) = HCC 80

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-9
Predictive ratios for aged-disabled community continuing enrollees: Deciles and percentiles of predicted 2005 expenditures, vascular disorders
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
VASC 2005 predicted:				
First (lowest) decile	17,470	5,746	5,573	0.970
Second decile	17,470	7,213	7,197	0.998
Third decile	17,470	8,383	8,560	1.021
Fourth decile	17,470	9,702	9,922	1.023
Fifth decile	17,470	11,046	11,441	1.036
Sixth decile	17,470	12,992	13,270	1.021
Seventh decile	17,469	15,253	15,604	1.023
Eighth decile	17,469	18,588	18,799	1.011
Ninth decile	17,469	23,870	23,871	1.000
Tenth (highest)	17,469	38,259	36,531	0.955
Top 5%	8,735	45,611	43,212	0.947
Top 1%	1,747	60,470	58,181	0.962

NOTES: Vascular Disease (VASC) = HCCs 104-105

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-10
Predictive ratios for aged-disabled community continuing enrollees: Deciles and percentiles of predicted 2005 expenditures, chronic obstructive pulmonary disease
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
COPD 2005 predicted:				
First (lowest) decile	18,590	5,460	5,633	1.032
Second decile	18,590	6,860	6,905	1.007
Third decile	18,590	8,108	8,160	1.007
Fourth decile	18,590	9,541	9,611	1.007
Fifth decile	18,590	11,043	11,342	1.027
Sixth decile	18,589	13,022	13,393	1.029
Seventh decile	18,589	15,509	15,808	1.019
Eighth decile	18,589	18,911	19,032	1.006
Ninth decile	18,589	23,820	23,946	1.005
Tenth (highest)	18,589	38,113	36,231	0.951
Top 5%	9,295	46,038	42,748	0.929
Top 1%	1,859	62,201	57,510	0.925

NOTES: Chronic Obstructive Pulmonary Disease (COPD) = HCCs 107-108

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-11
Predictive ratios for aged-disabled community continuing enrollees: Deciles and percentiles of predicted 2005 expenditures, cancer
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
CANCER 2005 predicted:				
First (lowest) decile	15,588	4,508	4,155	0.922
Second decile	15,587	5,522	5,195	0.941
Third decile	15,587	6,534	6,282	0.961
Fourth decile	15,587	7,885	7,680	0.974
Fifth decile	15,587	9,209	9,180	0.997
Sixth decile	15,587	10,531	11,008	1.045
Seventh decile	15,587	13,166	13,498	1.025
Eighth decile	15,587	16,749	17,390	1.038
Ninth decile	15,587	22,240	22,873	1.028
Tenth (highest)	15,587	36,120	35,123	0.972
Top 5%	7,794	42,935	41,588	0.969
Top 1%	1,559	59,990	56,092	0.935

NOTES: Cancer (CANCER) = HCCs 7-10

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-12
Predictive ratios for aged-disabled community continuing enrollees: Deciles and percentiles of predicted 2005 expenditures, heart arrhythmias
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
ARRHYTHM 2005 predicted:				
First (lowest) decile	16,339	5,328	5,290	0.993
Second decile	16,339	6,895	6,787	0.984
Third decile	16,339	8,193	8,180	0.998
Fourth decile	16,338	9,783	9,584	0.980
Fifth decile	16,338	11,085	11,126	1.004
Sixth decile	16,338	12,754	12,985	1.018
Seventh decile	16,338	15,051	15,293	1.016
Eighth decile	16,338	18,101	18,371	1.015
Ninth decile	16,338	22,923	23,202	1.012
Tenth (highest)	16,338	36,187	35,393	0.978
Top 5%	8,170	43,972	41,851	0.952
Top 1%	1,634	59,884	56,560	0.944

NOTES: Heart Arrhythmia: HCC 92

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-13
Predictive ratios for aged-disabled community continuing enrollees: Prior year hospital discharges
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
Prior Year (2004) Hospital Discharges:				
0	1,168,795	5,694	5,917	1.039
1	171,573	12,060	11,893	0.986
2	59,934	17,125	16,257	0.949
3+	40,945	28,871	23,714	0.821

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-14
Chronic condition special needs plans (C-SNPs) validation group definitions
(Version 12 CMS-HCC model)

SNP	C-SNP description and validation group definition (V12)
SNP 1	Chronic alcohol and other drug dependence = HCCs 51-52
SNP 2	Autoimmune disorders = HCC 38 (approximate mapping)
SNP 3	Cancer (excluding pre-cancer or in-situ status) = HCCs 7-10
SNP 4	Cardiovascular disorders = HCCs 81-84, 92-93, 104-105; HCCs 84 and 93 are not in the payment model
SNP 5	Chronic heart failure = HCC 80 (approximate mapping)
SNP 6	Dementia = HCC 49; HCC 49 is not in the payment model
SNP 7	Diabetes mellitus = HCCs 15-19
SNP 8	End-stage liver disease = HCC 25
SNP 9	End-stage renal disease requiring dialysis (all modes of dialysis) = ESRD continuing enrollee dialysis model
SNP 10	Severe hematological disorders = HCC 44 (approximate mapping) and HCC 46 (approximate mapping); HCC 46 is not in payment model
SNP 11	HIV/AIDS = HCC 1
SNP 12	Chronic lung disorders = HCC 108, HCC 109 (approximate mapping), HCC 110; HCCs 109-110 are not in the payment model
SNP 13	Chronic and disabling mental health conditions = HCCs 54-55
SNP 14	Neurologic disorders = HCCs 39 (approximate mapping), 67-68, 71-73, 74 (approximate mapping), 100-101, 102 (approximate mapping); HCCs 39 and 102 are not in the payment model
SNP 15	Stroke = HCCs 95-96, 100-101 (approximate mapping), 102 (approximate mapping); HCC 102 is not in the payment model

NOTE: These C-SNP validation group definitions are done at the HCC level, rather than at the diagnostic group or individual ICD-9-CM code level. HCCs identified as "approximate mapping" include a subset of diagnoses that are not specified in the 2008 Special Needs Plan Chronic Condition Panel Final Report. For example, SNP 2 Autoimmune disorders is restricted to polyarteritis nodosa, polymyalgia rheumatica, polymyositis, rheumatoid arthritis, and systemic lupus erythematosus. HCC 38 includes those diagnoses as well as additional inflammatory connective tissue disease diagnoses.

SOURCE: RTI analysis of 2008 Special Needs Plan Chronic Condition Panel Final Report.

Table 3-15
Predictive ratios for C-SNP conditions for 2004-2005 aged-disabled community continuing enrollees[1]: Consolidated SNP groups version 12 on 2004/2005 data

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
SNP1 Chronic alcohol and other drug dependence	15,734	17,194	17,194	1.000
SNP2 Autoimmune disorders	61,687	11,960	11,960	1.000
SNP3 Cancer	155,871	12,608	12,608	1.000
SNP4 Cardiovascular disorders	525,017	11,696	11,304	0.966
SNP5 Chronic heart failure	171,566	16,898	16,898	1.000
SNP6 Dementia	70,991	14,351	12,315	0.858
SNP7 Diabetes mellitus	300,593	11,103	11,103	1.000
SNP8 End-stage liver disease	2,891	23,634	23,634	1.000
SNP9 End-stage renal disease requiring dialysis[1]	—	—	—	—
SNP10 Severe hematological disorders	49,947	18,266	16,929	0.927
SNP11 HIV/AIDS	4,011	16,364	16,364	1.000
SNP12 Chronic lung disorders	242,736	13,130	12,883	0.981
SNP13 Chronic and disabling mental health conditions	77,616	11,444	11,444	1.000
SNP14 Neurologic disorders	262,212	11,469	10,728	0.935
SNP15 Stroke	67,668	14,762	14,614	0.990

NOTE: 1. Because this table focuses on the 2004-2005 Aged-Disabled Community Continuing Enrollee sample, predictive ratios were not calculated for SNP 9 (End-stage renal disease requiring dialysis). Those predictive ratios would need to be done using the 2002-2003 ESRD continuing enrollee dialysis model.

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims.

Table 3-16
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees[1]: Deciles and percentiles of predicted expenditures version 12 on 2004/2005 data

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
SNP1 Chronic alcohol and other drug dependence:				
First (lowest) decile	1,574	6,172	6,291	1.019
Second decile	1,574	8,612	8,802	1.022
Third decile	1,574	9,759	10,198	1.045
Fourth decile	1,574	10,694	11,822	1.105
Fifth decile	1,573	14,701	13,580	0.924
Sixth decile	1,573	14,973	15,696	1.048
Seventh decile	1,573	18,374	18,428	1.003
Eighth decile	1,573	22,947	22,202	0.968
Ninth decile	1,573	27,656	28,255	1.022
Tenth (highest)	1,573	44,563	42,872	0.962
Top 5%	787	52,870	50,252	0.950
Top 1%	158	66,041	65,760	0.996
SNP2 Autoimmune disorders:				
First (lowest) decile	6,169	5,301	4,930	0.930
Second decile	6,169	6,047	5,840	0.966
Third decile	6,169	7,014	6,807	0.970
Fourth decile	6,169	7,928	7,867	0.992
Fifth decile	6,169	8,736	9,036	1.034
Sixth decile	6,169	10,378	10,465	1.008
Seventh decile	6,169	11,997	12,342	1.029
Eighth decile	6,168	14,635	14,980	1.024
Ninth decile	6,168	18,799	19,336	1.029
Tenth (highest)	6,168	32,083	31,256	0.974
Top 5%	3,085	39,719	37,549	0.945
Top 1%	617	56,456	52,367	0.928

(continued)

Table 3-16 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees[1]: Deciles and percentiles of predicted expenditures version 12 on 2004/2005 data

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
SNP3 Cancer:				
First (lowest) decile	15,588	4,508	4,155	0.922
Second decile	15,587	5,522	5,195	0.941
Third decile	15,587	6,534	6,282	0.961
Fourth decile	15,587	7,885	7,680	0.974
Fifth decile	15,587	9,209	9,180	0.997
Sixth decile	15,587	10,531	11,008	1.045
Seventh decile	15,587	13,166	13,498	1.025
Eighth decile	15,587	16,749	17,390	1.038
Ninth decile	15,587	22,240	22,873	1.028
Tenth (highest)	15,587	36,120	35,123	0.972
Top 5%	7,794	42,935	41,588	0.969
Top 1%	1,559	59,990	56,092	0.935
SNP4 Cardiovascular disorders:				
First (lowest) decile	52,502	4,877	3,316	0.680
Second decile	52,502	5,763	4,998	0.867
Third decile	52,502	6,696	6,190	0.924
Fourth decile	52,502	7,737	7,374	0.953
Fifth decile	52,502	8,811	8,667	0.984
Sixth decile	52,502	10,353	10,169	0.982
Seventh decile	52,502	11,921	12,078	1.013
Eighth decile	52,501	14,557	14,732	1.012
Ninth decile	52,501	18,891	19,006	1.006
Tenth (highest)	52,501	31,283	30,479	0.974
Top 5%	26,251	38,361	36,617	0.955
Top 1%	5,251	55,857	51,162	0.916

(continued)

Table 3-16 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees[1]: Deciles and percentiles of predicted expenditures version 12 on 2004/2005 data

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
SNP5 Chronic heart failure:				
First (lowest) decile	17,157	7,058	6,938	0.983
Second decile	17,157	9,294	9,187	0.988
Third decile	17,157	10,738	10,849	1.010
Fourth decile	17,157	12,422	12,502	1.006
Fifth decile	17,157	13,856	14,235	1.027
Sixth decile	17,157	15,897	16,165	1.017
Seventh decile	17,156	18,222	18,480	1.014
Eighth decile	17,156	21,372	21,578	1.010
Ninth decile	17,156	26,273	26,314	1.002
Tenth (highest)	17,156	39,841	38,525	0.967
Top 5%	8,579	47,663	45,042	0.945
Top 1%	1,716	64,130	59,805	0.933
SNP6 Dementia:				
First (lowest) decile	7,100	5,713	3,465	0.607
Second decile	7,099	7,078	4,989	0.705
Third decile	7,099	8,621	6,321	0.733
Fourth decile	7,099	10,017	7,737	0.772
Fifth decile	7,099	11,593	9,352	0.807
Sixth decile	7,099	13,243	11,259	0.850
Seventh decile	7,099	15,979	13,620	0.852
Eighth decile	7,099	18,443	16,868	0.915
Ninth decile	7,099	23,377	22,025	0.942
Tenth (highest)	7,099	36,950	35,212	0.953
Top 5%	3,550	44,804	42,315	0.944
Top 1%	710	64,197	58,364	0.909

(continued)

Table 3-16 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees[1]: Deciles and percentiles of predicted expenditures version 12 on 2004/2005 data

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
SNP7 Diabetes mellitus:				
First (lowest) decile	30,060	3,960	3,651	0.922
Second decile	30,060	4,801	4,657	0.970
Third decile	30,060	5,796	5,655	0.976
Fourth decile	30,059	6,786	6,771	0.998
Fifth decile	30,059	8,027	8,050	1.003
Sixth decile	30,059	9,458	9,637	1.019
Seventh decile	30,059	11,296	11,661	1.032
Eighth decile	30,059	14,019	14,529	1.036
Ninth decile	30,059	18,915	19,166	1.013
Tenth (highest)	30,059	31,934	31,151	0.975
Top 5%	15,030	39,061	37,507	0.960
Top 1%	3,006	57,667	52,621	0.912
SNP8 End-stage liver disease:				
First (lowest) decile	290	8,675	10,485	1.209
Second decile	289	11,442	12,842	1.122
Third decile	289	13,200	14,904	1.129
Fourth decile	289	16,909	17,265	1.021
Fifth decile	289	20,943	19,733	0.942
Sixth decile	289	20,030	22,880	1.142
Seventh decile	289	25,332	26,760	1.056
Eighth decile	289	36,071	31,610	0.876
Ninth decile	289	41,056	37,910	0.923
Tenth (highest)	289	56,185	53,985	0.961
Top 5%	145	68,504	62,523	0.913
Top 1%	29	99,874	80,734	0.808

(continued)

Table 3-16 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees[1]: Deciles and percentiles of predicted expenditures version 12 on 2004/2005 data

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
SNP10 Severe hematological disorders:				
First (lowest) decile	4,995	5,311	3,623	0.682
Second decile	4,995	7,467	6,244	0.836
Third decile	4,995	9,669	8,650	0.895
Fourth decile	4,995	11,528	11,022	0.956
Fifth decile	4,995	14,277	13,508	0.946
Sixth decile	4,995	16,966	16,427	0.968
Seventh decile	4,995	20,469	19,797	0.967
Eighth decile	4,994	25,675	24,126	0.940
Ninth decile	4,994	32,888	30,450	0.926
Tenth (highest)	4,994	48,199	44,658	0.927
Top 5%	2,498	55,384	51,813	0.936
Top 1%	500	66,390	66,814	1.006
SNP11 HIV/AIDS:				
First (lowest) decile	402	5,646	8,533	1.511
Second decile	401	4,976	9,005	1.810
Third decile	401	5,858	9,749	1.664
Fourth decile	401	7,026	11,266	1.603
Fifth decile	401	8,869	12,455	1.404
Sixth decile	401	9,889	14,462	1.462
Seventh decile	401	13,453	16,512	1.227
Eighth decile	401	18,594	19,567	1.052
Ninth decile	401	36,879	24,862	0.674
Tenth (highest)	401	59,567	41,291	0.693
Top 5%	201	66,570	49,694	0.746
Top 1%	41	77,476	66,532	0.859

(continued)

Table 3-16 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees[1]: Deciles and percentiles of predicted expenditures version 12 on 2004/2005 data

