NATIONAL QUALITY FORUM

Measure Submission and Evaluation Worksheet 5.0

This form contains the information submitted by measure developers/stewards, organized according to NQF's measure evaluation criteria and process. The evaluation criteria, evaluation guidance documents, and a blank online submission form are available on the submitting standards web page.

NQF #: 0171 **NQF Project:** Care Coordination Project

(for Endorsement Maintenance Review)
Original Endorsement Date: Mar 31, 2009 **Most Recent Endorsement Date:** Mar 31, 2009

BRIEF MEASURE INFORMATION

De.1 **Measure Title:** Acute care hospitalization (risk-adjusted)

Co.1.1 **Measure Steward:** Centers for Medicare & Medicaid Services

De.2 **Brief Description of Measure:** Percentage of home health stays in which patients were admitted to an acute care hospital during the 60 days following the start of the home health stay.

2a1.1 **Numerator Statement:** Number of home health stays for patients who have a Medicare claim for an admission to an acute care hospital in the 60 days following the start of the home health stay.

2a1.4 **Denominator Statement:** Number of home health stays that begin during the 12-month observation period. A home health stay is a sequence of home health payment episodes separated from other home health payment episodes by at least 60 days.

2a1.8 **Denominator Exclusions:** The following are excluded: home health stays for patients who are not continuously enrolled in fee-for-service Medicare during the numerator window (60 days following the start of the home health stay) or until death; home health stays that begin with a Low Utilization Payment Adjustment (LUPA) claim; home health stays in which the patient receives service from multiple agencies during the first 60 days; and home health stays for patients who are not continuously enrolled in fee-for-service Medicare for the 6 months prior to the start of the home health stay.

1.1 **Measure Type:** Outcome
2a1. 25-26 **Data Source:** Administrative claims
2a1.33 **Level of Analysis:** Facility

1.2-1.4 **Is this measure paired with another measure?** No

De.3 **If included in a composite, please identify the composite measure** (*title and NQF number if endorsed*)**:**
Not currently included in a composite measure.

STAFF NOTES (*issues or questions regarding any criteria*)

Comments on Conditions for Consideration:

Is the measure untested? Yes☐ No☐ If untested, explain how it meets criteria for consideration for time-limited endorsement:

1a. Specific national health goal/priority identified by DHHS or NPP addressed by the measure (*check De.5*)**:**
5. Similar/related endorsed or submitted measures (*check 5.1*)**:**
Other Criteria:

Staff Reviewer Name(s):

1. IMPACT, OPPORTUITY, EVIDENCE - IMPORTANCE TO MEASURE AND REPORT

Importance to Measure and Report is a threshold criterion that must be met in order to recommend a measure for endorsement. All

three subcriteria must be met to pass this criterion. See guidance on evidence.
Measures must be judged to be important to measure and report in order to be evaluated against the remaining criteria. **(evaluation criteria)**

1a. High Impact: **H☐ M☐ L☐ I ☐**
(*The measure directly addresses a specific national health goal/priority identified by DHHS or NPP, or some other high impact aspect of healthcare.*)

De.4 **Subject/Topic Areas** *(Check all the areas that apply)*:
De.5 **Cross Cutting Areas** (*Check all the areas that apply*): Care Coordination, Overuse

1a.1 **Demonstrated High Impact Aspect of Healthcare:** Affects large numbers, High resource use, Patient/societal consequences of poor quality

1a.2 **If "Other," please describe:**

1a.3 **Summary of Evidence of High Impact** *(Provide epidemiologic or resource use data)*:
Acute care hospitalization is a national priority for Medicare recipients, based on evidence that 20% of all Medicare beneficiaries who were hospitalized had a return hospital stay within 30 days. In 2004, this cost the Medicare program $17.4 billion (1). Within home health care, publicly reported data indicate that 26% of home health care patients experience an acute care hospitalization, risk adjusted for factors that influence of the use of hospital care. There is no research on the extent to which these acute care hospitalizations are avoidable within home health care. However, there is evidence from studies of Medicare patients in general that there are interventions to reduce the need for hospital care within a substantial proportion of these Medicare beneficiaries. In addition, there are a number of national initiatives, both governmental (e.g. Quality Improvement Organizations, National Priorities Partnership) and through private foundations (e.g. Institute for Healthcare Improvement), addressing this issue. Thus there is room for improvement and this is a national priority issue.
Care coordination is one strategy that has been identified nationally by the National Priorities Partnership to address these high rates of hospital care. Models of care coordination and transitional care have been identified and tested in RCTs and are currently being tested in national demonstration projects with expectations that health care reform activities will incorporate care coordination for persons at high risk of hospitalization and rehospitalization (2). While there has been limited testing of these models within the existing home health care system, there is evidence of effectiveness: Daley reported a small study (N = 89 patients with heart failure [HF]) where care coordination resulted in a reduction in hospitalization rate beyond that expected (15% versus 20%)(3). Russell and colleagues provide preliminary findings on a care transition project within home health care that provided a 57% less likely need for hospital care for persons with HF(4).
In addition to care transition interventions, there is evidence that additional strategies like telehealth (TH) may be beneficial in reducing hospitalizations among home health care patients although the evidence on telehealth is more mixed in effectiveness in meta-analyses (5-8). Complicating the understanding of effectiveness of TH is that much telehealth research is done outside the existing home health care system. An additional strategy that has been found to reduce the likelihood of rehospitalization for home health care patients includes prompt physician follow up after a hospital stay. Wolff et al (9) found that 77.6% of home health recipients who received at least one physician evaluation and management visit during their home health stay were discharged to the community (rather than transferred to an inpatient facility) while only 70.6% of patients who did not receive physician visits were discharged to the community, suggesting that increasing physician visits may be cost effective.

1a.4 **Citations for Evidence of High Impact cited in 1a.3:**
(1) Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. N Engl J Med 2009; 360(14):1418-1428.
(2) Boult C, Green AF, Boult LB, Pacala JT, Snyder C, Leff B. Successful models of comprehensive care for older adults with chronic conditions: evidence for the Institute of Medicine´s "retooling for an aging America" report. J Am Geriatr Soc 2009; 57(12):2328-2337.
(3) Daley CM. A hybrid transitional care program. Crit Pathw Cardiol 2010; 9(4):231-234.
(4) Russell D, Rosati RJ, Sobolewski S, Marren J, Rosenfeld P. Implementing a transitional care program for high-risk heart failure patients: findings from a community-based partnership between a certified home healthcare agency and regional hospital. J Healthc Qual 2011; 33(6):17-24.
(5) Polisena J, Coyle D, Coyle K, McGill S. Home telehealth for chronic disease management: a systematic review and an analysis of economic evaluations. Int J Technol Assess Health Care 2009; 25(3):339-349.
(6) Polisena J, Tran K, Cimon K, Hutton B, McGill S, Palmer K. Home telehealth for diabetes management: a

systematic review and meta-analysis. Diabetes Obes Metab 2009; 11(10):913-930.
(7) Polisena J, Tran K, Cimon K, Hutton B, McGill S, Palmer K et al. Home telehealth for chronic obstructive pulmonary disease: a systematic review and meta-analysis. J Telemed Telecare 2010; 16(3):120-127.
(8) Polisena J, Tran K, Cimon K, Hutton B, McGill S, Palmer K et al. Home telemonitoring for congestive heart failure: a systematic review and meta-analysis. J Telemed Telecare 2010; 16(2):68-76.
(9) Wolff JL, Meadow A, Boyd CM, Weiss CO, Leff B. Physician evaluation and management of Medicare home health patients. Med Care 2009; 47(11):1147-1155.

1b. Opportunity for Improvement: H☐ M☐ L☐ I ☐
(*There is a demonstrated performance gap - variability or overall less than optimal performance*)

1b.1 Briefly explain the benefits (improvements in quality) envisioned by use of this measure:
Acute care hospitalization is a publicly reported outcome measure for home health care. Although there has been very modest progress in reducing the rate of ACH over time, rates remain substantial with 19.2% of home health patients experiencing hospitalization in the first 60 days of care. Home health care agencies focus on this measure as a measure of their effectiveness. CMS has provided support to the QIOs to address the high rates of ACH. There are other national initiatives to address ACH including work by the Institute for Healthcare Improvement, the National Priority Partnership and others. As described above, there are interventions that may be effective in reducing ACH including care transition models and telehealth. Thus, continued reporting is beneficial as this is one outcome that is a national priority across sites of care and for which there is evidence of how to impact the measure.
Prior iterations of this measure have been based on data derived from OASIS assessments. Of note, Wolff et al, (2008) in comparing OASIS and claims for utilization of care in the 14 days prior to home health care, found that the OASIS was not sufficiently accurate with kappa score of 0 and sensitivity and specificity of 55% and 45%, respectively. Thus the proposed use of claims-based measure have been found to be superior in research.