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
SNP12 Chronic lung disorders:				
First (lowest) decile	24,274	4,614	3,467	0.751
Second decile	24,274	5,857	5,700	0.973
Third decile	24,274	7,050	6,937	0.984
Fourth decile	24,274	8,452	8,263	0.978
Fifth decile	24,274	9,829	9,833	1.000
Sixth decile	24,274	11,581	11,780	1.017
Seventh decile	24,273	13,965	14,181	1.015
Eighth decile	24,273	17,119	17,323	1.012
Ninth decile	24,273	22,129	22,193	1.003
Tenth (highest)	24,273	36,163	34,427	0.952
Top 5%	12,137	44,038	40,946	0.930
Top 1%	2,428	61,926	55,950	0.903
SNP13 Chronic and disabling mental health conditions:				
First (lowest) decile	7,762	3,805	4,622	1.215
Second decile	7,762	4,632	5,491	1.185
Third decile	7,762	5,362	6,204	1.157
Fourth decile	7,762	6,430	7,156	1.113
Fifth decile	7,762	7,252	8,373	1.155
Sixth decile	7,762	9,648	9,758	1.011
Seventh decile	7,761	11,207	11,630	1.038
Eighth decile	7,761	15,009	14,294	0.952
Ninth decile	7,761	20,427	18,945	0.927
Tenth (highest)	7,761	35,772	32,336	0.904
Top 5%	3,881	44,496	39,638	0.891
Top 1%	777	67,098	56,720	0.845

(continued)

Table 3-16 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees[1]: Deciles and percentiles of predicted expenditures version 12 on 2004/2005 data

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
SNP14 Neurologic disorders:				
First (lowest) decile	26,222	4,338	2,511	0.579
Second decile	26,222	5,258	3,816	0.726
Third decile	26,221	6,175	5,039	0.816
Fourth decile	26,221	7,119	6,371	0.895
Fifth decile	26,221	8,380	7,826	0.934
Sixth decile	26,221	9,660	9,459	0.979
Seventh decile	26,221	11,344	11,529	1.016
Eighth decile	26,221	14,460	14,382	0.995
Ninth decile	26,221	19,257	19,052	0.989
Tenth (highest)	26,221	32,921	31,530	0.958
Top 5%	13,111	40,719	38,153	0.937
Top 1%	2,623	58,139	53,507	0.920
SNP15 Stroke:				
First (lowest) decile	6,767	5,097	4,628	0.908
Second decile	6,767	6,870	6,695	0.975
Third decile	6,767	8,027	8,280	1.032
Fourth decile	6,767	9,659	9,832	1.018
Fifth decile	6,767	11,430	11,548	1.010
Sixth decile	6,767	13,766	13,554	0.985
Seventh decile	6,767	15,974	16,059	1.005
Eighth decile	6,767	19,449	19,434	0.999
Ninth decile	6,766	24,680	24,866	1.008
Tenth (highest)	6,766	40,073	38,384	0.958
Top 5%	3,384	48,460	45,663	0.942
Top 1%	677	66,531	61,533	0.925

NOTE: 1. Because this table focuses on the 2004-2005 Aged-Disabled Community Continuing Enrollee sample, predictive ratios were not calculated for SNP 9 (End-stage renal disease requiring dialysis). Those predictive ratios would need to be done using the 2002-2003 ESRD continuing enrollee dialysis model.

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims.

Table 3-17
Predictive ratios for institutionalized continuing enrollees: Deciles and percentiles of predicted 2005 annualized expenditures
Version 12 CMS-HCC model and Demographic model

Validation groups	Number of beneficiaries	CMS-HCC model 2005 mean expenditures actual ($)	CMS-HCC model 2005 mean expenditures predicted ($)	CMS-HCC model Ratio predicted to actual	Demographic model actual	Demographic model predicted	Demographic model ratio predicted to actual
Sorted by CMS-HCC Model predicted expenditures							
First (lowest) decile	122,710	6,363	5,305	0.834	6,363	10,265	1.613
Second decile	122,710	7,478	7,037	0.941	7,478	12,021	1.607
Third decile	122,710	8,555	8,344	0.975	8,555	12,837	1.500
Fourth decile	122,710	9,470	9,584	1.012	9,470	13,468	1.422
Fifth decile	122,710	10,627	10,915	1.027	10,627	13,917	1.310
Sixth decile	122,710	12,043	12,438	1.033	12,043	14,249	1.183
Seventh decile	122,709	13,857	14,323	1.034	13,857	14,448	1.043
Eighth decile	122,709	16,452	16,913	1.028	16,452	14,581	0.886
Ninth decile	122,709	20,794	21,048	1.012	20,794	14,782	0.711
Tenth (highest)	122,709	32,375	32,001	0.988	32,375	15,329	0.473
Top 5%	61,355	38,578	37,605	0.975	38,578	15,600	0.404
Top 1%	12,271	53,874	49,871	0.926	53,874	16,131	0.299
Sorted by demographic model predicted expenditures							
First (lowest) decile	122,710	9,007	9,044	1.004	9,007	8,813	0.979
Second decile	122,710	10,259	10,266	1.001	10,259	10,449	1.019
Third decile	122,710	10,903	11,118	1.020	10,903	11,063	1.015
Fourth decile	122,710	12,364	12,348	0.999	12,364	12,185	0.986
Fifth decile	122,710	12,860	12,790	0.995	12,860	12,885	1.002
Sixth decile	122,710	13,866	13,797	0.995	13,866	13,773	0.993
Seventh decile	122,709	15,001	14,840	0.989	15,001	14,989	0.999
Eighth decile	122,709	16,037	16,046	1.001	16,037	16,082	1.003
Ninth decile	122,709	16,874	16,949	1.004	16,874	16,873	1.000
Tenth (highest)	122,709	18,300	18,278	0.999	18,300	18,358	1.003
Top 5%	61,355	18,805	18,475	0.982	18,805	18,930	1.007
Top 1%	12,271	20,738	19,419	0.936	20,738	20,692	0.998

NOTE: Demographic model includes age, sex, Medicaid enrollment, and originally disabled status.
SOURCE: RTI analysis of Medicare 2004-2005 100% institutional sample claims and enrollment data.

Table 3-18
Predictive ratios for institutionalized continuing enrollees: Number of payment HCCs
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
Number of HCCs included in the payment model:				
0	125,847	7,012	6,050	0.863
1-3	643,754	9,993	10,091	1.010
4-6	317,513	16,864	17,186	1.019
7-9	102,910	26,564	26,520	0.998
10+	37,072	41,378	39,788	0.962

SOURCE: RTI analysis of Medicare 2004-2005 100% institutional sample claims and enrollment data.

Table 3-19
Predictive Ratios for Institutionalized Continuing Enrollees: HCC Groups
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
DIAB	365,499	18,104	18,104	1.000
CHF	383,135	18,349	18,349	1.000
CAD	396,632	18,134	17,162	0.946
CVD	363,117	16,402	16,220	0.989
VASC	486,498	15,731	15,731	1.000
COPD	266,879	19,908	19,908	1.000
RENAL	128,753	23,409	23,409	1.000
DEMENTIA	680,740	13,154	13,410	1.019
CANCER	103,781	18,031	18,031	1.000

NOTES
Version 12 CMS-HCC Model:
Diabetes (DIAB) = HCCs 15-19
Congestive Heart Failure (CHF) = HCC 80
Coronary Artery Disease (CAD) = HCCs 81-84
Cerebrovascular Disease (CVD) = HCCs 95-100, 102-103
Vascular Disease (VASC) = HCCs 104-105
Chronic Obstructive Pulmonary Disease (COPD) = HCCs 107-108
Renal Disease (RENAL) = HCCs 130-132
Dementia (DEMENTIA) = HCCs 49
Cancer (CANCER) = HCCs 7-10
Heart Arrhythmia: HCC 92

SOURCE: RTI analysis of Medicare 2004-2005 100% institutional sample claims and enrollment data

Table 3-20
Predictive ratios for aged-disabled new enrollees: Demographics, true new enrollee subsample
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
All enrollees	207,481	5,369	5,370	1.000
Aged (sum of groups 65+ years)	147,531	4,771	4,804	1.007
Disabled (sum of groups 0-64 years)	59,950	6,867	6,787	0.988
Female, 0-34 Years	3,805	5,404	5,441	1.007
Female, 35-44 Years	4,964	6,510	6,257	0.961
Female, 45-54 Years	8,464	7,163	7,358	1.027
Female, 55-59 Years	6,007	7,757	8,056	1.038
Female, 60-64 Years	5,263	8,618	8,805	1.022
Female, 65 Years	66,664	4,054	4,062	1.002
Female, 66 Years	2,788	5,059	5,025	0.993
Female, 67 Years	1,724	4,734	5,534	1.169
Female, 68 Years	1,287	4,761	5,887	1.237
Female, 69 Years	1,078	5,726	6,201	1.083
Female, 70-74 Years	3,421	7,478	7,526	1.006
Female, 75-79 Years	1,849	9,444	9,469	1.003
Female, 80-84 Years	1,061	11,021	10,944	0.993
Female, 85+ Years	883	15,154	12,353	0.815
Male, 0-34 Years	4,793	4,524	4,305	0.952
Male, 35-44 Years	5,531	6,163	5,657	0.918
Male, 45-54 Years	8,533	7,061	6,324	0.896
Male, 55-59 Years	6,272	6,805	6,657	0.978
Male, 60-64 Years	6,318	7,601	8,080	1.063
Male, 65 Years	54,810	4,369	4,402	1.007
Male, 66 Years	2,665	4,867	4,905	1.008
Male, 67 Years	1,660	5,721	5,817	1.017
Male, 68 Years	1,239	5,753	5,767	1.003
Male, 69 Years	1,040	5,831	6,353	1.090
Male, 70-74 Years	3,046	7,330	7,762	1.059
Male, 75-79 Years	1,320	9,346	10,014	1.071
Male, 80-84 Years	673	12,247	11,721	0.957
Male, 85+ Years	323	16,484	13,567	0.823
Originally disabled 2005	1,494	8,741	9,295	1.063
Medicaid 2005	42,964	8,401	8,148	0.970

NOTES: 1. Predictive ratios reflect final model coefficients actuarially adjusted so that the predicted mean of the model equals the actual mean for true new enrollees.

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-21
Predictive Ratios for Aged-Disabled New Enrollees: Deciles and Percentiles of predicted 2005 annualized expenditures, True New Enrollee Subsample
Version 12 CMS-HCC model

Validation groups	Number of beneficiaries	2005 mean expenditures actual ($)	2005 mean expenditures predicted ($)	Ratio predicted to actual
2005 predicted:				
First (lowest) decile	20,749	3,804	3,627	0.953
Second decile	20,748	3,782	3,709	0.981
Third decile	20,748	3,494	3,709	1.062
Fourth decile	20,748	4,092	4,089	0.999
Fifth decile	20,748	4,035	4,104	1.017
Sixth decile	20,748	3,914	4,260	1.088
Seventh decile	20,748	5,645	5,477	0.970
Eighth decile	20,748	6,825	6,757	0.990
Ninth decile	20,748	7,859	7,700	0.980
Tenth (highest)	20,748	9,634	9,663	1.003
Top 5%	10,375	10,806	10,696	0.990
Top 1%	2,075	13,911	12,571	0.904

NOTES
1. Predictive ratios reflect final model coefficients actuarially adjusted so that the predicted mean of the model equals the actual mean for true new enrollees.

SOURCE: RTI analysis of Medicare 2004-2005 5% sample claims and enrollment data.

Table 3-22
CMS-HCC model R^2 statistics: Version 21 HCCs estimated on 2006-2007 data versus version 12 HCCs estimated on 2004-2005 data

Model	V12	V21
CMS-HCC Aged-Disabled Community Continuing Enrollees	0.1091	0.1246
CMS-HCC Aged-Disabled Institutional Continuing Enrollees	0.0886	0.0956
CMS-HCC Aged-Disabled New Enrollees	0.0151	0.0186
CMS-HCC ESRD Continuing Enrollee Dialysis[1]	0.0796	0.1134

[1] The V12 model is estimated on 2002-2003 data.

NOTES: Includes payment model HCCs only. Estimated on the calibration sample.

SOURCE: RTI analysis of Medicare claims and enrollment data—2004-2005 and 2006-2007 5% sample (community continuing enrollees; new enrollees), 2004-2005 and 2006-2007 100% long-term institutional sample, and 2002-2003 and 2006-2007 100% ESRD sample.

Table 3-23
Predictive ratios for aged-disabled community continuing enrollees: Demographics model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
All enrollees	1,441,247	1.000	1,359,100	1.000
Aged (age 65+)	1,234,070	1.000	1,153,324	1.000
Disabled (age < 65)	207,177	1.000	205,776	1.000
Female, 0-34	8,040	1.000	8,161	1.000
Female, 35-44	16,498	1.000	15,914	1.000
Female, 45-54	28,914	1.000	29,457	1.000
Female, 55-59	19,286	1.000	19,754	1.000
Female, 60-64	22,415	1.000	22,132	1.000
Female, 65-69	151,934	1.000	141,590	1.000
Female, 70-74	170,401	1.000	155,866	1.000
Female, 75-79	160,440	1.000	144,895	1.000
Female, 80-84	128,755	1.000	119,083	1.000
Female, 85-89	73,209	1.000	73,416	1.000
Female, 89-94	30,888	1.000	30,477	1.000
Female, 95 or older	9,194	1.000	9,095	1.000
Male, 0-34	10,767	1.000	10,637	1.000
Male, 35-44	22,249	1.000	20,145	1.000
Male, 45-54	35,601	1.000	35,442	1.000
Male, 55-59	20,727	1.000	21,121	1.000
Male, 60-64	22,680	1.000	23,013	1.000
Male, 65-69	127,824	1.000	118,696	1.000
Male, 70-74	136,024	1.000	126,673	1.000
Male, 75-79	114,404	1.000	105,406	1.000
Male, 80-84	79,507	1.000	75,126	1.000
Male, 85-89	37,102	1.000	38,524	1.000
Male, 89-94	11,991	1.000	12,071	1.000
Male, 95 or older	2,397	1.000	2,406	1.000
Originally disabled	97,450	1.000	91,266	1.000
Medicaid	245,202	1.000	264,547	1.000

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-24
Predictive ratios for aged-disabled community continuing enrollees: Deciles and percentiles of predicted annualized expenditures model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
First (lowest) decile	144,125	0.892	135,910	0.871
Second decile	144,125	0.929	135,910	0.919
Third decile	144,125	0.960	135,910	0.940
Fourth decile	144,125	0.974	135,910	0.984
Fifth decile	144,125	0.990	135,910	1.022
Sixth decile	144,125	0.998	135,910	1.007
Seventh decile	144,125	1.014	135,910	1.015
Eighth decile	144,124	1.032	135,910	1.033
Ninth decile	144,124	1.036	135,910	1.021
Tenth (highest)	144,124	0.999	135,910	1.000
Top 5%	72,063	0.983	67,956	0.987
Top 1%	14,413	0.941	13,592	0.959

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-25
Predictive ratios for aged-disabled community continuing enrollees: Number of payment HCCs model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
Number of HCCs included in the payment model:				
0	567,906	0.951	495,974	0.953
1-3	713,671	1.020	688,997	1.015
4-6	128,624	1.010	137,267	1.014
7-9	25,166	0.975	29,164	0.973
10+	5,880	0.928	7,698	0.952

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-26
Predictive ratios for aged-disabled community continuing enrollees: HCC groups model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC Model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
DIAB	300,593	1.000	301,176	1.000
CHF	171,566	1.000	158,298	1.000
CAD	338,239	0.939	317,249	0.939
CVD	150,009	0.947	148,074	0.954
VASC	174,696	1.000	178,695	1.000
COPD	185,895	1.000	175,306	1.000
RENAL	56,113	1.000	81,779	1.000
DEMENTIA	70,991	0.858	70,307	1.000
CANCER	155,871	1.000	151,530	1.000