1b.2 Summary of Data Demonstrating Performance Gap *(Variation or overall less than optimal performance across providers)*:
[*For Maintenance* – *Descriptive statistics for performance results for this measure - distribution of scores for measured entities by quartile/decile, mean, median, SD, min, max, etc.***]**

Observed Agency Rates:

Mean	17.0%
Std. Dev.	6.5%
Min	0.0%
10%	8.1%
25%	13.0%
50%	17.6%
75%	21.3%
90%	24.5%
Max	52.0%

Risk Adjusted Agency Rates:

Mean	17.9%
Std. Dev.	5.2%
Min	0.0%
10%	11.3%
25%	14.8%
50%	18.1%
75%	21.0%
90%	23.9%
Max	31.6%

1b.3 Citations for Data on Performance Gap: [*For Maintenance* – *Description of the data or sample for measure results reported in 1b.2 including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included***]**
Medicare certified agencies with at least 20 home health stays beginning between 1/1/2010 and 12/31/2010 and meeting the measure denominator criteria. There were 8,567 such agencies (85% of the 10,125 agencies with at least one stay beginning in 2010). The average size agency had 248 home health stays included in the measure numerator, while the median size agency had

102 home health stays.

1b.4 Summary of Data on Disparities by Population Group: [*For **Maintenance –Descriptive statistics for performance results for this measure by population group*]**

Group	# of HH Stays	% Acute Care Hosp.
Female	1,696,373	18.1%
Male	971,554	21.2%
Age <65	333,675	21.3%
Age 65-75	669,615	18.7%
Age 75-85	925,143	19.1%
Age 85+	739,494	18.9%
Black	327,122	19.7%
Hispanic	93,089	14.0%
Other	78,279	17.6%
White	2,169,437	19.4%

1b.5 Citations for Data on Disparities Cited in 1b.4: [*For **Maintenance – Description of the data or sample for measure results reported in 1b.4 including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included*]**

2010 Home Health Stays at Medicare Certified Agencies. LUPAs and patients not continuously enrolled in Medicare during the observation window were excluded. Population group analysis reports the observed rate of hospitalization and was conducted prior to applying additional measure exclusions needed for risk adjustment and agency attribution. Thus a total of 2,667,927 HH stays were included in this analysis with an overall observed rate of Acute Care Hospitalization of 19.2%.

1c. Evidence (*Measure focus is a health outcome OR meets the criteria for quantity, quality, consistency of the body of evidence.*)
Is the measure focus a health outcome? Yes☐ No☐ If not a health outcome, rate the body of evidence.

Quantity: H☐ M☐ L☐ I☐ Quality: H☐ M☐ L☐ I☐ Consistency: H☐ M☐ L☐ I☐

Quantity	Quality	Consistency	Does the measure pass subcriterion1c?
M-H	M-H	M-H	**Yes**☐
L	M-H	M	**Yes**☐ IF additional research unlikely to change conclusion that benefits to patients outweigh harms: otherwise **No**☐
M-H	L	M-H	**Yes**☐ IF potential benefits to patients clearly outweigh potential harms: otherwise **No**☐
L-M-H	L-M-H	L	**No** ☐

Health outcome – rationale supports relationship to at least one healthcare structure, process, intervention, or service	**Does the measure pass subcriterion1c?** **Yes**☐ IF rationale supports relationship

1c.1 Structure-Process-Outcome Relationship *(Briefly state the measure focus, e.g., health outcome, intermediate clinical outcome, process, structure; then identify the appropriate links, e.g., structure-process-health outcome; process- health outcome; intermediate clinical outcome-health outcome)*:
Process-outcome (as ACH is a utilization outcome). There is evidence that there are strategies that can be undertaken to reduce ACH use including care coordination, physician follow up, hospital discharge planning and a variety of home health care specific evidence-based strategies from the Quality Improvement Organizations (medication management, care provision (frontloading visits), patient education strategies, falls prevention and other topics).

1c.2-3 Type of Evidence *(Check all that apply)*:
Selected individual studies (rather than entire body of evidence)

1c.4 Directness of Evidence to the Specified Measure *(State the central topic, population, and outcomes addressed in the body*

of evidence and identify any differences from the measure focus and measure target population):
THERE IS VERY LITTLE HOME HEALTH CARE SPECIFIC RESEARCH ON THIS TOPIC.
Schade et al (2009) report on the QIO efforts to reduce ACH within home health care. They used an observational study design with 147 home health care agencies participating in the QIO program to reduce ACH matched with 147 agencies who did not enroll in the online registry for the program materials. The program materials were best practice intervention packets with extensive support and tailoring for home health care agencies. The best practices included agency- and clinician-specific materials such as medication management, care provision (frontloading visits), patient education strategies, falls prevention and other topics. The outcome measure was the risk adjusted ACH change rate at the agency level. Comparisons were made pre- (February through November 2006) and post-program (February through November 2007). Findings: There were no significant differences between participating and non-participating agencies in the change in the ACH rates. Changes were less than 0.01% regardless of group. A limitation to this study, however, is that non-participating agencies still downloaded the materials, suggesting that there was diffusion of the intervention that may have interfered with the change in ACH rate whereby both participating and "non-participating" agencies took action to reduce ACH.
Daley reported a small study (N = 89 patients with heart failure [HF]) where care coordination was conducted that included health literary assessment, medication reconciliation and cardiologist follow up after a hospitalization. A group of hospitalized patients served as the control group. The findings were that patients who received "care coordination" had a reduction in hospitalization rate beyond that expected (15% versus 20%).
Russell and colleagues provide preliminary findings on a care transition project within one home health care agency (N = 446) using an observational study design (not an RCT). Patients with heart failure were the focus of the program. The intervention was multi-faceted and included both hospital discharge planning and home health care follow-up. The researchers did not report the actual hospitalization rates between the groups. They report that the intervention group was 57% less likely (adjusted odds ratio) to be rehospitalized.
Two other studies, reported in the last 5 years, have been single agency studies with no control groups (Silver et al, 2010; Peterson-Sgro, 2007). These studies describe agency interventions to reduce ACH. These are more accurately described as quality improvement projects instead of research.

1c.5 Quantity of Studies in the Body of Evidence *(Total number of studies, not articles)*: Five studies

1c.6 Quality of Body of Evidence (*Summarize the certainty or confidence in the estimates of benefits and harms to patients across studies in the body of evidence resulting from study factors. Please address: a) study design/flaws; b) directness/indirectness of the evidence to this measure (e.g., interventions, comparisons, outcomes assessed, population included in the evidence); and c) imprecision/wide confidence intervals due to few patients or events*): While the five studies are home health care specific, two are quality improvement studies versus "research" as they do not include control groups or sufficient scientific rigor to allow for determination of the effects of the interventions. The study by Schade et al is more rigorous, uses an observational study design and matches agencies on factors that may have influenced the results. However, the diffusion of the intervention to the "non-participating" agencies made it impossible to determine whether the QIO best practice program materials were effective. The studies by Russell and Daley were more rigorous but were conducted in single home health care agencies, raising concerns about the extent to which the findings will be generalizable to other agencies. As well, the study by Russell used two different time periods for the control and intervention groups.

1c.7 Consistency of Results across Studies *(Summarize the consistency of the magnitude and direction of the effect):* The consistency of the findings are mixed, primarily because there are variations in what interventions agencies use.

1c.8 Net Benefit *(Provide estimates of effect for benefit/outcome; identify harms addressed and estimates of effect; and net benefit - benefit over harms)*:
It is difficult to use the evidence to determine net benefit as the largest study (Schade et al) found no difference while the two agency-specific studies found small to moderate effects for patients with heart failure.

1c.9 Grading of Strength/Quality of the Body of Evidence. Has the body of evidence been graded? No

1c.10 If body of evidence graded, identify the entity that graded the evidence including balance of representation and any disclosures regarding bias: N/A

1c.11 System Used for Grading the Body of Evidence: Other

1c.12 If other, identify and describe the grading scale with definitions: NA

1c.13 Grade Assigned to the Body of Evidence: N/A

1c.14 Summary of Controversy/Contradictory Evidence: Contradictory evidence as to the effects of various interventions but these are limited by the number (three rigorous studies) and the variations in the interventions employed.