NOTES:
Version 12 CMS-HCC Model:
- Diabetes (DIAB) = HCCs 15-19
- Congestive Heart Failure (CHF) = HCC 80
- Coronary Artery Disease (CAD) = HCCs 81-84
- Cerebrovascular Disease (CVD) = HCCs 95-100, 102-103
- Vascular Disease (VASC) = HCCs 104-105
- Chronic Obstructive Pulmonary Disease (COPD) = HCCs 107-108
- Renal Disease (RENAL) = HCCs 130-132
- Dementia (DEMENTIA) = HCCs 49
- Cancer (CANCER) = HCCs 7-10
- Heart Arrhythmia: HCC 92

Version 21 CMS-HCC Model:
- Diabetes (DIAB) = HCCs 17-19
- Congestive Heart Failure (CHF) = HCC 85
- Coronary Artery Disease (CAD) = HCCs 86-89
- Cerebrovascular Disease (CVD) = HCCs 99-105
- Vascular Disease (VASC) = HCCs 106-108
- Chronic Obstructive Pulmonary Disease (COPD) = HCCs 110-111
- Renal Disease (RENAL) = HCCs 134-141
- Dementia (DEMENTIA) = HCCs 51-52
- Cancer (CANCER) = HCCs 8-12

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-27
Predictive ratios for aged-disabled community continuing enrollees: Deciles and percentiles of predicted expenditures, diabetes model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
DIAB predicted:				
First (lowest) decile	30,060	0.922	30,118	0.891
Second decile	30,060	0.970	30,118	0.975
Third decile	30,060	0.976	30,118	0.993
Fourth decile	30,059	0.998	30,118	1.009
Fifth decile	30,059	1.003	30,118	1.047
Sixth decile	30,059	1.019	30,118	1.043
Seventh decile	30,059	1.032	30,117	1.020
Eighth decile	30,059	1.036	30,117	1.023
Ninth decile	30,059	1.013	30,117	1.020
Tenth (highest)	30,059	0.976	30,117	0.960
Top 5%	15,030	0.960	15,059	0.945
Top 1%	3,006	0.912	3,012	0.918

NOTES:
Version 12 CMS-HCC Model:
Diabetes (DIAB) = HCCs 15-19

Version 21 CMS-HCC Model:
Diabetes (DIAB) = HCCs 17-19

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-28
Predictive ratios for aged-disabled community continuing Enrollees: Deciles and percentiles of predicted expenditures, congestive heart failure model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
CHF predicted:				
First (lowest) decile	17,157	0.983	15,830	0.986
Second decile	17,157	0.989	15,830	0.994
Third decile	17,157	1.010	15,830	1.001
Fourth decile	17,157	1.006	15,830	1.018
Fifth decile	17,157	1.027	15,830	1.015
Sixth decile	17,157	1.017	15,830	1.043
Seventh decile	17,156	1.014	15,830	1.024
Eighth decile	17,156	1.010	15,830	1.017
Ninth decile	17,156	1.002	15,829	0.976
Tenth (highest)	17,156	0.967	15,829	0.967
Top 5%	8,579	0.945	7,915	0.967
Top 1%	1,716	0.933	1,583	0.974

NOTES:
Version 12 CMS-HCC Model:
Congestive Heart Failure (CHF) = HCC 80

Version 21 CMS-HCC Model:
Congestive Heart Failure (CHF) = HCC 85

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-29
Predictive ratios for aged-disabled community continuing Enrollees: Deciles and percentiles of predicted expenditures, vascular disorders model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
VASC predicted:				
First (lowest) decile	17,470	0.970	17,870	0.942
Second decile	17,470	0.998	17,870	0.957
Third decile	17,470	1.021	17,870	1.009
Fourth decile	17,470	1.023	17,870	1.047
Fifth decile	17,470	1.036	17,870	1.012
Sixth decile	17,470	1.021	17,869	1.036
Seventh decile	17,469	1.023	17,869	1.013
Eighth decile	17,469	1.011	17,869	1.034
Ninth decile	17,469	1.000	17,869	1.003
Tenth (highest)	17,469	0.955	17,869	0.961
Top 5%	8,735	0.947	8,935	0.947
Top 1%	1,747	0.962	1,787	0.927

NOTES:
Version 12 CMS-HCC Model:
Vascular Disease (VASC) = HCCs 104-105

Version 21 CMS-HCC Model:
Vascular Disease (VASC) = HCCs 106-108

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-30
Predictive ratios for aged-disabled community continuing Enrollees: Deciles and percentiles of predicted expenditures, chronic obstructive pulmonary disease model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
COPD predicted:				
First (lowest) decile	18,590	1.032	17,531	1.051
Second decile	18,590	1.007	17,531	1.012
Third decile	18,590	1.007	17,531	0.996
Fourth decile	18,590	1.007	17,531	1.020
Fifth decile	18,590	1.027	17,531	0.993
Sixth decile	18,589	1.029	17,531	1.017
Seventh decile	18,589	1.019	17,530	1.018
Eighth decile	18,589	1.006	17,530	1.009
Ninth decile	18,589	1.005	17,530	0.993
Tenth (highest)	18,589	0.951	17,530	0.972
Top 5%	9,295	0.929	8,766	0.965
Top 1%	1,859	0.925	1,754	0.953

NOTES:
Version 12 CMS-HCC Model:
Chronic Obstructive Pulmonary Disease (COPD) = HCCs 107-108

Version 21 CMS-HCC Model:
Chronic Obstructive Pulmonary Disease (COPD) = HCCs 110-111

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-31
Predictive ratios for aged-disabled community continuing Enrollees: Deciles and percentiles of predicted expenditures, cancer model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
CANCER predicted:				
First (lowest) decile	15,588	0.922	15,153	0.873
Second decile	15,587	0.941	15,153	0.958
Third decile	15,587	0.961	15,153	0.952
Fourth decile	15,587	0.974	15,153	0.973
Fifth decile	15,587	0.997	15,153	0.999
Sixth decile	15,587	1.045	15,153	1.029
Seventh decile	15,587	1.025	15,153	1.042
Eighth decile	15,587	1.038	15,153	1.011
Ninth decile	15,587	1.028	15,153	1.014
Tenth (highest)	15,587	0.972	15,153	1.002
Top 5%	7,794	0.969	7,577	1.004
Top 1%	1,559	0.935	1,516	1.024

NOTES:
Version 12 CMS-HCC Model:
Cancer (CANCER) = HCCs 7-10

Version 21 CMS-HCC Model:
Cancer (CANCER) = HCCs 8-12

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-32
Predictive ratios for aged-disabled community continuing Enrollees: Deciles and percentiles of predicted expenditures, heart arrhythmias model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
ARRHYTHM predicted:				
First (lowest) decile	16,339	0.993	16,096	0.974
Second decile	16,339	0.984	16,096	0.987
Third decile	16,339	0.998	16,096	0.982
Fourth decile	16,338	0.980	16,096	1.034
Fifth decile	16,338	1.004	16,096	0.986
Sixth decile	16,338	1.018	16,096	1.016
Seventh decile	16,338	1.016	16,096	1.006
Eighth decile	16,338	1.015	16,096	1.026
Ninth decile	16,338	1.012	16,096	1.016
Tenth (highest)	16,338	0.978	16,096	0.973
Top 5%	8,170	0.952	8,049	0.966
Top 1%	1,634	0.944	1,610	0.957

NOTES:
Version 12 CMS-HCC Model:
Heart Arrhythmia: HCC 92

Version 21 CMS-HCC Model:
Heart Arrhythmia = HCC 96

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-33
Predictive ratios for aged-disabled community continuing enrollees: Prior year hospital Discharges model comparison

Validation groups	**2004-2005 Data** Version 12 CMS-HCC model Number of beneficiaries	**2004-2005 Data** Version 12 CMS-HCC model Ratio predicted to actual	**2006-2007 Data** Version 21 CMS-HCC model Number of beneficiaries	**2006-2007 Data** Version 21 CMS-HCC model Ratio predicted to actual
Prior Year Hospital Discharges:				
0	1,168,795	1.039	1,104,010	1.037
1	171,573	0.986	163,823	0.985
2	59,934	0.949	54,402	0.955
3+	40,945	0.821	36,865	0.831

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-34
Validation group definitions for body systems/disease group HCC categories:
Version 12 CMS-HCC payment model and clinically-revised version 21 CMS-HCC payment model

Version 12 validation group definitions HCC	**Version 12 validation group definitions** HCC Description	HCC category	**Version 21 validation group definitions** HCC	**Version 21 validation group definitions** HCC description
HCC1	HIV/AIDS	Infection	HCC1	HIV/AIDS
HCC2	Septicemia/Shock		HCC2	Septicemia, Sepsis, Systemic Inflammatory Response Syndrome/Shock
HCC5	Opportunistic Infections		HCC6	Opportunistic Infections
HCC7	Metastatic Cancer and Acute Leukemia	Neoplasm	HCC8	Metastatic Cancer and Acute Leukemia
HCC8	Lung, Upper Digestive Tract, and Other Severe Cancers		HCC9	Lung and Other Severe Cancers
			HCC10	Lymphoma and Other Cancers
HCC9	Lymphatic, Head and Neck, Brain, and Other Major Cancers		HCC11	Colorectal, Bladder, and Other Cancers
			HCC12	Breast, Prostate, and Other Cancers and Tumors
HCC10	Breast, Prostate, Colorectal and Other Cancers and Tumors			
HCC15	Diabetes with Renal or Peripheral Circulatory Manifestation	Diabetes	HCC17	Diabetes with Acute Complications
			HCC18	Diabetes with Chronic Complications
HCC16	Diabetes with Neurologic or Other Specified Manifestation		HCC19	Diabetes without Complication
HCC17	Diabetes with Acute Complications			
HCC18	Diabetes with Ophthalmologic or Unspecified Manifestation			
HCC19	Diabetes without Complication			

(continued)

Table 3-34 (continued)
Validation group definitions for body systems/disease group HCC categories:
Version 12 CMS-HCC payment model and clinically-revised version 21 CMS-HCC payment model

Version 12 validation group definitions HCC	**Version 12 validation group definitions** HCC Description	HCC category	**Version 21 validation group definitions** HCC	**Version 21 validation group definitions** HCC description
HCC21	Protein-Calorie Malnutrition	Metabolic	HCC21	Protein-Calorie Malnutrition
			HCC22	Morbid Obesity
			HCC23	Other Significant Endocrine and Metabolic Disorders
HCC25	End-Stage Liver Disease	Liver	HCC27	End-Stage Liver Disease
HCC26	Cirrhosis of Liver		HCC28	Cirrhosis of Liver
HCC27	Chronic Hepatitis		HCC29	Chronic Hepatitis
HCC31	Intestinal Obstruction/Perforation	Gastrointestinal	HCC33	Intestinal Obstruction/Perforation
HCC32	Pancreatic Disease		HCC34	Chronic Pancreatitis
HCC33	Inflammatory Bowel Disease		HCC35	Inflammatory Bowel Disease
HCC37	Bone/Joint/Muscle Infections/Necrosis	Musculoskeletal	HCC39	Bone/Joint/Muscle Infections/Necrosis
HCC38	Rheumatoid Arthritis and Inflammatory Connective Tissue Disease		HCC40	Rheumatoid Arthritis and Inflammatory Connective Tissue Disease
HCC44	Severe Hematological Disorders	Blood	HCC46	Severe Hematological Disorders
HCC45	Disorders of Immunity		HCC47	Disorders of Immunity
			HCC48	Coagulation Defects and Other Specified Hematological Disorders
(See Note below.)		Cognitive	HCC51	Dementia With Complications
			HCC52	Dementia Without Complication

(continued)

Table 3-34 (continued)
Validation group definitions for body systems/disease group HCC categories:
Version 12 CMS-HCC payment model and clinically-revised version 21 CMS-HCC payment model

Version 12 validation group definitions HCC	**Version 12 validation group definitions** HCC Description	HCC category	**Version 21 validation group definitions** HCC	**Version 21 validation group definitions** HCC description
HCC51	Drug/Alcohol Psychosis	Substance Abuse	HCC54	Drug/Alcohol Psychosis
HCC52	Drug/Alcohol Dependence		HCC55	Drug/Alcohol Dependence
HCC54	Schizophrenia	Psychiatric	HCC57	Schizophrenia
HCC55	Major Depressive, Bipolar, and Paranoid Disorders		HCC58	Major Depressive, Bipolar, and Paranoid Disorders
HCC67	Quadriplegia, Other Extensive Paralysis	Spinal	HCC70	Quadriplegia
HCC68	Paraplegia		HCC71	Paraplegia
HCC69	Spinal Cord Disorders/Injuries		HCC72	Spinal Cord Disorders/Injuries
HCC70	Muscular Dystrophy	Neurological	HCC73	Amyotrophic Lateral Sclerosis and Other Motor Neuron Disease
HCC71	Polyneuropathy		HCC74	Cerebral Palsy
HCC72	Multiple Sclerosis		HCC75	Polyneuropathy
HCC73	Parkinson's and Huntington's Diseases		HCC76	Muscular Dystrophy
HCC74	Seizure Disorders and Convulsions		HCC77	Multiple Sclerosis
HCC75	Coma, Brain Compression/Anoxic Damage		HCC78	Parkinson's and Huntington's Diseases
			HCC79	Seizure Disorders and Convulsions
			HCC80	Coma, Brain Compression/Anoxic Damage

(continued)

Table 3-34 (continued)
Validation group definitions for body systems/disease group HCC categories:
Version 12 CMS-HCC payment model and clinically-revised version 21 CMS-HCC payment model

Version 12 validation group definitions HCC	**Version 12 validation group definitions** HCC Description	HCC category	**Version 21 validation group definitions** HCC	**Version 21 validation group definitions** HCC description
HCC77	Respirator Dependence/Tracheostomy Status	Arrest	HCC82	Respirator Dependence/Tracheostomy Status
HCC78	Respiratory Arrest		HCC83	Respiratory Arrest
HCC79	Cardio-Respiratory Failure and Shock		HCC84	Cardio-Respiratory Failure and Shock
HCC80	Congestive Heart Failure	Heart	HCC85	Congestive Heart Failure
HCC81	Acute Myocardial Infarction		HCC86	Acute Myocardial Infarction
HCC82	Unstable Angina and Other Acute Ischemic Heart Disease		HCC87	Unstable Angina and Other Acute Ischemic Heart Disease
HCC83	Angina Pectoris/Old Myocardial Infraction		HCC88	Angina Pectoris
			HCC96	Specified Heart Arrhythmias
HCC92	Specified Heart Arrhythmias			
HCC95	Cerebral Hemorrhage	Cerebrovascular Disease	HCC99	Cerebral Hemorrhage
HCC96	Ischemic or Unspecified Stroke		HCC100	Ischemic or Unspecified Stroke
HCC100	Hemiplegia/Hemiparesis		HCC103	Hemiplegia/Hemiparesis
HCC101	Cerebral Palsy and Other Paralytic Syndromes		HCC104	Monoplegia, Other Paralytic Syndromes
HCC104	Vascular Disease with Complications	Vascular	HCC106	Atherosclerosis of the Extremities with Ulceration or Gangrene
HCC105	Vascular Disease		HCC107	Vascular Disease with Complications
			HCC108	Vascular Disease

(continued)

Table 3-34 (continued)
Validation group definitions for body systems/disease group HCC categories:
Version 12 CMS-HCC payment model and clinically-revised version 21 CMS-HCC payment model

Version 12 validation group definitions HCC	**Version 12 validation group definitions** HCC Description	HCC category	**Version 21 validation group definitions** HCC	**Version 21 validation group definitions** HCC description
HCC107	Cystic Fibrosis	Lung	HCC110	Cystic Fibrosis
HCC108	Chronic Obstructive Pulmonary Disease		HCC111	Chronic Obstructive Pulmonary Disease
HCC111	Aspiration and Specified Bacterial Pneumonias		HCC112	Fibrosis of Lung and Other Chronic Lung Disorders
HCC112	Pneumococcal Pneumonia, Empyema, Lung Abscess		HCC114	Aspiration and Specified Bacterial Pneumonias
			HCC115	Pneumococcal Pneumonia, Empyema, Lung Abscess
HCC119	Proliferative Diabetic Retinopathy and Vitreous Hemorrhage	Eye	HCC122	Proliferative Diabetic Retinopathy and Vitreous Hemorrhage
			HCC124	Exudative Macular Degeneration
HCC130	Dialysis Status	Kidney	HCC134	Dialysis Status
HCC131	Renal Failure		HCC135	Acute Renal Failure
HCC132	Nephritis		HCC136	Chronic Kidney Disease, Stage 5
			HCC137	Chronic Kidney Disease, Severe (Stage 4)
			HCC138	Chronic Kidney Disease, Moderate (Stage 3)
			HCC139	Chronic Kidney Disease, Mild or Unspecified (Stages 1-2 or Unspecified)
			HCC140	Unspecified Renal Failure
			HCC141	Nephritis

(continued)

Table 3-34 (continued)
Validation group definitions for body systems/disease group HCC categories:
Version 12 CMS-HCC payment model and clinically-revised version 21 CMS-HCC payment model

Version 12 validation group definitions HCC	**Version 12 validation group definitions** HCC Description	HCC category	**Version 21 validation group definitions** HCC	**Version 21 validation group definitions** HCC description
HCC148	Decubitus Ulcer of Skin	Skin	HCC157	Pressure Ulcer of Skin with Necrosis Through to Muscle, Tendon, or Bone
HCC149	Chronic Ulcer of Skin, Except Decubitus		HCC158	Pressure Ulcer of Skin with Full Thickness Skin Loss
HCC150	Extensive Third-Degree Burns		HCC159	Pressure Ulcer of Skin with Partial Thickness Skin Loss
			HCC160	Pressure Pre-Ulcer Skin Changes or Unspecified Stage
			HCC161	Chronic Ulcer of Skin, Except Pressure
			HCC162	Severe Skin Burn or Condition
HCC154	Severe Head Injury	Injury	HCC166	Severe Head Injury
HCC155	Major Head Injury		HCC167	Major Head Injury
HCC157	Vertebral Fractures w/o Spinal Cord Injury		HCC169	Vertebral Fractures without Spinal Cord Injury
HCC158	Hip Fracture/Dislocation		HCC170	Hip Fracture/Dislocation
HCC161	Traumatic Amputation		HCC173	Traumatic Amputations and Complications
HCC164	Major Complications of Medical Care and Trauma	Complications	HCC176	Complications of Specified Implanted Device or Graft
HCC174	Major Organ Transplant Status	Transplant	HCC186	Major Organ Transplant or Replacement Status

(continued)

Table 3-34 (continued)
Validation group definitions for body systems/disease group HCC categories:
Version 12 CMS-HCC payment model and clinically-revised version 21 CMS-HCC payment model

Version 12 validation group definitions HCC	**Version 12 validation group definitions** HCC Description	HCC category	**Version 21 validation group definitions** HCC	**Version 21 validation group definitions** HCC description
HCC176	Artificial Openings for Feeding or Elimination	Openings	HCC188	Artificial Openings for Feeding or Elimination
HCC177	Amputation Status, Lower Limb/Amputation Complications	Amputation	HCC189	Amputation Status, Lower Limb/Amputation Complications

NOTE:

For predictive ratio purposes, the Cognitive category for Version 12 is defined as HCC49 Dementia/Cerebral Degeneration, which is not in the V12 CMS-HCC payment model.

SOURCE: RTI analysis of CMS-HCC models.

Table 3-35
Predictive ratios for aged-disabled community continuing enrollees: Body systems/disease group HCC categories model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Infection	20,766	24,947	25,029	1.003	21,899	26,847	26,954	1.004
Neoplasm	155,871	12,608	12,608	1.000	151,530	13,634	13,634	1.000
Diabetes	300,593	11,103	11,103	1.000	301,176	11,824	11,824	1.000
Metabolic	11,273	29,410	29,410	1.000	46,867	18,692	18,739	1.003
Liver	12,012	17,202	17,202	1.000	11,939	18,232	18,232	1.000
Gastrointestinal	41,977	16,341	16,317	0.999	30,686	17,967	18,054	1.005
Musculoskeletal	71,516	13,033	13,046	1.001	70,285	14,240	14,268	1.002
Blood	21,487	23,295	23,422	1.005	55,361	19,969	20,032	1.003
Cognitive	70,991	14,351	12,315	0.858	70,307	16,312	16,312	1.000
Substance Abuse	15,734	17,194	17,194	1.000	16,333	18,718	18,718	1.000
Psychiatric	77,616	11,444	11,444	1.000	77,929	12,322	12,322	1.000
Spinal	12,214	18,450	18,450	1.000	10,833	19,800	19,932	1.007
Neurological	111,616	14,017	14,081	1.005	116,477	15,014	15,036	1.001
Arrest	42,920	23,058	23,058	1.000	26,765	28,406	28,406	1.000
Heart	331,281	13,553	13,590	1.003	294,567	14,914	14,938	1.002
Cerebrovascular Disease	61,880	14,972	14,977	1.000	54,292	17,223	17,252	1.002
Vascular	174,696	14,529	14,529	1.000	178,695	15,519	15,519	1.000
Lung	192,060	14,612	14,642	1.002	191,436	15,764	15,778	1.001
Eye	10,715	13,967	13,967	1.000	29,590	13,034	13,021	0.999
Kidney	56,113	19,302	19,302	1.000	81,779	19,194	19,194	1.000

(continued)

Table 3-35 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Body systems/disease group HCC categories model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Skin	41,739	18,671	18,667	1.000	40,699	20,782	20,782	1.000
Injury	37,918	16,202	16,204	1.000	37,894	18,187	18,102	0.995
Complications	38,558	18,222	18,222	1.000	16,959	22,790	22,790	1.000
Transplant	1,351	21,153	21,153	1.000	1,513	26,301	26,301	1.000
Openings	7,442	25,639	25,639	1.000	7,311	28,101	28,101	1.000
Amputation	2,706	25,083	24,227	0.966	2,309	24,266	24,266	1.000

NOTE:

See Table 3-44 for validation group definitions of these categories.

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-36
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Infection:								
First (lowest) decile	2,077	6,334	8,572	1.353	2,190	5,108	6,981	1.367
Second decile	2,077	8,993	11,803	1.312	2,190	9,222	10,861	1.178
Third decile	2,077	12,486	14,973	1.199	2,190	13,198	14,607	1.107
Fourth decile	2,077	16,109	18,222	1.131	2,190	17,663	18,508	1.048
Fifth decile	2,077	20,771	21,764	1.048	2,190	22,427	22,776	1.016
Sixth decile	2,077	24,760	25,690	1.038	2,190	27,006	27,581	1.021
Seventh decile	2,076	31,315	30,052	0.960	2,190	33,015	32,926	0.997
Eighth decile	2,076	36,442	35,213	0.966	2,190	39,530	39,407	0.997
Ninth decile	2,076	46,560	42,633	0.916	2,190	49,068	47,880	0.976
Tenth (highest)	2,076	64,530	56,841	0.881	2,189	71,772	65,501	0.913
Top 5%	1,039	68,527	63,219	0.923	1,095	78,479	73,628	0.938
Top 1%	208	79,899	76,467	0.957	219	105,141	89,851	0.855
Neoplasm:								
First (lowest) decile	15,588	4,508	4,155	0.922	15,153	4,840	4,224	0.873
Second decile	15,587	5,522	5,195	0.941	15,153	5,693	5,455	0.958
Third decile	15,587	6,534	6,282	0.961	15,153	7,089	6,746	0.952
Fourth decile	15,587	7,885	7,680	0.974	15,153	8,387	8,156	0.972
Fifth decile	15,587	9,209	9,180	0.997	15,153	9,699	9,691	0.999
Sixth decile	15,587	10,531	11,008	1.045	15,153	11,276	11,608	1.029
Seventh decile	15,587	13,166	13,498	1.025	15,153	13,690	14,267	1.042
Eighth decile	15,587	16,749	17,390	1.038	15,153	18,182	18,384	1.011
Ninth decile	15,587	22,240	22,873	1.028	15,153	24,549	24,889	1.014
Tenth (highest)	15,587	36,120	35,123	0.972	15,153	39,583	39,657	1.002
Top 5%	7,794	42,935	41,588	0.969	7,577	47,124	47,303	1.004
Top 1%	1,559	59,990	56,092	0.935	1,516	62,754	64,272	1.024

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Diabetes:								
First (lowest) decile	30,060	3,960	3,651	0.922	30,118	3,979	3,546	0.891
Second decile	30,060	4,801	4,657	0.970	30,118	4,882	4,758	0.975
Third decile	30,060	5,796	5,655	0.976	30,118	5,951	5,907	0.993
Fourth decile	30,059	6,786	6,771	0.998	30,118	7,034	7,101	1.010
Fifth decile	30,059	8,027	8,050	1.003	30,118	8,057	8,435	1.047
Sixth decile	30,059	9,458	9,637	1.019	30,118	9,665	10,079	1.043
Seventh decile	30,059	11,296	11,661	1.032	30,117	11,995	12,240	1.020
Eighth decile	30,059	14,019	14,529	1.036	30,117	15,020	15,373	1.024
Ninth decile	30,059	18,915	19,166	1.013	30,117	20,050	20,459	1.020
Tenth (highest)	30,059	31,934	31,151	0.975	30,117	35,695	34,273	0.960
Top 5%	15,030	39,061	37,507	0.960	15,059	44,202	41,791	0.945
Top 1%	3,006	57,667	52,621	0.912	3,012	65,443	60,045	0.918
Metabolic:								
First (lowest) decile	1,128	10,856	12,222	1.126	4,687	4,943	5,178	1.048
Second decile	1,128	14,346	16,409	1.144	4,687	6,801	7,297	1.073
Third decile	1,128	17,754	19,699	1.110	4,687	8,300	9,245	1.114
Fourth decile	1,127	20,561	23,125	1.125	4,687	10,777	11,406	1.058
Fifth decile	1,127	24,947	26,610	1.067	4,687	13,700	13,983	1.021
Sixth decile	1,127	33,822	30,296	0.896	4,687	16,669	17,273	1.036
Seventh decile	1,127	35,236	34,356	0.975	4,687	20,551	21,384	1.041
Eighth decile	1,127	40,267	39,466	0.980	4,686	27,387	26,671	0.974
Ninth decile	1,127	49,974	46,380	0.928	4,686	35,015	34,370	0.982
Tenth (highest)	1,127	62,844	60,191	0.958	4,686	55,842	52,755	0.945
Top 5%	564	68,422	66,408	0.971	2,344	65,094	61,740	0.948
Top 1%	113	84,925	79,181	0.932	469	85,883	80,477	0.937

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Liver:								
First (lowest) decile	1,202	5,079	5,569	1.096	1,194	5,849	5,598	0.957
Second decile	1,202	7,376	7,502	1.017	1,194	7,572	7,798	1.030
Third decile	1,201	8,447	9,343	1.106	1,194	8,739	9,696	1.110
Fourth decile	1,201	8,767	11,384	1.299	1,194	11,165	11,812	1.058
Fifth decile	1,201	12,596	13,414	1.065	1,194	12,183	14,051	1.153
Sixth decile	1,201	13,910	15,869	1.141	1,194	17,039	16,680	0.979
Seventh decile	1,201	19,723	19,025	0.965	1,194	20,516	19,997	0.975
Eighth decile	1,201	26,786	23,280	0.869	1,194	25,229	24,672	0.978
Ninth decile	1,201	30,163	29,763	0.987	1,194	31,902	31,820	0.997
Tenth (highest)	1,201	47,648	44,470	0.933	1,193	50,811	48,355	0.952
Top 5%	601	55,537	52,221	0.940	597	58,767	56,708	0.965
Top 1%	121	70,164	69,325	0.988	120	78,122	76,452	0.979
Gastrointestinal:								
First (lowest) decile	4,198	4,747	4,984	1.050	3,069	5,715	5,212	0.912
Second decile	4,198	6,560	6,834	1.042	3,069	7,225	7,172	0.993
Third decile	4,198	8,422	8,524	1.012	3,069	8,412	9,028	1.073
Fourth decile	4,198	10,155	10,351	1.019	3,069	10,770	11,062	1.027
Fifth decile	4,198	11,922	12,430	1.043	3,069	12,801	13,400	1.047
Sixth decile	4,198	14,178	14,985	1.057	3,069	16,123	16,254	1.008
Seventh decile	4,198	17,881	18,220	1.019	3,068	18,971	19,996	1.054
Eighth decile	4,197	22,345	22,678	1.015	3,068	24,760	25,103	1.014
Ninth decile	4,197	29,864	29,108	0.975	3,068	33,899	32,575	0.961
Tenth (highest)	4,197	46,818	43,846	0.937	3,068	51,075	50,596	0.991
Top 5%	2,099	55,753	51,430	0.922	1,535	61,361	59,655	0.972
Top 1%	420	63,885	66,860	1.047	307	86,253	78,550	0.911

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Musculoskeletal:								
First (lowest) decile	7,152	5,383	4,986	0.926	7,029	5,585	5,500	0.985
Second decile	7,152	6,303	6,073	0.964	7,029	6,624	6,621	1.000
Third decile	7,152	7,184	7,104	0.989	7,029	7,663	7,814	1.020
Fourth decile	7,152	8,009	8,294	1.036	7,029	9,139	9,062	0.992
Fifth decile	7,152	9,195	9,602	1.044	7,029	9,915	10,494	1.058
Sixth decile	7,152	10,754	11,275	1.048	7,028	11,988	12,225	1.020
Seventh decile	7,151	13,623	13,469	0.989	7,028	14,639	14,559	0.995
Eighth decile	7,151	15,942	16,613	1.042	7,028	17,300	17,969	1.039
Ninth decile	7,151	21,382	21,889	1.024	7,028	23,366	23,700	1.014
Tenth (highest)	7,151	37,235	35,631	0.957	7,028	40,853	39,216	0.960
Top 5%	3,576	45,787	42,807	0.935	3,515	49,658	47,629	0.959
Top 1%	716	62,197	58,541	0.941	703	69,989	66,221	0.946
Blood:								
First (lowest) decile	2,149	6,029	10,314	1.711	5,537	5,655	5,754	1.018
Second decile	2,149	9,478	12,686	1.338	5,536	8,236	8,420	1.022
Third decile	2,149	13,550	15,098	1.114	5,536	10,013	10,851	1.084
Fourth decile	2,149	16,606	17,506	1.054	5,536	13,166	13,385	1.017
Fifth decile	2,149	19,273	20,148	1.045	5,536	15,462	16,109	1.042
Sixth decile	2,149	24,558	23,340	0.950	5,536	18,465	19,188	1.039
Seventh decile	2,149	28,226	27,098	0.960	5,536	21,932	22,896	1.044
Eighth decile	2,148	33,844	31,333	0.926	5,536	28,046	27,827	0.992
Ninth decile	2,148	39,859	37,000	0.928	5,536	36,289	35,228	0.971
Tenth (highest)	2,148	54,783	50,736	0.926	5,536	53,621	51,169	0.954
Top 5%	1,075	60,079	57,512	0.957	2,769	62,930	59,047	0.938
Top 1%	215	65,332	72,119	1.104	554	76,634	76,358	0.996