1c.15 Citations for Evidence other than Guidelines*(Guidelines addressed below)*:
Reference List

(1) Peterson-Sgro K. Reducing acute care hospitalization and emergent care use through home health disease management: one agency´s success story. Home Healthc Nurse 2007; 25(10):622-627.
(2) Schade CP, Esslinger E, Anderson D, Sun Y, Knowles B. Impact of a national campaign on hospital readmissions in home care patients. Int J Qual Health Care 2009; 21(3):176-182.
(3) Silver MP, Ferry RJ, Edmonds C. Causes of unplanned hospital admissions: implications for practice and policy. Home Healthc Nurse 2010; 28(2):71-81.
(4) Daley CM. A hybrid transitional care program. Crit Pathw Cardiol 2010; 9(4):231-234.
(5) Russell D, Rosati RJ, Sobolewski S, Marren J, Rosenfeld P. Implementing a transitional care program for high-risk heart failure patients: findings from a community-based partnership between a certified home healthcare agency and regional hospital. J Healthc Qual 2011; 33(6):17-24.

1c.16 Quote verbatim, the specific guideline recommendation *(Including guideline # and/or page #)*:
No guidelines were identified for this measure:
A search of guideline.gov with the terms "hospitalization" and 'rehospitalization" did not return any relevant guidelines.
Systematic reviews and meta-analyses:
A PubMed Search using the term "rehospitalization" and the limits of meta-analysis or practice guideline returned for the last three years returned 5 results, none of which were relevant. A search within 5 years returned 12 results, none of which were relevant.

1c.17 Clinical Practice Guideline Citation: N/A

1c.18 National Guideline Clearinghouse or other URL: N/A

1c.19 Grading of Strength of Guideline Recommendation. Has the recommendation been graded? No

1c.20 If guideline recommendation graded, identify the entity that graded the evidence including balance of representation and any disclosures regarding bias:

1c.21 System Used for Grading the Strength of Guideline Recommendation: Other

1c.22 If other, identify and describe the grading scale with definitions: N/A

1c.23 Grade Assigned to the Recommendation: N/A

1c.24 Rationale for Using this Guideline Over Others: N/A

Based on the NQF descriptions for rating the evidence, what was the developer's assessment of the quantity, quality, and consistency of the body of evidence?
1c.25 Quantity: Low **1c.26** Quality: Moderate**1c.27** Consistency**:** Moderate

Was the threshold criterion, *Importance to Measure and Report*, met?
(*1a & 1b must be rated moderate or high and 1c yes*) Yes☐ No☐
Provide rationale based on specific subcriteria:

For a new measure if the Committee votes NO, then STOP.
For a measure undergoing endorsement maintenance, if the Committee votes NO because of 1b. (no opportunity for

improvement), it may be considered for continued endorsement and all criteria need to be evaluated.

2. RELIABILITY & VALIDITY - SCIENTIFIC ACCEPTABILITY OF MEASURE PROPERTIES

Extent to which the measure, as specified, produces consistent (reliable) and credible (valid) results about the quality of care when implemented. **(evaluation criteria)**
Measure testing must demonstrate adequate reliability and validity in order to be recommended for endorsement. Testing may be conducted for data elements and/or the computed measure score. Testing information and results should be entered in the appropriate field. Supplemental materials may be referenced or attached in item 2.1. See guidance on measure testing.

S.1 **Measure Web Page** *(In the future, NQF will require measure stewards to provide a URL link to a web page where current detailed specifications can be obtained*). Do you have a web page where current detailed specifications for this measure can be obtained? No

S.2 **If yes, provide web page URL:**

2a. RELIABILITY. Precise Specifications and Reliability Testing: H☐ M☐ L☐ I☐

2a1. Precise Measure Specifications. (*The measure specifications precise and unambiguous.*)

2a1.1 **Numerator Statement** *(Brief, narrative description of the measure focus or what is being measured about the target population, e.g., cases from the target population with the target process, condition, event, or outcome)*:
Number of home health stays for patients who have a Medicare claim for an admission to an acute care hospital in the 60 days following the start of the home health stay.

2a1.2 **Numerator Time Window** *(The time period in which the target process, condition, event, or outcome is eligible for inclusion)*:
60 days following the start of the home health stay.

2a1.3 **Numerator Details** *(All information required to identify and calculate the cases from the target population with the target process, condition, event, or outcome such as definitions, codes with descriptors, and/or specific data collection items/responses*:
The 60 day time window is calculated by adding 60 days to the "from" date in the first home health claim in the series of home health claims that comprise the home health stay. Acute care hospitalization occurs (and the home health stay is included in the numerator) if the patient has at least one Medicare inpatient claim from short term or critical access hospitals (identified by CMS Certification Number ending in 0001-0879, 0800-0899, or 1300-1399) during the 60 day window.

2a1.4 **Denominator Statement** *(Brief, narrative description of the target population being measured)*:
Number of home health stays that begin during the 12-month observation period. A home health stay is a sequence of home health payment episodes separated from other home health payment episodes by at least 60 days.

2a1.5 **Target Population Category** *(Check all the populations for which the measure is specified and tested if any)*: Adult/Elderly Care

2a1.6 **Denominator Time Window** *(The time period in which cases are eligible for inclusion)*:
12-month observation period, updated quarterly.

2a1.7 **Denominator Details** (*All information required to identify and calculate the target population/denominator such as definitions, codes with descriptors, and/or specific data collection items/responses)*:
A home health stay is a sequence of home health payment episodes separated from other home health payment episodes by at least 60 days. Each home health payment episode is associated with a Medicare home health (HH) claim, so home health stays are constructed from claims data using the following procedure.
1. First, retrieve HH claims with a "from" date (FROM_DT) during the 12-month observation period or the 120 days prior to the beginning of the observation period and sequence these claims by "from" date for each beneficiary.
2. Second, drop claims with the same "from" date and "through" date (THROUGH_DT) and claims listing no visits and no payment. Additionally, if multiple claims have the same "from" date, keep only the claim with the most recent process date.
3. Third, set Stay_Start_Date(1) equal to the "from" date on the beneficiary's first claim. Step through the claims sequentially to determine which claims begin new home health stays. If the claim "from" date is more than 60 days after the "through" date on

the previous claim, then the claim begins a new stay. If the claim "from" date is within 60 days of the "through" date on the previous claim, then the claim continues the stay associated with the previous claim.
4. Fourth, for each stay, set Stay_Start_Date(n) equal to the "from" date of the first claim in the sequence of claims defining that stay. Set Stay_End_Date(n) equal to the "through" date on the last claim in that stay. Confirm that Stay_Start_Date(n+1) – Stay_End_Date(n) > 60 days for all adjacent stays.
5. Finally, drop stays that begin before the 12-month observation window.
Note the examining claims from the 120 days before the beginning of the 12-month observation period is necessary to ensure that stays beginning during the observation period are in fact separated from previous home health claims by at least 60 days.

2a1.8 Denominator Exclusions *(Brief narrative description of exclusions from the target population)*:
The following are excluded: home health stays for patients who are not continuously enrolled in fee-for-service Medicare during the numerator window (60 days following the start of the home health stay) or until death; home health stays that begin with a Low Utilization Payment Adjustment (LUPA) claim; home health stays in which the patient receives service from multiple agencies during the first 60 days; and home health stays for patients who are not continuously enrolled in fee-for-service Medicare for the 6 months prior to the start of the home health stay.

2a1.9 Denominator Exclusion Details *(All information required to identify and calculate exclusions from the denominator such as definitions, codes with descriptors, and/or specific data collection items/responses)*:
1. Home health stays for patients who are not continuously enrolled in fee-for-service Medicare during the numerator window (60 days following the start of the home health stay) or until death.
• Both enrollment status and beneficiary death date are identified using the Medicare Enrollment Database (EDB).
2. Home health stays that begin with a Low Utilization Payment Adjustment (LUPA) claim.
• Exclude the stay if LUPAIND = L for the first claim in the home health stay.
3. Home health stays in which the patient receives service from multiple agencies during the first 60 days.
• Define Initial_Provider = PROVIDER on the first claim in the home health stay.
• If Intial_Provider does not equal PROVIDER for a subsequent claim in the home health stay AND if the "from" date of the subsequent claim is within 60 days of Stay_Start_Date, then exclude the stay.
4. Home health stays for patients who are not continuously enrolled in fee-for-service Medicare for the 6 months prior to the start of the home health stay.
• Enrollment status is identified using the Medicare Enrollment Database (EDB).

2a1.10 Stratification Details/Variables *(All information required to stratify the measure results including the stratification variables, codes with descriptors, definitions, and/or specific data collection items/responses)*:
N/A - not stratified

2a1.11 Risk Adjustment Type *(Select type. Provide specifications for risk stratification in 2a1.10 and for statistical model in 2a1.13)*: Statistical risk model **2a1.12 If "Other," please describe:**

2a1.13 Statistical Risk Model and Variables *(Name the statistical method - e.g., logistic regression and list all the risk factor variables. Note - risk model development should be addressed in 2b4.)*:
Multinomial logit with outcomes of "No acute event", "Emergency Department use but no Hospitalization", and "Acute Care Hospitalization".