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Cognitive:								
First (lowest) decile	7,100	5,713	3,465	0.607	7,031	6,261	6,581	1.051
Second decile	7,099	7,078	4,989	0.705	7,031	8,647	8,433	0.975
Third decile	7,099	8,621	6,321	0.733	7,031	10,015	9,938	0.992
Fourth decile	7,099	10,017	7,737	0.772	7,031	11,107	11,452	1.031
Fifth decile	7,099	11,593	9,352	0.807	7,031	12,986	13,149	1.013
Sixth decile	7,099	13,243	11,259	0.850	7,031	15,066	15,132	1.004
Seventh decile	7,099	15,979	13,620	0.852	7,031	17,747	17,601	0.992
Eighth decile	7,099	18,443	16,868	0.915	7,030	20,925	21,106	1.009
Ninth decile	7,099	23,377	22,025	0.942	7,030	26,799	26,598	0.992
Tenth (highest)	7,099	36,950	35,212	0.953	7,030	41,683	41,095	0.986
Top 5%	3,550	44,804	42,315	0.944	3,516	50,615	48,923	0.967
Top 1%	710	64,197	58,364	0.909	704	78,420	67,544	0.861
Substance Abuse:								
First (lowest) decile	1,574	6,172	6,291	1.019	1,634	6,362	6,754	1.062
Second decile	1,574	8,612	8,802	1.022	1,634	8,028	9,060	1.129
Third decile	1,574	9,759	10,198	1.045	1,634	10,279	10,533	1.025
Fourth decile	1,574	10,694	11,822	1.105	1,633	12,199	12,263	1.005
Fifth decile	1,573	14,701	13,580	0.924	1,633	13,558	14,260	1.052
Sixth decile	1,573	14,973	15,696	1.048	1,633	17,366	16,756	0.965
Seventh decile	1,573	18,374	18,428	1.003	1,633	19,811	19,992	1.009
Eighth decile	1,573	22,947	22,202	0.968	1,633	24,460	24,519	1.002
Ninth decile	1,573	27,656	28,255	1.022	1,633	32,447	31,232	0.963
Tenth (highest)	1,573	44,563	42,872	0.962	1,633	49,949	48,749	0.976
Top 5%	787	52,870	50,252	0.950	817	60,446	57,775	0.956
Top 1%	158	66,041	65,760	0.996	164	84,993	76,102	0.895

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Psychiatric:								
First (lowest) decile	7,762	3,805	4,622	1.215	7,793	3,974	4,634	1.166
Second decile	7,762	4,632	5,491	1.185	7,793	4,693	5,555	1.184
Third decile	7,762	5,362	6,204	1.157	7,793	5,436	6,395	1.176
Fourth decile	7,762	6,430	7,156	1.113	7,793	6,809	7,578	1.113
Fifth decile	7,762	7,252	8,373	1.155	7,793	8,298	8,884	1.071
Sixth decile	7,762	9,648	9,758	1.011	7,793	9,940	10,424	1.049
Seventh decile	7,761	11,207	11,630	1.038	7,793	12,387	12,474	1.007
Eighth decile	7,761	15,009	14,294	0.952	7,793	15,891	15,437	0.971
Ninth decile	7,761	20,427	18,945	0.927	7,793	22,027	20,678	0.939
Tenth (highest)	7,761	35,772	32,336	0.904	7,792	39,138	35,870	0.917
Top 5%	3,881	44,496	39,638	0.891	3,897	48,719	44,160	0.906
Top 1%	777	67,098	56,720	0.845	780	71,047	63,808	0.898
Spinal:								
First (lowest) decile	1,222	5,899	7,271	1.233	1,084	5,501	6,699	1.218
Second decile	1,222	6,523	9,323	1.429	1,084	8,378	9,220	1.101
Third decile	1,222	9,170	10,845	1.183	1,084	9,696	11,137	1.149
Fourth decile	1,222	11,854	12,628	1.065	1,083	11,366	13,200	1.161
Fifth decile	1,221	13,423	14,685	1.094	1,083	15,010	15,626	1.041
Sixth decile	1,221	16,202	17,103	1.056	1,083	18,286	18,357	1.004
Seventh decile	1,221	18,718	20,105	1.074	1,083	22,092	21,676	0.981
Eighth decile	1,221	24,286	24,312	1.001	1,083	27,117	26,361	0.972
Ninth decile	1,221	34,766	30,780	0.885	1,083	35,116	33,496	0.954
Tenth (highest)	1,221	54,057	45,555	0.843	1,083	54,430	51,716	0.950
Top 5%	611	62,910	53,253	0.846	542	64,968	60,898	0.937
Top 1%	123	75,719	68,214	0.901	109	88,978	81,622	0.917

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Neurological:								
First (lowest) decile	11,162	4,020	4,623	1.150	11,648	4,297	4,564	1.062
Second decile	11,162	6,125	6,551	1.070	11,648	6,504	6,699	1.030
Third decile	11,162	7,537	7,960	1.056	11,648	7,720	8,239	1.067
Fourth decile	11,162	8,991	9,345	1.039	11,648	9,165	9,800	1.069
Fifth decile	11,162	10,261	10,918	1.064	11,648	11,243	11,505	1.023
Sixth decile	11,162	12,453	12,739	1.023	11,648	13,193	13,521	1.025
Seventh decile	11,161	14,918	15,072	1.010	11,648	15,791	16,052	1.017
Eighth decile	11,161	18,518	18,357	0.991	11,647	19,626	19,630	1.000
Ninth decile	11,161	24,047	23,693	0.985	11,647	25,758	25,408	0.986
Tenth (highest)	11,161	39,178	36,982	0.944	11,647	43,207	40,858	0.946
Top 5%	5,581	47,377	43,953	0.928	5,824	53,062	49,206	0.927
Top 1%	1,117	62,717	59,419	0.947	1,165	73,081	68,115	0.932
Arrest:								
First (lowest) decile	4,292	8,532	9,518	1.116	2,677	9,484	9,671	1.020
Second decile	4,292	11,994	12,667	1.056	2,677	14,675	14,536	0.991
Third decile	4,292	14,493	15,273	1.054	2,677	18,548	18,207	0.982
Fourth decile	4,292	17,386	17,757	1.021	2,677	20,463	21,669	1.059
Fifth decile	4,292	20,053	20,232	1.009	2,677	23,288	25,147	1.080
Sixth decile	4,292	22,776	22,977	1.009	2,676	27,895	28,694	1.029
Seventh decile	4,292	25,033	26,131	1.044	2,676	32,382	32,780	1.012
Eighth decile	4,292	30,438	30,141	0.990	2,676	38,044	38,046	1.000
Ninth decile	4,292	36,696	36,068	0.983	2,676	46,119	45,654	0.990
Tenth (highest)	4,292	54,494	49,968	0.917	2,676	67,343	62,868	0.934
Top 5%	2,147	62,114	56,843	0.915	1,339	75,077	71,241	0.949
Top 1%	430	73,801	70,796	0.959	268	107,586	87,782	0.816

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Heart:								
First (lowest) decile	33,129	5,435	5,143	0.946	29,457	5,572	5,313	0.954
Second decile	33,128	6,769	6,670	0.985	29,457	7,219	7,111	0.985
Third decile	33,128	8,054	8,008	0.994	29,457	8,671	8,615	0.994
Fourth decile	33,128	9,432	9,351	0.991	29,457	9,857	10,158	1.031
Fifth decile	33,128	10,700	10,835	1.013	29,457	11,814	11,808	0.999
Sixth decile	33,128	12,240	12,571	1.027	29,457	13,391	13,754	1.027
Seventh decile	33,128	14,201	14,715	1.036	29,457	15,844	16,128	1.018
Eighth decile	33,128	17,177	17,555	1.022	29,456	18,773	19,314	1.029
Ninth decile	33,128	21,852	22,054	1.009	29,456	24,227	24,413	1.008
Tenth (highest)	33,128	34,538	33,800	0.979	29,456	39,455	38,308	0.971
Top 5%	16,565	41,751	40,101	0.960	14,729	47,419	45,804	0.966
Top 1%	3,313	59,652	54,828	0.919	2,946	66,843	63,572	0.951
Cerebrovascular Disease:								
First (lowest) decile	6,188	5,191	5,015	0.966	5,430	6,036	6,185	1.025
Second decile	6,188	6,830	7,031	1.029	5,430	7,765	8,386	1.080
Third decile	6,188	8,249	8,581	1.040	5,429	8,951	10,134	1.132
Fourth decile	6,188	9,953	10,144	1.019	5,429	11,486	11,853	1.032
Fifth decile	6,188	11,578	11,861	1.024	5,429	13,369	13,762	1.029
Sixth decile	6,188	13,937	13,889	0.997	5,429	15,703	16,001	1.019
Seventh decile	6,188	16,003	16,398	1.025	5,429	18,677	18,791	1.006
Eighth decile	6,188	19,985	19,836	0.993	5,429	22,646	22,633	0.999
Ninth decile	6,188	25,016	25,318	1.012	5,429	29,341	28,738	0.979
Tenth (highest)	6,188	40,525	38,945	0.961	5,429	47,528	44,564	0.938
Top 5%	3,095	49,050	46,294	0.944	2,715	57,383	53,219	0.927
Top 1%	619	67,121	62,118	0.925	543	77,204	71,953	0.932

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Vascular:								
First (lowest) decile	17,470	5,746	5,573	0.970	17,870	5,980	5,630	0.941
Second decile	17,470	7,213	7,197	0.998	17,870	7,818	7,481	0.957
Third decile	17,470	8,383	8,560	1.021	17,870	8,866	8,942	1.009
Fourth decile	17,470	9,702	9,922	1.023	17,870	9,957	10,421	1.047
Fifth decile	17,470	11,046	11,441	1.036	17,870	11,931	12,073	1.012
Sixth decile	17,470	12,992	13,270	1.021	17,869	13,571	14,062	1.036
Seventh decile	17,469	15,253	15,604	1.023	17,869	16,394	16,599	1.013
Eighth decile	17,469	18,588	18,799	1.011	17,869	19,403	20,054	1.034
Ninth decile	17,469	23,870	23,871	1.000	17,869	25,575	25,639	1.003
Tenth (highest)	17,469	38,259	36,531	0.955	17,869	42,000	40,367	0.961
Top 5%	8,735	45,611	43,212	0.947	8,935	50,986	48,302	0.947
Top 1%	1,747	60,470	58,181	0.962	1,787	72,000	66,749	0.927
Lung:								
First (lowest) decile	19,206	5,474	5,635	1.029	19,144	5,450	5,776	1.060
Second decile	19,206	6,869	6,938	1.010	19,144	7,128	7,224	1.013
Third decile	19,206	8,186	8,225	1.005	19,144	8,567	8,640	1.009
Fourth decile	19,206	9,573	9,711	1.014	19,144	9,958	10,185	1.023
Fifth decile	19,206	11,197	11,489	1.026	19,144	12,206	12,071	0.989
Sixth decile	19,206	13,268	13,583	1.024	19,144	14,090	14,335	1.017
Seventh decile	19,206	15,629	16,056	1.027	19,143	16,750	17,072	1.019
Eighth decile	19,206	19,245	19,377	1.007	19,143	20,649	20,777	1.006
Ninth decile	19,206	24,164	24,432	1.011	19,143	26,632	26,582	0.998
Tenth (highest)	19,206	38,952	37,080	0.952	19,143	42,939	41,597	0.969
Top 5%	9,604	47,022	43,777	0.931	9,572	51,840	49,638	0.958
Top 1%	1,921	63,214	58,662	0.928	1,915	72,376	68,075	0.941

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Eye:								
First (lowest) decile	1,072	4,883	5,149	1.054	2,959	5,812	5,199	0.895
Second decile	1,072	6,612	6,685	1.011	2,959	6,891	6,658	0.966
Third decile	1,072	7,677	7,884	1.027	2,959	7,938	7,717	0.972
Fourth decile	1,072	10,134	9,285	0.916	2,959	8,832	8,832	1.000
Fifth decile	1,072	10,286	10,799	1.050	2,959	10,618	10,084	0.950
Sixth decile	1,071	11,853	12,661	1.068	2,959	10,862	11,568	1.065
Seventh decile	1,071	15,918	14,956	0.940	2,959	12,319	13,488	1.095
Eighth decile	1,071	17,859	18,151	1.016	2,959	16,380	16,216	0.990
Ninth decile	1,071	22,117	22,960	1.038	2,959	20,113	20,651	1.027
Tenth (highest)	1,071	36,041	34,744	0.964	2,959	33,885	33,067	0.976
Top 5%	536	43,846	40,937	0.934	1,480	41,839	39,839	0.952
Top 1%	108	56,164	54,833	0.976	296	59,080	55,482	0.939
Kidney:								
First (lowest) decile	5,612	6,031	6,358	1.054	8,178	5,861	5,775	0.985
Second decile	5,612	8,582	8,888	1.036	8,178	8,490	8,365	0.985
Third decile	5,612	10,722	11,157	1.041	8,178	10,089	10,580	1.049
Fourth decile	5,611	13,582	13,649	1.005	8,178	13,116	12,977	0.989
Fifth decile	5,611	15,718	16,288	1.036	8,178	15,637	15,645	1.001
Sixth decile	5,611	19,453	19,183	0.986	8,178	17,053	18,591	1.090
Seventh decile	5,611	21,638	22,460	1.038	8,178	21,600	22,022	1.020
Eighth decile	5,611	26,319	26,456	1.005	8,178	26,080	26,338	1.010
Ninth decile	5,611	32,193	32,031	0.995	8,178	33,436	32,608	0.975
Tenth (highest)	5,611	48,685	45,825	0.941	8,177	50,610	48,645	0.961
Top 5%	2,806	56,393	52,780	0.936	4,089	59,872	56,900	0.950
Top 1%	562	69,899	67,065	0.959	818	81,340	75,037	0.923

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Skin:								
First (lowest) decile	4,174	6,065	6,945	1.145	4,070	6,476	7,797	1.204
Second decile	4,174	8,984	9,274	1.032	4,070	9,221	10,432	1.131
Third decile	4,174	10,808	11,233	1.039	4,070	11,428	12,465	1.091
Fourth decile	4,174	12,622	13,163	1.043	4,070	13,791	14,514	1.052
Fifth decile	4,174	14,374	15,268	1.062	4,070	16,552	16,832	1.017
Sixth decile	4,174	16,642	17,711	1.064	4,070	19,464	19,529	1.003
Seventh decile	4,174	20,174	20,770	1.030	4,070	23,174	23,014	0.993
Eighth decile	4,174	25,114	24,933	0.993	4,070	28,797	27,602	0.959
Ninth decile	4,174	33,238	31,289	0.941	4,070	35,639	34,599	0.971
Tenth (highest)	4,173	50,163	46,349	0.924	4,069	55,702	52,262	0.938
Top 5%	2,087	58,935	53,951	0.915	2,035	65,033	61,403	0.944
Top 1%	418	75,666	69,113	0.913	407	86,354	80,243	0.929
Injury:								
First (lowest) decile	3,792	5,618	5,673	1.010	3,790	5,518	6,031	1.093
Second decile	3,792	7,742	7,923	1.023	3,790	8,380	8,581	1.024
Third decile	3,792	9,748	9,493	0.974	3,790	10,171	10,475	1.030
Fourth decile	3,792	11,066	11,111	1.004	3,790	12,790	12,387	0.968
Fifth decile	3,792	13,198	12,954	0.982	3,789	14,355	14,453	1.007
Sixth decile	3,792	16,181	15,133	0.935	3,789	17,683	16,910	0.956
Seventh decile	3,792	17,420	17,863	1.025	3,789	19,628	20,044	1.021
Eighth decile	3,792	21,077	21,620	1.026	3,789	24,385	24,187	0.992
Ninth decile	3,791	27,085	27,356	1.010	3,789	31,156	30,459	0.978
Tenth (highest)	3,791	40,529	40,638	1.003	3,789	47,173	46,641	0.989
Top 5%	1,896	47,656	47,606	0.999	1,895	54,911	54,934	1.000
Top 1%	380	59,259	62,330	1.052	379	74,059	73,154	0.988