Risk factors include:

Prior Care Setting – where the beneficiary received care immediately prior to beginning the home health stay. Variables are defined by examining Medicare institutional claims for the 30 days prior to Stay_Start_Date. Categories are Community (no Inpatient or Skilled Nursing Claims), Inpatient stay of 0-3 days, Inpatient stay of 4-8 days, Inpatient more than 9 days, Skilled Nursing stay of 0-13 days, Skilled Nursing stay of 14-41 days, and Skilled Nursing stay of 42+ days. A patient cared for in both a skilled nursing facility and an inpatient hospital during the 30 days prior to starting home health care is included in the skilled nursing categories not the inpatient categories. The length of stay is determined from the last inpatient or skilled nursing stay prior to beginning home health care.

Age and Gender Interactions – Age categories are <65, 65-74, 75-84, 85+ and are determined based on the patient's age at

Stay_Start_Date.

Dual (Medicare/Medicaid) eligibility– A beneficiary with at least one month of Medicaid enrollment in the 6 months prior to Stay_Start_Date is considered dual eligible.

CMS Hierarchical condition categories (HCCs) –HCCs were developed for the risk adjustment model used in determining capitation payments to Medicare Advantage plans and are calculated using Part A and B Medicare claims. While the CMS-HHC model uses a full year of claims data to calculate HCCs, for these measures, we use only 6 months of data to limit the number of home health stays excluded due to missing HCC data.

Details of the CMS-HCC model and the code lists for defining the HCCs can be found here:
https://www.cms.gov/MedicareAdvtgSpecRateStats/06_Risk_adjustment.asp

A description of the development of the CMS-HCC model can be found here:
https://www.cms.gov/HealthCareFinancingReview/Downloads/04Summerpg119.pdf

2a1.14-16 Detailed Risk Model Available at Web page URL (or attachment). Include coefficients, equations, codes with descriptors, definitions, and/or specific data collection items/responses. Attach documents only if they are not available on a webpage and keep attached file to 5 MB or less. NQF strongly prefers you make documents available at a Web page URL**.** Please supply login/password if needed**:**
Attachment
PrelimRiskModel_EDandACH_Jan2012-634626639629246205.pdf

2a1.17-18. Type of Score: Rate/proportion

2a1.19 Interpretation of Score *(Classifies interpretation of score according to whether better quality is associated with a higher score, a lower score, a score falling within a defined interval, or a passing score)***:** Better quality = Lower score

2a1.20 Calculation Algorithm/Measure Logic*(Describe the calculation of the measure score as an ordered sequence of steps including identifying the target population; exclusions; cases meeting the target process, condition, event, or outcome; aggregating data; risk adjustment; etc.)***:**

1. Construct Home Health Stays from HH Claims (see 2a1.7 for details)
2. Identify numerator window (60 days following Stay_Start_Date) for each stay and exclude stays for patients who are not continuously enrolled in fee-for-service Medicare during the numerator window or until patient death.
3. Exclude stays that begin with a LUPA or that involve a provider change during the numerator window
4. Link stays to enrollment data by beneficiary.
5. Exclude stays for patients who are not continuously enrolled in fee-for-service Medicare during the 6 months prior to Stay_Start_Date.
6. Calculate demographic risk factors for each stay (age, gender, dual eligibility, etc.) using enrollment data.
7. Link to Part A and Part B claims for 6 months prior to Stay_Start_Date for each beneficiary
8. Calculate prior care setting indicators and HCCs.
9. Link to Inpatient (IP) claims from Short Stay and Critical Access hospitals for numerator window (60 days following Stay_Start_Date)
10. Set Hospital Admission indicator (Hosp_Admit = 1) if any IP claims are linked to the stay in step 9.
11. Using coefficients from the multinomial logit risk model and risk factors calculated in steps 6 and 8, calculate the predicted probability of being included in the measure numerator for each stay (Pred_Hosp). Additionally calculate the average of Pred_Hosp across all stays that are included in the measure denominator (not excluded in steps 3 or 5) and call this value National_pred_Hosp.
12. Calculate observed and risk-adjusted rates for each home health agency (Initial_Provider:

a. Calculate the observed rate of Acute Care Hospitalization as the fraction all (non-excluded) HH Stays with that agency as Initial_Provider that are also included in the measure numerator (Hosp_Admit = 1). Call the value Agency_obs_Hosp.
b. Calculate the agency predicated rate of Acute Care Hospitalization by taking the average of Pred_ Hosp across all (non-

excluded) stays with that agency as Initial_Provider. Call this value Agency_pred_Hosp.
c. Calculate the risk adjusted rate of Acute Care Hospitalization using the following formula: Agency_riskadj_Hosp = National_pred_Hosp + (Agency_obs_Hosp – Agency_pred_Hosp)

2a1.21-23 Calculation Algorithm/Measure Logic Diagram URL or attachment:
URL
see 2a1.20 for algorithm

2a1.24 Sampling (Survey) Methodology. If measure is based on a sample (or survey), provide instructions for obtaining the sample, conducting the survey and guidance on minimum sample size (response rate)**:**
N/A

2a1.25 Data Source *(Check all the sources for which the measure is specified and tested*). If other, please describe**:**
Administrative claims

2a1.26 Data Source/Data Collection Instrument (*Identify the specific data source/data collection instrument, e.g. name of database, clinical registry, collection instrument, etc.*)**:** Denominator: Medicare Home Health Claims
Numerator: Medicare Inpatient Claims
Exclusions: Medicare Home Health Claims, Medicare Enrollment Data
Risk Factors: Medicare Enrollment Data, Medicare Part A & B Claims

2a1.27-29 Data Source/data Collection Instrument Reference Web Page URL or Attachment: URL
Identification of Short Term Hospitals: https://www.cms.gov/transmittals/downloads/R29SOMA.pdf General Medicare Data Documentation: http://www.resdac.org/ddvh/index.asp

2a1.30-32 Data Dictionary/Code Table Web Page URL or Attachment:
URL
Claims: http://www.resdac.org/ddvh/dd_via2.asp Enrollment: http://www.resdac.org/ddde/dd_de.asp

2a1.33 Level of Analysis (*Check the levels of analysis for which the measure is specified and tested)***:** Facility

2a1.34-35 Care Setting *(Check all the settings for which the measure is specified and tested)***:** Home Health

2a2. Reliability Testing. (*Reliability testing was conducted with appropriate method, scope, and adequate demonstration of reliability*.)

2a2.1 Data/Sample *(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)***:**
All agencies with at least 20 home health stays beginning between 1/1/2010 and 12/31/2010 were included in the reliability analysis, because only information for agencies with at least 20 episodes is publicly reported. Of the 10,125 agencies with any home health stays in 2010, 8,567 agencies met the threshold for the Acute Care Hospitalization measure. For the national analysis, a beta-binomial distribution was fitted using all agencies. For the HHR (hospital referral region) analysis described below, separate beta-binomials were fitted for each of 306 HHRs, using only those agencies in the HHR. It is worth noting that even the agencies that are in HRRs with only two agencies have high reliability scores, because these small HRR agencies tend to service many home health patients relative to the rest of the country.

2a2.2 Analytic Method *(Describe method of reliability testing & rationale)***:**
Reliability analysis of this measure follows the beta-binomial method described in "The Reliability of Provider Profiling: A Tutorial" by John L. Adams. The beta-binomial method was developed for provider level measures reported as rates, and it allows one to calculate an agency level "reliability score," interpreted as the percent of variance due to the difference in measure score among providers. Thus, a reliability score of .80 signifies that 80% of the variance is due to differences among providers, and 20% of the variance is due to measurement error or sampling uncertainty. A high reliability score implies that performance on a measure is unlikely to be due to measurement error or insufficient sample size, but rather due to true differences between the agency and other

agencies. Each agency receives an agency specific reliability score which depends on both agency size, agency performance on the measure, and measure variance for the relevant comparison group of agencies.
In addition to calculating reliability scores at the national level, we also calculated agency reliability scores at the level of hospital referral regions (HRRs), because the HRR grouping more adequately captures the types of comparisons health care consumers are likely to make. HRRs are region designations determined in the Dartmouth Atlas of Health Care study, and they represent regional health care markets for tertiary medical care that generally requires the service of a major referral center. They are aggregated hospital service areas (HSAs) and thus aggregated local health care markets. The HRRs are used to determine categories of sufficient size to make comparisons while still capturing the local set of HHA choices available to a beneficiary.

2a2.3 **Testing Results** *(Reliability statistics, assessment of adequacy in the context of norms for the test conducted)***:**
Distribution of Within National Reliability Scores

Mean	0.831
Min	0.336
10th	0.623
25th	0.756
Median	0.871
75th	0.938
90th	0.969
Max	1.000

The distribution of national reliability scores (percent of variance due to the difference in measure score among providers at the national level) shows the majority of agencies have a reliability score greater than 0.871, implying that their performance can likely be distinguished from other agencies (i.e., performance on this measure is unlikely to be due to measurement error or insufficient sample size, but is instead due to true differences between the agency and other agencies as it substantially exceeds within agency variation).
Distribution of Within HHR Reliability Scores

Mean	0.727
Min	0.074
10th	0.435
25th	0.607
Median	0.772
75th	0.881
90th	0.938
Max	1.000

The distribution of HRR reliability scores (percent of variance due to the difference in measure score among providers at the HRR level) for this measure also shows that at least 50% of agencies have a reliability score greater than 0.772, suggesting that between agency variation substantially exceeds within agency variation even at the HRR level.

2b. VALIDITY. Validity, Testing, <u>including all Threats to Validity</u>: H☐ M☐ L☐ I ☐

2b1.1 **Describe how the measure specifications** *(measure focus, target population, and exclusions)* **are consistent with the evidence cited in support of the measure focus (***criterion 1c)* **and identify any differences from the evidence:**
CMS chose to respecify the Acute Care Hospitalization measure with Medicare claims data to enhance the validity and reliability of this measure. The measure population is limited to fee-for-service (FFS) Medicare beneficiaries, ensuring that Medicare claims are filed for all covered services. The measure numerator is a broad measure of utilization (Acute Care Hospitalization) that can be cleanly identified using claims data. Because claims form the basis of Medicare payments, CMS invests significant resources in validating claims submissions prior to payment.

2b2. Validity Testing. (*Validity testing was conducted with appropriate method, scope, and adequate demonstration of validity.)*

2b2.1 **Data/Sample** *(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)***:**
As CMS audits a sample of claims for acute inpatient hospitalizations as part of annual payment error calculations, additional validity testing of measure elements has not been conducted. The annual payment error calculation for 2010 involved a sample of Medicare claims that were then compared to medical records and included 2,454 claims for Acute Inpatient Hospitalizations.

2b2.2 **Analytic Method** *(Describe method of validity testing and rationale; if face validity, describe systematic assessment)***:**

Review of 2010 Medicare CERT Report. Available at: https://www.cms.gov/CERT/Downloads/Medicare_FFS_2010_CERT_Report.pdf

2b2.3 **Testing Results** *(Statistical results, assessment of adequacy in the context of norms for the test conducted; if face validity, describe results of systematic assessment)***:**
Of the sampled claims, the hospital had no record of seeing the patient in only one case. It is possible that an extremely small fraction of claims represent care that did not occur, but this problem is clearly not widespread. For acute inpatient hospital claims reviewed, 9.5% had some type of payment error. Payment error analysis can also shed light on cases where the patient was hospitalized, but the hospitalization was not medically necessary. Payment errors include insufficient documentation, meaning the reviewers can't determine if the treatment (including hospital admission) was medically necessary, and medical necessity errors. In some cases, the reviewers determined that the patient's medical condition did not require admission to an acute inpatient hospital. Thus 9.5% represents an upper bound on the extent to which Medicare claims document hospitalizations that were not medically necessary.

POTENTIAL THREATS TO VALIDITY. (*All potential threats to validity were appropriately tested with adequate results.*)

2b3. Measure Exclusions. (*Exclusions were supported by the clinical evidence in 1c or appropriately tested with results demonstrating the need to specify them.*)

2b3.1 **Data/Sample for analysis of exclusions** *(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)***:**
All home health stays (constructed from Medicare HH claims for Medicare certified HH agencies) beginning in 2010. Prior to applying exclusions, there were 3,069,749 such stays.

2b3.2 **Analytic Method** (*Describe type of analysis and rationale for examining exclusions, including exclusion related to patient preference)***:**
Frequencies. Exclusion criteria are based on either data requirements for calculating the measure (continuous enrollment in fee-for-service Medicare) or clear attribution of the measure to the home health agency (LUPAs and change of provider).

2b3.3 **Results** *(Provide statistical results for analysis of exclusions, e.g., frequency, variability, sensitivity analyses):*
126,480 stays (4%) were excluded because the patient was not continuously enrolled in fee-for-service Medicare during the numerator window (60 days after Stay_Start_Date) or until death.
275,342 stays (9%) were excluded because the first claim in the stay was a LUPAs.
37,733 stays (1%) were excluded because the beneficiary changed agencies during the numerator window.
116,757 stays (4%) were excluded because the patient was not continuously enrolled in fee-for-service Medicare for six month look-back period used to calculate HCCs.

2b4. Risk Adjustment Strategy. (*For outcome measures, adjustment for differences in case mix (severity) across measured entities was appropriately tested with adequate results.*)

2b4.1 **Data/Sample** *(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)***:**
Initial home health stays in 2010 for each patient (2,289,530 stays total) were used to calibrate the multinomial logit model and to estimate counterfactuals. Subsequent stays were excluded to avoid overweighting characteristics of patients with multiple home health stays.

2b4.2 **Analytic Method (***Describe methods and rationale for development and testing of risk model or risk stratification including selection of factors/variables)***:**
Calculation of counterfactuals to show impact of each risk factor. Each risk factor has an associated counterfactual value that can be interpreted as the population value of the measure if all patients in the population had the risk factor but had the observed distribution of all other risk factors. The percentage difference between the counterfactual and the true population value shows the relative impact of each risk factor on the outcome.
Please note the measure is specified currently for a basic risk adjustment model that uses risk factors from the Medicare Advantage risk adjustment model. The measure developer is currently comparing various approaches to risk adjusting this measure. Specifically, the developer is examining the impact of using information collected at the beginning of home health stays via the OASIS assessment as part of the risk model. Competing models will be compared to this basic model using goodness-of-fit

statistics and clinicians will review the final set of risk factors. The risk model will be finalized in Spring 2012, prior to the first public reporting of this measure.

2b4.3 **Testing Results** *(Statistical risk model: Provide quantitative assessment of relative contribution of model risk factors; risk model performance metrics including cross-validation discrimination and calibration statistics, calibration curve and risk decile plot, and assessment of adequacy in the context of norms for risk models. Risk stratification: Provide quantitative assessment of relationship of risk factors to the outcome and differences in outcomes among the strata)***:**
Among first HH stays in 2010, the population average for Acute Care Hospitalization was 18.7%. If the counterfactual for a risk factor is greater than 18.7%, then that risk factor is associated with higher rates of ED use. If it is lower than 18.7% then that risk factor is associated with lower rates of ED use.
Prior Care Setting

Community	15.6%	(16.3% lower than population avg)
Inpatient, 0-3 days	18.5%	(1.2% lower)
Inpatient, 4-8 days	20.1%	(7.4% higher)
Inpatient, 9+ days	25.4%	(35.7% higher)
Skilled Nursing, 0-13 days	18.4%	(1.4% lower)
Skilled Nursing, 14-41 days	18.5%	(1.2% lower)
Skilled Nursing, 42+ days	19.1%	(2.1% lower)

Patients who did not receive care from a hospital or from a skilled nursing facility in the 30 days prior to beginning home care (community admitted patients) are less likely to be hospitalization in the 60 day numerator window. Patients with a long hospital stay (but who didn't receive skilled nursing) are substantially more likely to be hospitalized during the 60 day window.

Age-Gender Interaction

<65, Female	19.2%	(2.9% higher)
<65, Male	18.8%	(0.5% higher)
65-75, Female	17.0%	(9.1% lower)
65-75, Male	17.9%	(3.9% lower)
75-85, Female	18.0%	(3.8% lower)
75-85, Male	19.3%	(3.6% higher)
85+, Female	19.6%	(5.1% higher)
85+, Male	21.0%	(12.3% higher)

The oldest old (85+) and the disabled (<65) are more likely to be hospitalized than are patients between 65 and 84. This potentially reflects increased frailty of the oldest old.

Dual Status	19.4%	(3.8% higher)

Patients with both Medicare and Medicaid are more likely to experience acute care hospitalization than patients with only Medicare. This may reflects differences in usual source of care between dual eligibles and non-dual eligibles, and may also capture differences in health status and functional status not captured by the 6 month HCCs.