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Complications:								
First (lowest) decile	3,856	6,245	5,561	0.890	1,696	7,158	8,139	1.137
Second decile	3,856	8,354	7,946	0.951	1,696	10,734	10,728	0.999
Third decile	3,856	9,977	9,986	1.001	1,696	11,963	12,867	1.076
Fourth decile	3,856	12,358	12,075	0.977	1,696	14,614	15,136	1.036
Fifth decile	3,856	13,258	14,393	1.086	1,696	16,630	17,752	1.067
Sixth decile	3,856	16,642	17,189	1.033	1,696	20,032	21,130	1.055
Seventh decile	3,856	19,410	20,604	1.062	1,696	24,733	25,283	1.022
Eighth decile	3,856	24,303	25,057	1.031	1,696	31,894	30,886	0.968
Ninth decile	3,855	32,102	31,579	0.984	1,696	41,599	39,202	0.942
Tenth (highest)	3,855	48,684	46,593	0.957	1,695	60,854	58,107	0.955
Top 5%	1,928	56,906	54,109	0.951	848	72,459	67,231	0.928
Top 1%	386	71,180	68,723	0.965	170	102,395	85,827	0.838
Transplant:								
First (lowest) decile	136	7,024	8,353	1.189	152	8,993	11,846	1.317
Second decile	135	9,528	10,578	1.110	152	9,312	14,216	1.527
Third decile	135	11,211	12,446	1.110	152	10,442	16,167	1.548
Fourth decile	135	14,299	14,502	1.014	151	13,755	18,186	1.322
Fifth decile	135	16,009	17,037	1.064	151	19,162	20,374	1.063
Sixth decile	135	19,010	19,646	1.033	151	20,477	23,393	1.142
Seventh decile	135	21,345	23,206	1.087	151	30,382	27,552	0.907
Eighth decile	135	29,452	27,760	0.943	151	33,440	33,372	0.998
Ninth decile	135	37,700	35,102	0.931	151	49,204	42,524	0.864
Tenth (highest)	135	55,402	51,124	0.923	151	76,421	61,435	0.804
Top 5%	68	60,920	58,274	0.957	76	81,111	69,835	0.861
Top 1%	14	92,658	77,594	0.837	16	98,323	88,054	0.896

(continued)

Table 3-36 (continued)
Predictive ratios for aged-disabled community continuing enrollees: Deciles of predicted expenditures, body systems/disease group HCC categories

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
Openings:								
First (lowest) decile	745	8,708	9,343	1.073	732	9,707	9,673	0.996
Second decile	745	11,751	12,383	1.054	731	13,525	13,026	0.963
Third decile	744	15,875	15,294	0.963	731	14,481	16,050	1.108
Fourth decile	744	16,576	18,449	1.113	731	19,225	19,318	1.005
Fifth decile	744	21,824	21,928	1.005	731	22,629	23,359	1.032
Sixth decile	744	25,572	25,923	1.014	731	28,819	27,854	0.967
Seventh decile	744	31,253	30,444	0.974	731	36,322	32,967	0.908
Eighth decile	744	33,636	35,770	1.063	731	39,897	39,551	0.991
Ninth decile	744	46,450	43,398	0.934	731	43,586	48,605	1.115
Tenth (highest)	744	61,103	58,811	0.962	731	70,602	68,332	0.968
Top 5%	373	68,721	65,762	0.957	366	82,560	77,226	0.935
Top 1%	75	102,874	79,926	0.777	74	114,935	94,565	0.823
Amputation:								
First (lowest) decile	271	8,386	8,768	1.046	231	8,749	9,982	1.141
Second decile	271	10,726	12,610	1.176	231	10,715	13,059	1.219
Third decile	271	16,568	15,765	0.952	231	14,143	15,816	1.118
Fourth decile	271	19,247	18,657	0.969	231	16,335	18,384	1.125
Fifth decile	271	19,851	21,461	1.081	231	20,488	21,008	1.025
Sixth decile	271	28,486	24,628	0.865	231	27,424	23,916	0.872
Seventh decile	270	29,798	28,157	0.945	231	30,274	27,345	0.903
Eighth decile	270	33,731	32,848	0.974	231	31,371	31,557	1.006
Ninth decile	270	40,087	39,028	0.974	231	38,736	37,651	0.972
Tenth (highest)	270	56,131	51,383	0.915	230	53,122	52,076	0.980
Top 5%	136	62,585	57,273	0.915	116	56,763	59,639	1.051
Top 1%	28	61,211	70,061	1.145	24	79,730	76,616	0.961

NOTE: See Table 3-44 for validation group definitions of these categories..
SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and enrollment data.

Table 3-37
Chronic condition special needs plans (C-SNPs) validation group definitions (version 12 and version 21 CMS-HCC models)

SNP	C-SNP Description and Validation Group Definition (V12)	C-SNP Description and Validation Group Definition (V21)
SNP 1	Chronic alcohol and other drug dependence = HCCs 51-52	Chronic alcohol and other drug dependence = HCCs 54-55
SNP 2	Autoimmune disorders = HCC 38 (approximate mapping)	Autoimmune disorders = HCC 40 (subset)
SNP 3	Cancer (excluding pre-cancer or in-situ status) = HCCs 7-10	Cancer (excluding pre-cancer or in-situ status) = HCCs 8-12
SNP 4	Cardiovascular disorders = HCCs 81-84, 92-93, 104-105; HCCs 84 and 93 are not in the payment model	Cardiovascular disorders = HCCs 86-89, 96-97, 106-108; HCCs 89 and 97 are not in the payment model
SNP 5	Chronic heart failure = HCC 80 (approximate mapping)	Chronic heart failure = HCC 85 (subset)
SNP 6	Dementia = HCC 49; HCC 49 is not in the payment model	Dementia = HCCs 51-52
SNP 7	Diabetes mellitus = HCCs 15-19	Diabetes mellitus = HCCs 17-19
SNP 8	End-stage liver disease = HCC 25	End-stage liver disease = HCC 27
SNP 9	End-stage renal disease requiring dialysis (all modes of dialysis) = ESRD continuing enrollee dialysis model	End-stage renal disease requiring dialysis (all modes of dialysis) = ESRD continuing enrollee dialysis model
SNP 10	Severe hematological disorders = HCC 44 (approximate mapping) and HCC 46 (approximate mapping); HCC 46 is not in payment model	Severe hematological disorders = HCC 46 (subset), 48 (subset), 107-108 (subsets)
SNP 11	HIV/AIDS = HCC 1	HIV/AIDS = HCC 1
SNP 12	Chronic lung disorders = HCC 108, HCC 109 (approximate mapping), HCC 110; HCCs 109-110 are not in the payment model	Chronic lung disorders = HCC 85 (subset), HCC 111, HCC 112 (subset), HCC 113; HCC 113 is not in the payment model
SNP 13	Chronic and disabling mental health conditions = HCCs 54-55	Chronic and disabling mental health conditions = HCCs 57-58
SNP 14	Neurologic disorders = HCCs 39 (approximate mapping), 67-68, 71-73, 74 (approximate mapping), 100-101, 102 (approximate mapping); HCCs 39 and 102 are not in the payment model	Neurologic disorders = HCCs 41 (subset), 70-71, 73, 75, 77-78, 79 (subsets), 103-104, 105 (subset); HCCs 41 and 105 are not in the payment model
SNP 15	Stroke = HCCs 95-96, 100-101 (approximate mapping), 102 (approximate mapping); HCC 102 is not in the payment model	Stroke = HCCs 99-100, 103-104 (subset), 105 (subset); HCC 105 is not in the payment model

NOTE: The Version 12 (V12) and Version 21 (V21) C-SNP validation group definitions are comparable, but not exact matches. The V21 definitions are more precise, in part because they were initially used to analyze the most recent data (2006-2007 data). The V21 definitions are done at the HCC level when possible, and at the diagnostic group level or ICD-9-CM code level as needed. The V12 definitions are done at the HCC level only and therefore may include non-specified diagnoses. The V12 definitions were done at the HCC level because they were also used for other analyses that allowed for only complete HCCs. One disease subcategory, Chronic venous thromboembolic disorder, is part of SNP 4 Cardiovascular disorders and is repeated in SNP 10 Severe hematologic disorders; it is included within both SNP 4 and SNP 10 in the V21 definitions. For the V12 definitions, this subcategory is included only within SNP 4 in order to reduce the number of non-related diagnoses in the corresponding HCCs that would have mapped to SNP 10.

SOURCE: RTI analysis of 2008 Special Needs Plan Chronic Condition Panel Final Report.

Table 3-38
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP1 Chronic alcohol and other drug dependence	15,734	17,194	17,194	1.000	16,333	18,718	18,718	1.000
SNP2 Autoimmune disorders	61,687	11,960	11,960	1.000	43,597	13,475	13,299	0.987
SNP3 Cancer	155,871	12,608	12,608	1.000	151,530	13,634	13,634	1.000
SNP4 Cardiovascular disorders	525,017	11,696	11,304	0.966	503,818	12,582	12,184	0.968
SNP5 Chronic heart failure	171,566	16,898	16,898	1.000	153,921	18,169	18,274	1.006
SNP6 Dementia	70,991	14,351	12,315	0.858	70,307	16,312	16,312	1.000
SNP7 Diabetes mellitus	300,593	11,103	11,103	1.000	301,176	11,824	11,824	1.000
SNP8 End-stage liver disease	2,891	23,634	23,634	1.000	2,771	26,058	26,058	1.000
SNP9 End-stage renal disease requiring dialysis[1]					266,192	76,034	76,034	1.000
SNP10 Severe hematological disorders	49,947	18,266	16,929	0.927	34,632	21,420	21,080	0.984
SNP11 HIV/AIDS	4,011	16,364	16,364	1.000	4,014	13,695	13,695	1.000

(continued)

Table 3-38 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) actual	**Version 21 CMS-HCC model** 2006 Mean expenditures ($) predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP12 Chronic lung disorders	242,736	13,130	12,883	0.981	231,179	14,294	14,054	0.983
SNP13 Chronic and disabling mental health conditions	77,616	11,444	11,444	1.000	77,929	12,322	12,322	1.000
SNP14 Neurologic disorders	262,212	11,469	10,728	0.935	153,869	14,710	13,881	0.944
SNP15 Stroke	67,668	14,762	14,614	0.990	51,201	17,005	16,891	0.993

NOTES:

1. SNP 9 (End-stage renal disease requiring dialysis) predictive ratios are calculated for the Version 21 model only, using the ESRD continuing enrollee dialysis model, which is estimated on the 100% ESRD sample.
2. The validation group definitions differ by model version. In general the V12 definitions are broader because they are based on complete HCCs only. This results in large differences in the number of beneficiaries for some SNPs (e.g., SNP14), as well as potentially lower V12 predictive ratios if the full are non-payment model HCCs. See Table 3-47 for complete C-SNP validation group definitions.

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and 2006-2007 100% ESRD claims.

Table 3-39
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees: Deciles and percentiles of predicted expenditures model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP1 Chronic alcohol and other drug dependence:								
First (lowest) decile	1,574	6,172	6,291	1.019	1,634	6,362	6,754	1.062
Second decile	1,574	8,612	8,802	1.022	1,634	8,028	9,060	1.129
Third decile	1,574	9,759	10,198	1.045	1,634	10,279	10,533	1.025
Fourth decile	1,574	10,694	11,822	1.105	1,633	12,199	12,263	1.005
Fifth decile	1,573	14,701	13,580	0.924	1,633	13,558	14,260	1.052
Sixth decile	1,573	14,973	15,696	1.048	1,633	17,366	16,756	0.965
Seventh decile	1,573	18,374	18,428	1.003	1,633	19,811	19,992	1.009
Eighth decile	1,573	22,947	22,202	0.968	1,633	24,460	24,519	1.002
Ninth decile	1,573	27,656	28,255	1.022	1,633	32,447	31,232	0.963
Tenth (highest)	1,573	44,563	42,872	0.962	1,633	49,949	48,749	0.976
Top 5%	787	52,870	50,252	0.950	817	60,446	57,775	0.956
Top 1%	158	66,041	65,760	0.996	164	84,993	76,102	0.895
SNP2 Autoimmune disorders:								
First (lowest) decile	6,169	5,301	4,930	0.930	4,360	5,886	5,486	0.932
Second decile	6,169	6,047	5,840	0.966	4,360	6,604	6,509	0.986
Third decile	6,169	7,014	6,807	0.970	4,360	7,980	7,628	0.956
Fourth decile	6,169	7,928	7,867	0.992	4,360	8,901	8,758	0.984
Fifth decile	6,169	8,736	9,036	1.034	4,360	9,799	10,038	1.024
Sixth decile	6,169	10,378	10,465	1.008	4,360	11,690	11,577	0.990
Seventh decile	6,169	11,997	12,342	1.029	4,360	13,943	13,589	0.975
Eighth decile	6,168	14,635	14,980	1.024	4,359	16,489	16,573	1.005
Ninth decile	6,168	18,799	19,336	1.029	4,359	21,333	21,411	1.004
Tenth (highest)	6,168	32,083	31,256	0.974	4,359	35,787	35,022	0.979
Top 5%	3,085	39,719	37,549	0.945	2,180	42,752	42,391	0.992
Top 1%	617	56,456	52,367	0.928	436	62,779	60,039	0.956

(continued)

Table 3-39 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees: Deciles and percentiles of predicted expenditures model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP3 Cancer:								
First (lowest) decile	15,588	4,508	4,155	0.922	15,153	4,840	4,224	0.873
Second decile	15,587	5,522	5,195	0.941	15,153	5,693	5,455	0.958
Third decile	15,587	6,534	6,282	0.961	15,153	7,089	6,746	0.952
Fourth decile	15,587	7,885	7,680	0.974	15,153	8,387	8,156	0.972
Fifth decile	15,587	9,209	9,180	0.997	15,153	9,699	9,691	0.999
Sixth decile	15,587	10,531	11,008	1.045	15,153	11,276	11,608	1.029
Seventh decile	15,587	13,166	13,498	1.025	15,153	13,690	14,267	1.042
Eighth decile	15,587	16,749	17,390	1.038	15,153	18,182	18,384	1.011
Ninth decile	15,587	22,240	22,873	1.028	15,153	24,549	24,889	1.014
Tenth (highest)	15,587	36,120	35,123	0.972	15,153	39,583	39,657	1.002
Top 5%	7,794	42,935	41,588	0.969	7,577	47,124	47,303	1.004
Top 1%	1,559	59,990	56,092	0.935	1,516	62,754	64,272	1.024
SNP4 Cardiovascular disorders:								
First (lowest) decile	52,502	4,877	3,316	0.680	50,382	4,838	3,359	0.694
Second decile	52,502	5,763	4,998	0.867	50,382	5,978	5,193	0.869
Third decile	52,502	6,696	6,190	0.924	50,382	7,235	6,499	0.898
Fourth decile	52,502	7,737	7,374	0.953	50,382	8,204	7,823	0.954
Fifth decile	52,502	8,811	8,667	0.984	50,382	9,329	9,209	0.987
Sixth decile	52,502	10,353	10,169	0.982	50,382	10,734	10,854	1.011
Seventh decile	52,502	11,921	12,078	1.013	50,382	13,020	12,946	0.994
Eighth decile	52,501	14,557	14,732	1.012	50,382	15,817	15,851	1.002
Ninth decile	52,501	18,891	19,006	1.006	50,381	20,349	20,585	1.012
Tenth (highest)	52,501	31,283	30,479	0.974	50,381	34,643	33,893	0.978
Top 5%	26,251	38,361	36,617	0.955	25,191	42,431	41,141	0.970
Top 1%	5,251	55,857	51,162	0.916	5,039	61,483	58,543	0.952