HCCs – due to space constraints, counterfactuals for all HCCs are not reported. However, one finding of note is that patients with HCCs for ESRD and certain types of cancer have elevated rates of Acute Care Hospitalization. Some of these hospitalizations likely represent planned hospitalization – in this specification, the elevated rate of hospitalization for these patients is captured by the risk adjustment. However, CMS is also considering excluding planned hospitalizations (consistent with existing rehospitalization measures) from this measure and would appreciate the committee's thoughts on such an exclusion.

End-Stage Liver Disease	27.7%	(48.4% higher)
Metastatic Cancer and Acute Leukemia	29.1%	(55.7% higher)
Lung/Upper Digestive/Oth Sev Cancer	24.1%	(28.8% higher)
Lymphatic/Head/Neck/Brain/Maj Cancer	22.7%	(21.7% higher)

2b4.4 **If outcome or resource use measure is not risk adjusted, provide rationale and analyses to justify lack of adjustment:** NA

2b5. Identification of Meaningful Differences in Performance. (*The performance measure scores were appropriately analyzed and discriminated meaningful differences in quality.*)

2b5.1 Data/Sample *(Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)***:**
Medicare certified agencies with at least 20 home health stays beginning between 1/1/2010 and 12/31/2010 and meeting the measure denominator criteria. There were 8,567 such agencies (85% of the 10,125 agencies with at least one stay beginning in 2010). The average size agency had 248 home health stays included in the measure numerator, while the median size agency had 102 home health stays.

2b5.2 Analytic Method *(Describe methods and rationale to identify statistically significant and practically/meaningfully differences in performance)***:**
The distribution risk-adjusted agency rates was analyzed to determine the inter-quartile range and the 90th vs. 10th percentile differences.

2b5.3 Results *(Provide measure performance results/scores, e.g., distribution by quartile, mean, median, SD, etc.; identification of statistically significant and meaningfully differences in performance)*:
Risk Adjusted Agency Rates:

Mean	17.9%
Std. Dev.	5.2%
Min	0.0%
10%	11.3%
25%	14.8%
50%	18.1%
75%	21.0%
90%	23.9%
Max	31.6%

Inter-quartile range (75th – 25th) = 21.0 – 14.8 = 6.2%
90th – 10th percentile = 23.9 – 11.3 = 12.6%
While the accounting for differences in case-mix (risk-adjustment) narrows the distribution in rates of Acute Care Hospitalization somewhat, an agency at the 75th percentile still has a risk-adjusted rate of Acute Care Hospitalization that is 6.2 percentage points higher than an agency at the 25th percentile, meaning the poorer quality agency experiences many more hospitalizations than the better agency.

2b6. Comparability of Multiple Data Sources/Methods. (*If specified for more than one data source, the various approaches result in comparable scores.*)

2b6.1 Data/Sample *(Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)***:**
NA - single data source

2b6.2 Analytic Method *(Describe methods and rationale for testing comparability of scores produced by the different data sources specified in the measure)***:**
NA - single data source

2b6.3 Testing Results *(Provide statistical results, e.g., correlation statistics, comparison of rankings; assessment of adequacy in the context of norms for the test conducted)***:**
NA - single data source

2c. Disparities in Care: H☐ M☐ L☐ I ☐ NA☐ (*If applicable, the measure specifications allow identification of disparities.*)

2c.1 If measure is stratified for disparities, provide stratified results *(Scores by stratified categories/cohorts)***:** NA

2c.2 If disparities have been reported/identified (e.g., in 1b), but measure is not specified to detect disparities, please explain:

2.1-2.3 Supplemental Testing Methodology Information:

Steering Committee: Overall, was the criterion, *Scientific Acceptability of Measure Properties*, met?
(*Reliability and Validity must be rated moderate or high*) Yes☐ No☐
Provide rationale based on specific subcriteria:

If the Committee votes No, STOP

3. USABILITY

Extent to which intended audiences (e.g., consumers, purchasers, providers, policy makers) can understand the results of the measure and are likely to find them useful for decision making. **(evaluation criteria)**

C.1 **Intended Purpose/ Use** *(Check all the purposes and/or uses for which the measure is intended)***:** Public Reporting, Quality Improvement with Benchmarking (external benchmarking to multiple organizations)

3.1 **Current Use** *(Check all that apply; for any that are checked, provide the specific program information in the following questions)*: Public Reporting, Quality Improvement with Benchmarking (external benchmarking to multiple organizations)

3a. Usefulness for Public Reporting: H☐ M☐ L☐ I ☐
(*The measure is meaningful, understandable and useful for public reporting.*)

3a.1. **Use in Public Reporting - disclosure of performance results to the public at large** *(If used in a public reporting program, provide name of program(s), locations, Web page URL(s)).* If not publicly reported in a national or community program, state the reason AND plans to achieve public reporting, potential reporting programs or commitments, and timeline, e.g., within 3 years of endorsement: **[*For Maintenance* –** *If not publicly reported, describe progress made toward achieving disclosure of performance results to the public at large and expected date for public reporting; provide rationale why continued endorsement should be considered.***]**
The previously endorsed version of this measures (calculated using OASIS data) is currently publicly reported on Medicare Home Health Compare and CMS intends to begin reporting Acute Care Hospitalization using claims data in mid 2012.

3a.2.**Provide a rationale for why the measure performance results are meaningful, understandable, and useful for public reporting**. If usefulness was demonstrated (e.g., focus group, cognitive testing), describe the data, method, and results**:** The CMS Center for Medicare contracted with L&M Policy Research (L&M) to help ensure that measures on the Home Health Compare (HHC) website are easy to understand and meet the needs of consumers.
L&M possesses extensive knowledge of public health care issues and is experienced in qualitative and quantitative research methods and health services management and operations, including health communications. L & M also has plain language experts that are skilled in crafting straightforward language that allows CMS to provide beneficiaries, caregivers, health care professionals, and information intermediaries a better understanding of information on choice tools, such as HHC, which allows for more informed decisions on health related issues.
L&M's work during 2009-2010 with CMS includes an environmental scan of home health public reporting initiatives and a literature review of published and unpublished research relating to consumers' comprehension and use of home health quality measures.
L&M independently convened its external advisory workgroup, comprised of representatives of consumer advocacy organizations, professional associations, quality improvement professionals, and experts in public reporting, to provide guidance on the organization, content, and usability of the home health measures website.

3.2 **Use for other Accountability Functions (payment, certification, accreditation).** If used in a public accountability program, provide name of program(s), locations, Web page URL(s)**:**

3b. Usefulness for Quality Improvement: H☐ M☐ L☐ I ☐
(*The measure is meaningful, understandable and useful for quality improvement.*)

3b.1. **Use in QI.** If used in quality improvement program, provide name of program(s), locations, Web page URL(s):
[*For Maintenance* – *If not used for QI, indicate the reasons and describe progress toward using performance results for improvement***]**.
Quality Improvement: Home Health Quality Initiatives

https://www.cms.gov/HomeHealthQualityInits/01_Overview.asp#TopOfPage

3b.2. Provide rationale for why the measure performance results are meaningful, understandable, and useful for quality improvement. If usefulness was demonstrated *(e.g., QI initiative),* describe the data, method and results:
Data on the proportion of home health stays with associated hospitalizations provides agencies with a tool to evaluate the quality of their care and investigate how changes to processes of care impact patient outcomes related to resource use.

Overall, to what extent was the criterion, *Usability*, met? H☐ M☐ L☐ I ☐
Provide rationale based on specific subcriteria:

4. FEASIBILITY

Extent to which the required data are readily available, retrievable without undue burden, and can be implemented for performance measurement. **(evaluation criteria)**

4a. Data Generated as a Byproduct of Care Processes: H☐ M☐ L☐ I ☐

4a.1-2 How are the data elements needed to compute measure scores generated? *(Check all that apply).*
Data used in the measure are**:**
generated by and used by healthcare personnel during the provision of care, e.g., blood pressure, lab value, medical condition
Directly from Medicare hospital claim dates

4b. Electronic Sources: H☐ M☐ L☐ I ☐

4b.1 Are the data elements needed for the measure as specified available electronically *(Elements that are needed to compute measure scores are in defined, computer-readable fields)***:** ALL data elements in electronic claims

4b.2 If ALL data elements are not from electronic sources, specify a credible, near-term path to electronic capture, OR provide a rationale for using other than electronic sources:

4c. Susceptibility to Inaccuracies, Errors, or Unintended Consequences: H☐ M☐ L☐ I ☐

4c.1 Identify susceptibility to inaccuracies, errors, or unintended consequences of the measurement identified during testing and/or operational use and strategies to prevent, minimize, or detect. If audited, provide results:
A key issue in using this measure to accurately identify performance at the home health agency level regards attribution. Two decisions were made to assure proper attribution. First, the numerator window was synchronized to the length of home health prospective payment episodes (60 days) and home health stays beginning with low utilization payment episodes were excluded. This means that stays included in the measure were those in which the HHA was paid to provide appropriate home health care to the patient during the measurement period. Second, stays in which the patient changed home health providers during the numerator window were also excluded from measurement. Although provider switches often follow acute care utilization (ED use or hospitalization) and may reflect patient or caregiver dissatisfaction with the initial provider, we chose to exclude all HH stays with multiple providers during the numerator window. This ensures that agencies that do not have sufficient time to impact a patient's health are not penalized for that patient's outcomes.