(continued)

Table 3-39 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees: Deciles and percentiles of predicted expenditures model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP5 Chronic heart failure:								
First (lowest) decile	17,157	7,058	6,938	0.983	15,393	7,161	7,042	0.983
Second decile	17,157	9,294	9,187	0.988	15,392	9,558	9,644	1.009
Third decile	17,157	10,738	10,849	1.010	15,392	11,542	11,531	0.999
Fourth decile	17,157	12,422	12,502	1.006	15,392	13,114	13,358	1.019
Fifth decile	17,157	13,856	14,235	1.027	15,392	15,004	15,249	1.016
Sixth decile	17,157	15,897	16,165	1.017	15,392	16,803	17,377	1.034
Seventh decile	17,156	18,222	18,480	1.014	15,392	19,112	19,925	1.043
Eighth decile	17,156	21,372	21,578	1.010	15,392	22,761	23,325	1.025
Ninth decile	17,156	26,273	26,314	1.002	15,392	29,201	28,673	0.982
Tenth (highest)	17,156	39,841	38,525	0.967	15,392	44,048	43,044	0.977
Top 5%	8,579	47,663	45,042	0.945	7,697	51,857	50,785	0.979
Top 1%	1,716	64,130	59,805	0.933	1,540	70,189	68,744	0.979
SNP6 Dementia:								
First (lowest) decile	7,100	5,713	3,465	0.607	7,031	6,261	6,581	1.051
Second decile	7,099	7,078	4,989	0.705	7,031	8,647	8,433	0.975
Third decile	7,099	8,621	6,321	0.733	7,031	10,015	9,938	0.992
Fourth decile	7,099	10,017	7,737	0.772	7,031	11,107	11,452	1.031
Fifth decile	7,099	11,593	9,352	0.807	7,031	12,986	13,149	1.013
Sixth decile	7,099	13,243	11,259	0.850	7,031	15,066	15,132	1.004
Seventh decile	7,099	15,979	13,620	0.852	7,031	17,747	17,601	0.992
Eighth decile	7,099	18,443	16,868	0.915	7,030	20,925	21,106	1.009
Ninth decile	7,099	23,377	22,025	0.942	7,030	26,799	26,598	0.992
Tenth (highest)	7,099	36,950	35,212	0.953	7,030	41,683	41,095	0.986
Top 5%	3,550	44,804	42,315	0.944	3,516	50,615	48,923	0.967
Top 1%	710	64,197	58,364	0.909	704	78,420	67,544	0.861

(continued)

Table 3-39 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees: Deciles and percentiles of predicted expenditures model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP7 Diabetes mellitus:								
First (lowest) decile	30,060	3,960	3,651	0.922	30,118	3,979	3,546	0.891
Second decile	30,060	4,801	4,657	0.970	30,118	4,882	4,758	0.975
Third decile	30,060	5,796	5,655	0.976	30,118	5,951	5,907	0.993
Fourth decile	30,059	6,786	6,771	0.998	30,118	7,034	7,101	1.010
Fifth decile	30,059	8,027	8,050	1.003	30,118	8,057	8,435	1.047
Sixth decile	30,059	9,458	9,637	1.019	30,118	9,665	10,079	1.043
Seventh decile	30,059	11,296	11,661	1.032	30,117	11,995	12,240	1.020
Eighth decile	30,059	14,019	14,529	1.036	30,117	15,020	15,373	1.024
Ninth decile	30,059	18,915	19,166	1.013	30,117	20,050	20,459	1.020
Tenth (highest)	30,059	31,934	31,151	0.975	30,117	35,695	34,273	0.960
Top 5%	15,030	39,061	37,507	0.960	15,059	44,202	41,791	0.945
Top 1%	3,006	57,667	52,621	0.912	3,012	65,443	60,045	0.918
SNP8 End-stage liver disease:								
First (lowest) decile	290	8,675	10,485	1.209	278	8,457	11,337	1.341
Second decile	289	11,442	12,842	1.122	277	11,132	14,081	1.265
Third decile	289	13,200	14,904	1.129	277	15,980	16,613	1.040
Fourth decile	289	16,909	17,265	1.021	277	22,896	19,334	0.844
Fifth decile	289	20,943	19,733	0.942	277	21,006	22,016	1.048
Sixth decile	289	20,030	22,880	1.142	277	21,262	25,082	1.180
Seventh decile	289	25,332	26,760	1.056	277	31,158	29,018	0.931
Eighth decile	289	36,071	31,610	0.876	277	31,823	34,151	1.073
Ninth decile	289	41,056	37,910	0.923	277	46,652	41,391	0.887
Tenth (highest)	289	56,185	53,985	0.961	277	61,217	57,118	0.933
Top 5%	145	68,504	62,523	0.913	139	74,756	64,986	0.869
Top 1%	29	99,874	80,734	0.808	28	87,046	83,511	0.959

(continued)

Table 3-39 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees: Deciles and percentiles of predicted expenditures model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP9 End-stage renal disease requiring dialysis[1]:								
First (lowest) decile	—	—	—	—	26,620	47,336	48,298	1.020
Second decile	—	—	—	—	26,620	55,685	55,226	0.992
Third decile	—	—	—	—	26,619	61,053	60,445	0.990
Fourth decile	—	—	—	—	26,619	66,214	65,283	0.986
Fifth decile	—	—	—	—	26,619	69,898	70,240	1.005
Sixth decile	—	—	—	—	26,619	75,361	75,657	1.004
Seventh decile	—	—	—	—	26,619	81,843	81,771	0.999
Eighth decile	—	—	—	—	26,619	88,636	89,374	1.008
Ninth decile	—	—	—	—	26,619	100,367	100,350	1.000
Tenth (highest)	—	—	—	—	26,619	125,255	124,965	0.998
Top 5%	—	—	—	—	13,310	136,671	136,755	1.001
Top 1%	—	—	—	—	2,662	161,298	160,763	0.997
SNP10 Severe hematological disorders:								
First (lowest) decile	4,995	5,311	3,623	0.682	3,464	6,179	6,186	1.001
Second decile	4,995	7,467	6,244	0.836	3,464	8,511	9,000	1.057
Third decile	4,995	9,669	8,650	0.895	3,463	11,135	11,482	1.031
Fourth decile	4,995	11,528	11,022	0.956	3,463	13,811	14,004	1.014
Fifth decile	4,995	14,277	13,508	0.946	3,463	16,339	16,821	1.029
Sixth decile	4,995	16,966	16,427	0.968	3,463	19,220	20,088	1.045
Seventh decile	4,995	20,469	19,797	0.967	3,463	23,755	24,276	1.022
Eighth decile	4,994	25,675	24,126	0.940	3,463	30,267	29,517	0.975
Ninth decile	4,994	32,888	30,450	0.926	3,463	38,953	37,048	0.951
Tenth (highest)	4,994	48,199	44,658	0.927	3,463	59,040	54,130	0.917
Top 5%	2,498	55,384	51,813	0.936	1,732	67,479	62,290	0.923
Top 1%	500	66,390	66,814	1.006	347	84,549	80,344	0.950

(continued)

Table 3-39 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees: Deciles and percentiles of predicted expenditures model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP11 HIV/AIDS:								
First (lowest) decile	402	5,646	8,533	1.511	402	4,861	5,422	1.115
Second decile	401	4,976	9,005	1.810	402	4,137	6,127	1.481
Third decile	401	5,858	9,749	1.664	402	5,831	6,920	1.187
Fourth decile	401	7,026	11,266	1.603	402	5,135	8,269	1.610
Fifth decile	401	8,869	12,455	1.404	401	7,609	9,465	1.244
Sixth decile	401	9,889	14,462	1.462	401	9,953	11,259	1.131
Seventh decile	401	13,453	16,512	1.227	401	10,346	13,560	1.311
Eighth decile	401	18,594	19,567	1.052	401	15,839	16,669	1.052
Ninth decile	401	36,879	24,862	0.674	401	28,988	22,206	0.766
Tenth (highest)	401	59,567	41,291	0.693	401	48,516	40,329	0.831
Top 5%	201	66,570	49,694	0.746	201	55,876	49,431	0.885
Top 1%	41	77,476	66,532	0.859	41	63,454	69,648	1.098
SNP12 Chronic lung disorders:								
First (lowest) decile	24,274	4,614	3,467	0.751	23,118	4,940	3,807	0.771
Second decile	24,274	5,857	5,700	0.973	23,118	6,199	6,063	0.978
Third decile	24,274	7,050	6,937	0.984	23,118	7,566	7,442	0.984
Fourth decile	24,274	8,452	8,263	0.978	23,118	8,813	8,860	1.005
Fifth decile	24,274	9,829	9,833	1.000	23,118	10,514	10,534	1.002
Sixth decile	24,274	11,581	11,780	1.017	23,118	12,633	12,628	1.000
Seventh decile	24,273	13,965	14,181	1.015	23,118	15,171	15,236	1.004
Eighth decile	24,273	17,119	17,323	1.012	23,118	18,610	18,704	1.005
Ninth decile	24,273	22,129	22,193	1.003	23,118	24,265	24,216	0.998
Tenth (highest)	24,273	36,163	34,427	0.952	23,117	39,990	38,675	0.967
Top 5%	12,137	44,038	40,946	0.930	11,559	48,219	46,428	0.963
Top 1%	2,428	61,926	55,950	0.903	2,312	68,696	64,704	0.942

(continued)

Table 3-39 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees: Deciles and percentiles of predicted expenditures model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP13 Chronic and disabling mental health conditions:								
First (lowest) decile	7,762	3,805	4,622	1.215	7,793	3,974	4,634	1.166
Second decile	7,762	4,632	5,491	1.185	7,793	4,693	5,555	1.184
Third decile	7,762	5,362	6,204	1.157	7,793	5,436	6,395	1.176
Fourth decile	7,762	6,430	7,156	1.113	7,793	6,809	7,578	1.113
Fifth decile	7,762	7,252	8,373	1.155	7,793	8,298	8,884	1.071
Sixth decile	7,762	9,648	9,758	1.011	7,793	9,940	10,424	1.049
Seventh decile	7,761	11,207	11,630	1.038	7,793	12,387	12,474	1.007
Eighth decile	7,761	15,009	14,294	0.952	7,793	15,891	15,437	0.971
Ninth decile	7,761	20,427	18,945	0.927	7,793	22,027	20,678	0.939
Tenth (highest)	7,761	35,772	32,336	0.904	7,792	39,138	35,870	0.917
Top 5%	3,881	44,496	39,638	0.891	3,897	48,719	44,160	0.906
Top 1%	777	67,098	56,720	0.845	780	71,047	63,808	0.898
SNP14 Neurologic disorders:								
First (lowest) decile	26,222	4,338	2,511	0.579	15,387	6,136	3,612	0.589
Second decile	26,222	5,258	3,816	0.726	15,387	7,338	5,744	0.783
Third decile	26,221	6,175	5,039	0.816	15,387	8,237	7,393	0.898
Fourth decile	26,221	7,119	6,371	0.895	15,387	9,332	8,911	0.955
Fifth decile	26,221	8,380	7,826	0.934	15,387	10,640	10,569	0.993
Sixth decile	26,221	9,660	9,459	0.979	15,387	12,829	12,503	0.975
Seventh decile	26,221	11,344	11,529	1.016	15,387	14,979	14,924	0.996
Eighth decile	26,221	14,460	14,382	0.995	15,387	18,287	18,294	1.000
Ninth decile	26,221	19,257	19,052	0.989	15,387	24,255	23,718	0.978
Tenth (highest)	26,221	32,921	31,530	0.958	15,386	40,480	38,488	0.951
Top 5%	13,111	40,719	38,153	0.937	7,694	49,356	46,493	0.942
Top 1%	2,623	58,139	53,507	0.920	1,539	68,151	65,376	0.959

(continued)

Table 3-39 (continued)
Predictive ratios for C-SNP conditions for aged-disabled community continuing enrollees: Deciles and percentiles of predicted expenditures model comparison

Validation groups	**Version 12 CMS-HCC model** Number of beneficiaries	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Actual	**Version 12 CMS-HCC model** 2005 Mean expenditures ($) Predicted	**Version 12 CMS-HCC model** Ratio predicted to actual	**Version 21 CMS-HCC model** Number of beneficiaries	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Actual	**Version 21 CMS-HCC model** 2007 Mean expenditures ($) Predicted	**Version 21 CMS-HCC model** Ratio predicted to actual
SNP15 Stroke:								
First (lowest) decile	6,767	5,097	4,628	0.908	5,121	6,245	6,009	0.962
Second decile	6,767	6,870	6,695	0.975	5,120	7,817	8,222	1.052
Third decile	6,767	8,027	8,280	1.032	5,120	9,022	9,925	1.100
Fourth decile	6,767	9,659	9,832	1.018	5,120	11,015	11,601	1.053
Fifth decile	6,767	11,430	11,548	1.010	5,120	13,407	13,473	1.005
Sixth decile	6,767	13,766	13,554	0.985	5,120	15,249	15,646	1.026
Seventh decile	6,767	15,974	16,059	1.005	5,120	18,368	18,361	1.000
Eighth decile	6,767	19,449	19,434	0.999	5,120	22,223	22,090	0.994
Ninth decile	6,766	24,680	24,866	1.008	5,120	28,627	28,094	0.981
Tenth (highest)	6,766	40,073	38,384	0.958	5,120	47,045	43,704	0.929
Top 5%	3,384	48,460	45,663	0.942	2,561	57,060	52,260	0.916
Top 1%	677	66,531	61,533	0.925	513	77,138	71,154	0.922

NOTES:

1. SNP 9 (End-stage renal disease requiring dialysis) predictive ratios are calculated for the Version 21 model only, using the ESRD continuing enrollee dialysis model, which is estimated on the 100% ESRD sample.
2. The validation group definitions differ by model version. In general the V12 definitions are broader because they are based on complete HCCs only. This results in large differences in the number of beneficiaries for some SNPs (e.g., SNP14), as well as potentially lower V12 predictive ratios if the full are non-payment model HCCs. See Table 3-37 for complete C-SNP validation group definitions.

SOURCE: RTI analysis of Medicare 2004-2005 and 2006-2007 5% sample claims and 2006-2007 100% ESRD claims.

SECTION 4
MORTALITY RATE ANALYSIS FOR CHRONIC CONDITION SPECIAL NEEDS PLANS

4.1 Introduction

Chronic condition Special Needs plans (C-SNPs) enroll beneficiaries who have an identified condition or set of conditions. For continuing enrollees in chronic condition special needs plans (C-SNPs), capitation payments to the C-SNP plans are risk adjusted using the CMS-HCC risk adjustment model, which is calibrated on the Medicare FFS population. As described in Section 2, the CMS-HCC model reflects hierarchies among related disease categories and, for unrelated diseases, HCCs accumulate. For example, a beneficiary with Diabetes with Complications, Congestive Heart Failure, and Chronic Obstructive Pulmonary Disease has (at least) three separate HCCs coded, and his/her predicted cost will reflect increments for each disease. Thus the basic structure of the HCC model is additive. As discussed in Section 3, the risk adjustment model works well for all deciles of risk—both across the Medicare population and among the C-SNP-enrolled populations—and is expected to work well for C-SNPs that enroll concentrations of beneficiaries with specific conditions.