4d. Data Collection Strategy/Implementation: H☐ M☐ L☐ I ☐

A.2 Please check if either of the following apply (*regarding proprietary measures*)**:**
4d.1 Describe what you have learned/modified as a result of testing and/or operational use of the measure regarding data collection, availability of data, missing data, timing and frequency of data collection, sampling, patient confidentiality, time and cost of data collection, other feasibility/implementation issues *(e.g., fees for use of proprietary measures)***:**
Implementing claims-based measures such as this one requires extensive familiarity with Medicare claims and enrollment data. Because multiple types of claims are used, beneficiaries must be linked across claim types and enrollment files. Additionally, different types of claims suffer from different submission lags. Thus it is important to use the most up-to-date claims data possible in calculating claims based measures. For public reporting, this measure will be updated quarterly on a rolling basis. While the latest quarter in the observation window may have slightly lower rates of Acute Care Hospitalization due to claims delay, these events will be captured in the next quarterly update.

Overall, to what extent was the criterion, *Feasibility*, met? H☐ M☐ L☐ I ☐
Provide rationale based on specific subcriteria:

OVERALL SUITABILITY FOR ENDORSEMENT

Does the measure meet all the NQF criteria for endorsement? Yes☐ No☐
Rationale:

If the Committee votes No, STOP.
If the Committee votes Yes, the final recommendation is contingent on comparison to related and competing measures.

5. COMPARISON TO RELATED AND COMPETING MEASURES

If a measure meets the above criteria and there are endorsed or new related measures (either the same measure focus or the same target population) or competing measures (both the same measure focus and the same target population), the measures are compared to address harmonization and/or selection of the best measure before a final recommendation is made.

5.1 **If there are related measures *(either same measure focus or target population)* or competing measures *(both the same measure focus and same target population*), list the NQF # and title of all related and/or competing measures:**
0173 : Emergency Department Use without Hospitalization

5a. Harmonization

5a.1 **If this measure has EITHER the same measure focus OR the same target population as NQF-endorsed measure(s): Are the measure specifications completely harmonized?** Yes

5a.2 **If the measure specifications are not completely harmonized, identify the differences, rationale, and impact on interpretability and data collection burden:**

5b. Competing Measure(s)

5b.1 **If this measure has both the same measure focus and the same target population as NQF-endorsed measure(s): Describe why this measure is superior to competing measures** *(e.g., a more valid or efficient way to measure quality)***; OR provide a rationale for the additive value of endorsing an additional measure.** *(Provide analyses when possible)*:

CONTACT INFORMATION

Co.1 **Measure Steward (Intellectual Property Owner):** Centers for Medicare & Medicaid Services, 7500 Security Boulevard , Mail Stop S3-01-02, Baltimore, Maryland, 21244-1850

Co.2 **Point of Contact:** Robin, Dowell, BSN, robin.dowell@cms.hhs.gov, 410-786-0060-

Co.3 **Measure Developer if different from Measure Steward:** Centers for Medicare & Medicaid Services, 7500 Security Boulevard, Baltimore, Maryland, 21244

Co.4 **Point of Contact:** Robin, Dowell, Robin.Dowell@CMS.hhs.gov, 410-786-6738-

Co.5 **Submitter:** Keziah, Cook, kcook@acumenllc.com, 410-786-6738-, Centers for Medicare & Medicaid Services

Co.6 **Additional organizations that sponsored/participated in measure development:**
Abt Associates, Inc.
Case Western Reserve University
University of Colorado at Denver, Division of Health Care Policy and Research

Co.7 **Public Contact:** Robin, Dowell, BSN, robin.dowell@cms.hhs.gov, 410-786-0060-, Centers for Medicare & Medicaid Services

ADDITIONAL INFORMATION

Workgroup/Expert Panel involved in measure development Ad.1 **Provide a list of sponsoring organizations and workgroup/panel members' names and organizations. Describe the members' role in measure development.**
Ad.2 **If adapted, provide title of original measure, NQF # if endorsed, and measure steward. Briefly describe the reasons for adapting the original measure and any work with the original measure steward:**
Measure Developer/Steward Updates and Ongoing Maintenance Ad.3 **Year the measure was first released:** 2005 Ad.4 **Month and Year of most recent revision:** 12, 2011 Ad.5 **What is your frequency for review/update of this measure?** annual Ad.6 **When is the next scheduled review/update for this measure?** 09, 2012
Ad.7 **Copyright statement:**
Ad.8 **Disclaimers:**
Ad.9 **Additional Information/Comments:**
Date of Submission (*MM/DD/YY*)**:** 01/13/2012

Preliminary Risk Adjustment Model for Home Health Claims-Based Utilization Measures

Acumen, LLC **Jan-12**

Method:	Multinomial Logit with three mutually exclusive outcomes: No event, ED Use without Hospitalization, and Acute Care Hospitalization
Risk factors:	
Prior Care Setting	Where the beneficiary received care immediately prior to beginning the home health stay. Variables are defined by examining Medicare institutional claims for the 30 days prior to Stay_Start_Date. Categories are Community (no Inpatient or Skilled Nursing Claims), Inpatient stay of 0-3 days, Inpatient stay of 4-8 days, Inpatient more than 9 days, Skilled Nursing stay of 0-13 days, Skilled Nursing stay of 14-41 days, and Skilled Nursing stay of 42+ days. A patient cared for in both a skilled nursing facility and an inpatient hospital during the 30 days prior to starting home health care is included in the skilled nursing categories not the inpatient categories. The length of stay is determined from the last inpatient or skilled nursing stay prior to beginning home health care.
Age and Gender Interactions	Age categories are <65, 65-74, 75-84, 85+ and are determined based on the patient's age at Stay_Start_Date.
Dual (Medicare/Medicaid) eligibility	A beneficiary with at least one month of Medicaid enrollment in the 6 months prior to Stay_Start_Date is considered dual eligible.
CMS Hierarchical condition categories (HCCs)	HCCs were developed for the risk adjustment model used in determining capitation payments to Medicare Advantage plans and are calculated using Part A and B Medicare claims. While the CMS-HHC model uses a full year of claims data to calculate HCCs, for these measures, we use only 6 months of data to limit the number of home health stays excluded due to missing HCC data. (HCC codes list are available here: https://www.cms.gov/MedicareAdvtgSpecRateStats/06_Risk_adjustment.asp
Data used for Calibration:	First home health stays in 2010 that meet measure denominator criteria are included.
Interpretation of Counterfactuals:	Counterfactuals are calculated by simulating a population in which all patients have the indicated risk factor (e.g. All patients enter HH care from the community, all patients are males over 85, etc.) but have the observed distribution of other risk factors. If a risk factor's counterfactual rate for an outcome is higher than the observed rate of that outcome, then the risk factor is associated with a greater probabilty of the outcome.