However, it is possible that, compared to FFS beneficiaries with similar diagnostic profiles, C-SNP beneficiaries have unmeasured severity of illness, which could cause C-SNP risk scores and, therefore, their plan payments to be too low or too high. To empirically examine this possibility, we examine C-SNP mortality rates, which should be correlated with severity of illness. We calculate the expected mortality rate for C-SNP enrollees based on a matched sample of FFS beneficiaries. If the actual mortality rate for C-SNP enrollees is significantly higher than the expected mortality rate, this would be evidence that C-SNP enrollees have an unmeasured higher severity of illness, and that reimbursements might be too low. On the other hand, if the actual mortality rate is significantly lower than the expected mortality rate, this would be evidence that C-SNP enrollees have an unmeasured lower severity of illness, and that reimbursements might be too high.

We now describe the data used for the C-SNP mortality analysis. We then present comparison results using age/sex adjustments. Next, we describe risk adjusted matching methods, present results, and offer conclusions.

4.2 Data

In this section we describe the data used to calculate the actual and expected mortality rates for C-SNP enrollees. We focus on those chronic conditions identified in Table 4-1, which are the chronic conditions that were determined by the 2008 Special Needs Plan Chronic Condition Panel to meet the definition of severe or disabling and in need of specialized care management. Each C-SNP type is defined as a set of one or more HCCs. For each C-SNP type, we calculate the actual and expected mortality rate for beneficiaries with each type of condition, enrolled in C-SNPs. As mentioned, the expected mortality rate for a C-SNP type is based on a matched sample of FFS beneficiaries.

To start, we used the Health Plan Management System plan-level identification information to identify C-SNP plans in 2008. We then identified all Medicare beneficiaries who were enrolled in C-SNPs during 2008. We identified C-SNP enrollees who were continuing, community enrollees in 2008. This group would have a full year of diagnosis reporting and have valid risk scores capturing morbidity. The 2008 CMS-HCC risk score file was used to identify the HCCs and community risk score for each SNP enrollee. The 2008 Denominator file was used to identify which of the C-SNPs enrollees died in the year 2008.

For each C-SNP type, we identified 2008 C-SNP enrollees with one or more HCCs for that C-SNP type. A person with multiple C-SNP diagnoses can appear under more than one C-SNP type. We then calculated the actual mortality rate among these enrollees, where decedents were defined as those that died during 2008.

Using the 100 percent 2008 Medicare FFS population, we identified continuing, community enrollees. We used the 2008 risk score file to identify HCCs and community risk scores. For each C-SNP type, FFS beneficiaries who had one or more relevant HCCs were identified (note that FFS beneficiaries are not C-SNP enrollees; however, FFS beneficiaries and C-SNP enrollees can be matched on the HCCs that define the C-SNP type). Using the Denominator file we identified which beneficiaries died in 2008.

In our first analysis, we calculate the C-SNP expected mortality rate based on a FFS sample matched on C-SNP type conditions and demographics. However, matching on risk scores is more comprehensive because the risk scores incorporate both diagnostic and demographic information. Therefore, in our second analysis, we calculate the C-SNP expected mortality rate based on a FFS sample matched on C-SNP type conditions and risk scores.

4.3 Comparison of Actual and Expected Mortality Rates with Age/Sex Adjustments

4.3.1 Descriptive Results

Table 4-2 contains a comparison of actual mortality rates for 2008 C-SNP and FFS enrollees with at least one HCC from any C-SNP type. Actual mortality rates are provided overall and by age/sex categories. Overall, we find that C-SNP enrollees have a 22.7 percent lower mortality rate than FFS enrollees. Differentiating mortality rates by age/sex groupings, we find that C-SNP enrollee mortality rates are higher than FFS mortality rates among the youngest age/sex groups. On the other hand, C-SNP enrollee mortality rates are lower than FFS mortality rates among the older age/sex groups.

4.3.2 Age/Sex Adjustment Results

Table 4-3 contains C-SNP enrollee 2008 actual and expected mortality rates by C-SNP type, where the expected mortality rates are based on a FFS sample matched on C-SNP conditions and age/sex. We find that, for all C-SNP types, the actual C-SNP mortality rate is lower than expected based on FFS rates. The percent difference in mortality rates range from about 2 to 26 percent.

4.4 Risk Adjustment Methodology

We now describe the algorithm for calculating the expected mortality rate using risk adjustment. For each C-SNP type, we identified 2008 C-SNP enrollees with one or more of the HCCs for that C-SNP type. We then calculated risk score quintiles for the C-SNP type; 20 percent of C-SNP enrollees would be in each risk score range. For example, for SNP11 (HIV/AIDS), the C-SNP enrollee risk scores at the upper end of the 1st, 2nd, 3rd, 4th, and 5th quintiles are 1.463, 1.806, 2.331, 3.217, and 12.976, respectively (see Table 4-4).

For each C-SNP type, the next step is to create five FFS groups based on the risk score quintiles of C-SNP enrollees. We identified the percentage of the 2008 FFS beneficiaries with at least one of the C-SNP type conditions whose risk scores fall into each quintile. For example, from Table 4-4, we see that for SNP11 (HIV/AIDS), the percentages of FFS beneficiaries for that C-SNP type in the 1st, 2nd, 3rd, 4th, and 5th risk score quintiles are 31.26 percent, 19.26 percent, 17.53 percent, 15.88 percent, and 16.07 percent, respectively. Next, we calculate the actual mortality rate for the FFS beneficiaries in each of the five groups, as shown in Table 4-4. Finally, to calculate the expected mortality rate for C-SNP enrollees in a given C-SNP type, the actual mortality rate for each of the five FFS groups is weighted by 0.2 (it represents one quintile), and these values are summed to give the expected mortality rate. From Table 4-4, we see that for SNP11 (HIV/AIDS), the expected mortality rate for C-SNP enrollees is 4.51 percent, which then can be compared to the actual mortality rate (as described in Section 4.1). This process was followed for each C-SNP type.

4.5 Comparison of Actual and Expected Mortality Rates using Risk Adjustment

Table 4-5 contains C-SNP enrollee 2008 actual and expected mortality rates by C-SNP type, where the expected mortality rates are based on a FFS sample matched on C-SNP conditions and risk scores. Within C-SNP types, we find that the smallest group is SNP8 (End-stage liver disease) with 940 beneficiaries, and the largest group is SNP7 (Diabetes mellitus) with 138,815 beneficiaries. The actual mortality rates for C-SNP enrollees range from about 3 percent to 13 percent across C-SNP types, and the expected mortality rates range from about 5 percent to 19 percent.

For all C-SNP types, we find that the actual mortality rate for C-SNP enrollees is less than the mortality rate among beneficiaries from the FFS population, matched on chronic conditions and risk scores. The largest difference occurs for SNP10 (Severe hematological disorders), with a -6.30 percentage point difference (in absolute terms) in actual and expected mortality rates. The smallest difference occurs for SNP11 (HIV/AIDS), with a -1.10 percentage point difference (in absolute terms). In the last column of Table 4-5 we find that across the C-SNP types that the C-SNP actual mortality rates range from 21 percent to 34 percent below the expected mortality rates. As a final note, we find that for all C-SNP types, the amount (in percentage terms) that the C-SNP actual mortality rate is below expected is more pronounced when using risk score adjustments than when using age/sex adjustments (comparing last column of Tables 4-3 and 4-5).

4.6 Conclusions

Overall, we find that the actual mortality rate among C-SNP enrollees is lower than among FFS beneficiaries, whether computed by matching on age and sex or by matching on risk scores, which account for each person's comorbidities. From these results, it does not appear that C-SNP enrollees have an unmeasured higher severity of illness, and thus there does not appear to be evidence that C-SNP plan payments are too low. If anything, the results suggest the opposite.

Table 4-1
Chronic condition special needs plans (C-SNPs) validation group definitions (V12)

C-SNP type number	C-SNP type definitions
SNP 1	Chronic alcohol and other drug dependence = HCCs 51-52
SNP 2	Autoimmune disorders = HCC 38 (approximate mapping)
SNP 3	Cancer (excluding pre-cancer or in-situ status) = HCCs 7-10
SNP 4	Cardiovascular disorders = HCCs 81-83, 92, 104-105
SNP 5	Chronic heart failure = HCC 80 (approximate mapping)
SNP 6	Dementia = HCC 49; HCC 49 is not in the payment model
SNP 7	Diabetes mellitus = HCCs 15-19
SNP 8	End-stage liver disease = HCC 25
SNP 9	End-stage renal disease requiring dialysis (all modes of dialysis) = ESRD continuing enrollee dialysis model
SNP 10	Severe hematological disorders = HCC 44 (approximate mapping)
SNP 11	HIV/AIDS = HCC 1
SNP 12	Chronic lung disorders = HCC 108
SNP 13	Chronic and disabling mental health conditions = HCCs 54-55
SNP 14	Neurologic disorders = HCCs 67-68, 71-73, 74 (approximate mapping), 100-101
SNP 15	Stroke = HCCs 95-96, 100-101 (approximate mapping)

NOTE: Because this analysis used risk score files as the source of HCCs, the C-SNP disease groups are defined only by payment model HCCs (Version 12). HCCs identified as "approximate mapping" include a subset of diagnoses not specified by the panel. SNP 6 Dementia is excluded from this analysis because it is fully defined by a non-payment model HCC. SNP 9 End-stage renal disease requiring dialysis is excluded from this analysis because it is defined by the ESRD continuing enrollee dialysis model.

SOURCE: RTI analysis of 2008 Special Needs Plan Chronic Condition Panel Final Report.

Table 4-2
Comparison of C-SNPs and FFS enrollees mortality rates by age/sex categories

	C-SNP enrollees N	C-SNP enrollees mortality rate (%)	FFS enrollees N	FFS enrollees mortality rate (%)	Percent difference between C-SNP and FFS mortality rates
Full Sample	227,681	4.22	16,268,447	5.46	-22.71
Male Aged 0 to 64	19,473	3.10	1,314,434	2.96	4.73
Male Aged 65 to 74	45,480	3.60	2,699,901	3.61	-0.28
Male Aged 75-84	29,105	6.23	2,423,902	6.85	-9.05
Male Aged 85+	7,140	13.32	806,260	15.40	-13.51
Female Aged 0 to 64	20,192	2.21	1,338,605	2.10	5.24
Female Aged 65 to 74	53,957	2.28	3,027,751	2.72	-16.18
Female Aged 75-84	40,119	4.34	3,151,115	5.19	-16.38
Female Aged 85+	12,215	9.64	1,506,479	12.44	-22.51

NOTE:

1. Actual mortality rate defined as died January 1–December 31, 2008.

SOURCE: RTI analysis of 2008 Medicare HPMS, CME, Denominator, and Risk Score Files.

Computer Output: stat015_v2.

Table 4-3
Actual versus expected mortality rates for 2008 chronic condition SNP enrollees, using age/sex adjustments, by C-SNP type

C-SNP type #	C-SNP type label	C-SNP sample size	FFS sample size	SNP actual mortality rate (%)	SNP expected mortality rate: age/sex adjusted (%)	Percent difference between SNP actual and expected mortality rates
SNP 1	Chronic alcohol and other drug dependence	4,120	343,705	7.11	8.19	-13.19
SNP 2	Autoimmune disorders	15,726	1,253,970	4.10	4.31	-4.87
SNP 3	Cancer (excluding pre-cancer or in-situ status)	29,341	3,134,484	7.70	7.89	-2.41
SNP 4	Cardiovascular disorders	103,048	7,182,941	5.76	6.45	-10.70
SNP 5	Chronic heart failure	52,136	3,180,098	8.54	9.97	-14.34
SNP 7	Diabetes mellitus	138,815	6,355,650	4.04	4.58	-11.79
SNP 8	End-stage liver disease	940	61,175	13.40	18.15	-26.17
SNP 10	Severe hematological disorders	2,287	226,735	13.16	17.81	-26.11
SNP 11	HIV/AIDS	1,555	82,989	3.41	4.13	-17.43
SNP 12	Chronic lung disorders	53,289	3,534,422	7.05	8.35	-15.57
SNP 13	Chronic and disabling mental health conditions	20,186	1,626,326	3.69	4.45	-17.08
SNP 14	Neurologic disorders	43,401	2,639,126	5.59	6.51	-14.13
SNP 15	Stroke	18,532	1,134,712	7.78	8.55	-9.01

NOTES:
1. Actual mortality rate defined as died January 1–December 31, 2008.
2. Expected mortality based on sample of FFS beneficiaries matched on SNP type and age/sex distribution.
3. SNP types defined by Version 12 CMS-HCCs.

SOURCE: RTI analysis of 2008 Medicare HPMS, CME, Denominator, and Risk Score Files.

Computer Output: stat013_v2.

Table 4-4
C-SNP enrollee expected mortality rate calculation for C-SNP type 11 (HIV/AIDS)—matched by risk scores

Quintile	Risk scores from C-SNP population[1]	Percent of FFS enrollees in each quintile	Mortality rate for FFS enrollees (%)	Expected mortality rate calculation (0.2 weighted FFS rate)
1st	1.463	31.26	1.25	0.25
2nd	1.806	19.26	1.80	0.36
3rd	2.331	17.53	2.45	0.49
4th	3.217	15.88	3.72	0.74
5th	12.976	16.07	13.33	2.67
Total/Mean	—	100%	—	**4.51**

NOTES:

1. Risk scores are the upper end of each quintile. Columns may not add to total due to rounding.

SOURCE: RTI Analysis of 2008 Medicare Administrative Data.

Computer Output: stat006_v3_snp11.

Table 4-5
Actual versus expected mortality rates for 2008 chronic condition SNP enrollees, using risk score adjustment, by C-SNP type

C-SNP Type #	C-SNP Type Label	C-SNP Sample Size	FFS Sample Size	C-SNP Actual Mortality Rate (%)	C-SNP Expected Mortality Rate: Risk Score Adjusted (%)	Percent Difference between C-SNP Actual and Expected Mortality Rates
SNP 1	Chronic alcohol and other drug dependence	4,120	343,705	7.11	8.98	-20.82
SNP 2	Autoimmune disorders	15,726	1,253,970	4.10	5.79	-29.19
SNP 3	Cancer (excluding pre-cancer or in-situ status)	29,341	3,134,484	7.70	10.00	-23.00
SNP 4	Cardiovascular disorders	103,048	7,182,941	5.76	8.68	-33.64
SNP 5	Chronic heart failure	52,136	3,180,098	8.54	12.56	-32.01
SNP 7	Diabetes mellitus	138,815	6,355,650	4.04	5.61	-27.99
SNP 8	End-stage liver disease	940	61,175	13.40	18.96	-29.32
SNP 10	Severe hematological disorders	2,287	226,735	13.16	19.46	-32.37
SNP 11	HIV/AIDS	1,555	82,989	3.41	4.51	-24.39
SNP 12	Chronic lung disorders	53,289	3,534,422	7.05	9.87	-28.57
SNP 13	Chronic and disabling mental health conditions	20,186	1,626,326	3.69	5.46	-32.42
SNP 14	Neurologic disorders	43,401	2,639,126	5.59	8.39	-33.37
SNP 15	Stroke	18,532	1,134,712	7.78	10.78	-27.83

NOTES:
1. Actual mortality rate defined as died January 1–December 31, 2008.
2. Expected mortality based on sample of FFS beneficiaries matched on SNP type and risk scores.
3. SNP types defined by Version 12 CMS-HCCs.

Computer Output: stat008_v3.

SOURCE: RTI analysis of 2008 Medicare HPMS, CME, Denominator, and Risk Score Files.

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