Enrollment requirement: Continuous enrollment in A/B/FFS and alive for entire home health episode (or until death) as well as the 6 months prior to the episode
Only beneficiaries' first HH episode of 2010 are included
Beneficiaries who switched providers within the 60-day window are excluded

Study Average		Population Size		Probability of Outcome		Probability of Outcome		Probability of Outcome	
				No Acute Event		Emergency Department Use without Hospitalization		Acute Care Hospitalization	
No Controls (Study Average)		2,289,530		71.1%		10.2%		18.7%	
Control Variables		Population Size (%)		Probability of Outcome	Percent Change from Study Average	Probability of Outcome	Percent Change from Study Average	Probability of Outcome	Percent Change from Study Average
				No Acute Event		Outpatient ER		Hospitalization	
Prior Care Setting	Community	855,654	37.4%	74.2%	4.2%	10.2%	0.2%	15.6%	-16.3%
	Inpatient, 0-3 days	180,512	7.9%	70.2%	-1.3%	11.3%	11.3%	18.5%	-1.2%
	Inpatient, 4-8 days	572,347	25.0%	69.6%	-2.1%	10.3%	1.3%	20.1%	7.4%
	Inpatient, 9+ days	216,658	9.5%	64.4%	-9.4%	10.2%	0.4%	25.4%	35.7%
	Skilled Nursing, 0-13 days	107,886	4.7%	71.6%	0.6%	10.0%	-2.0%	18.4%	-1.4%
	Skilled Nursing, 14-41 days	243,958	10.7%	72.1%	1.3%	9.5%	-6.9%	18.5%	-1.2%
	Skilled Nursing, 42+ days	112,515	4.9%	70.9%	-0.4%	10.1%	-1.1%	19.1%	2.1%
Age-Gender Interaction	<65, Female	148,645	6.5%	67.1%	-5.7%	13.7%	34.3%	19.2%	2.9%
	<65, Male	121,997	5.3%	69.6%	-2.2%	11.7%	14.4%	18.8%	0.5%
	65-75, Female	341,912	14.9%	73.5%	3.3%	9.5%	-6.5%	17.0%	-9.1%
	65-75, Male	228,285	10.0%	73.1%	2.7%	9.0%	-11.7%	17.9%	-3.9%
	75-85, Female	516,968	22.6%	72.2%	1.5%	9.8%	-3.4%	18.0%	-3.8%
	75-85, Male	293,463	12.8%	71.4%	0.3%	9.3%	-8.7%	19.3%	3.6%
	85+, Female	446,921	19.5%	69.9%	-1.8%	10.5%	3.2%	19.6%	5.1%
	85+, Male	191,339	8.4%	68.7%	-3.5%	10.3%	1.5%	21.0%	12.3%
Dual Status		591,308	25.8%	69.4%	-2.5%	11.3%	10.5%	19.4%	3.8%
HCC (6-month lookback)	HIV/AIDS	7,112	0.3%	69.7%	-2.0%	10.3%	1.3%	20.0%	7.1%
	Septicemia/Shock	124,964	5.5%	70.6%	-0.7%	9.8%	-3.8%	19.6%	4.8%
	Opportunistic Infections	15,158	0.7%	67.6%	-5.0%	10.0%	-1.8%	22.4%	19.9%
	Metastatic Cancer and Acute Leukemia	76,657	3.3%	60.1%	-15.4%	10.8%	5.8%	29.1%	55.7%
	Lung/Upper Digestive/Oth Sev Cancer	44,864	2.0%	65.1%	-8.5%	10.8%	6.2%	24.1%	28.8%
	Lymphatic/Head/Neck/Brain/Maj Cancer	54,148	2.4%	66.8%	-6.0%	10.4%	2.3%	22.7%	21.7%
	Breast/Prostate/Colorectal/Oth Cancer	182,580	8.0%	71.4%	0.4%	10.0%	-1.4%	18.6%	-0.6%
	Diabetes with Renal Manifestation	162,082	7.1%	68.6%	-3.5%	10.4%	2.5%	20.9%	12.1%
	Diabs w/ Neurol/Periph Circ Manifest	144,426	6.3%	68.9%	-3.2%	10.9%	7.4%	20.2%	8.0%
	Diabetes with Acute Complications	6,830	0.3%	71.0%	-0.2%	11.1%	9.3%	17.9%	-4.2%
	Diab w/ Ophthalmologic Manifestation	38,900	1.7%	71.0%	-0.2%	10.3%	0.8%	18.7%	0.2%
	Diabetes w/ No/Unspecified comp	451,893	19.7%	71.1%	-0.1%	10.3%	1.5%	18.6%	-0.6%
	Protein-Calorie Malnutrition	123,886	5.4%	69.1%	-2.8%	10.4%	2.1%	20.5%	9.6%
	End-Stage Liver Disease	16,279	0.7%	61.9%	-13.0%	10.4%	1.8%	27.7%	48.4%
	Cirrhosis of Liver	15,612	0.7%	67.2%	-5.5%	10.4%	2.2%	22.3%	19.6%
	Chronic Hepatitis	9,704	0.4%	67.4%	-5.3%	11.9%	16.5%	20.8%	11.2%
	Intestinal Obstruction/Perforation	114,993	5.0%	70.4%	-1.0%	10.5%	2.7%	19.1%	2.4%
	Pancreatic Disease	53,385	2.3%	67.5%	-5.1%	11.1%	9.3%	21.4%	14.4%
	Inflammatory Bowel Disease	25,504	1.1%	68.4%	-3.9%	10.3%	1.2%	21.3%	14.1%
	Bone/Joint/Muscle Infect/Necrosis	65,439	2.9%	70.1%	-1.5%	9.8%	-3.5%	20.1%	7.7%
	Rheum Arthritis/Inflam Conn Tissue	153,324	6.7%	69.3%	-2.6%	10.9%	7.3%	19.8%	6.0%
	Severe Hematological Disorders	49,171	2.1%	66.9%	-6.0%	10.2%	0.2%	22.9%	22.8%
	Disorders of Immunity	30,619	1.3%	68.4%	-3.9%	9.9%	-2.5%	21.7%	16.2%
	Drug/Alcohol Psychosis	32,298	1.4%	68.4%	-3.8%	12.7%	24.6%	18.9%	1.0%
	Drug/Alcohol Dependence	28,223	1.2%	65.6%	-7.8%	13.1%	28.9%	21.3%	14.0%
	Schizophrenia	36,206	1.6%	68.8%	-3.3%	13.1%	28.5%	18.1%	-2.9%
	Major Depressive, Bipolar, Paranoid	157,827	6.9%	68.5%	-3.7%	12.1%	18.5%	19.4%	3.9%
	Quadriplegia, Oth Extens Paralysis	11,933	0.5%	69.3%	-2.6%	10.8%	6.4%	19.9%	6.4%
	Paraplegia	11,731	0.5%	69.0%	-3.1%	10.4%	2.3%	20.6%	10.3%
	Spinal Cord Disorders/Injuries	30,225	1.3%	69.5%	-2.2%	11.2%	9.7%	19.3%	3.2%
	Muscular Dystrophy	2,198	0.1%	72.4%	1.7%	9.9%	-3.0%	17.8%	-4.9%
	Polyneuropathy	223,853	9.8%	70.2%	-1.3%	10.7%	5.3%	19.1%	2.0%
	Multiple Sclerosis	17,916	0.8%	70.7%	-0.6%	10.1%	-1.0%	19.2%	2.8%
	Parkinson's and Huntington's Disease	79,958	3.5%	68.0%	-4.4%	12.5%	22.8%	19.5%	4.3%
	Seizure Disorders and Convulsions	111,219	4.9%	66.9%	-6.0%	12.1%	18.8%	21.0%	12.5%
	Coma, Brain Compression/Anoxic Damage	16,237	0.7%	69.2%	-2.8%	10.7%	5.5%	20.1%	7.6%
	Resp Depend/Tracheostomy Status	20,480	0.9%	71.4%	0.4%	10.6%	4.4%	17.9%	-4.0%
	Respiratory Arrest	4,438	0.2%	71.0%	-0.1%	10.1%	-1.2%	18.9%	1.1%
	Cardio-Respiratory Failure and Shock	305,753	13.4%	70.3%	-1.2%	10.1%	-0.9%	19.6%	4.9%
	Congestive Heart Failure	681,279	29.8%	68.4%	-3.9%	10.3%	0.9%	21.3%	14.2%
	Acute Myocardial Infarction	85,981	3.8%	67.7%	-4.8%	11.1%	9.2%	21.2%	13.4%
	Unstable Angina/Oth ac Ischemic Heart	90,631	4.0%	68.0%	-4.3%	11.7%	14.8%	20.3%	8.5%
	Angina Pectoris/Old Myocardial Infect	173,622	7.6%	69.1%	-2.9%	11.3%	11.3%	19.6%	4.8%
	Specified Heart Arrhythmias	609,571	26.6%	69.5%	-2.2%	10.6%	4.4%	19.8%	6.1%
	Cerebral Hemorrhage	36,439	1.6%	69.5%	-2.3%	11.3%	11.0%	19.2%	2.8%
	Ischemic or Unspecified Stroke	207,955	9.1%	69.9%	-1.8%	11.0%	8.1%	19.1%	2.3%
	Hemiplegia/Hemiparesis	85,960	3.8%	70.2%	-1.3%	10.7%	5.2%	19.1%	2.2%
	Cerebral Palsy, Other Paralytic Syndromes	10,318	0.5%	71.9%	1.0%	10.6%	4.5%	17.5%	-6.4%
	Peripheral Vascular Disease with Complications	134,059	5.9%	68.2%	-4.1%	10.7%	5.1%	21.1%	12.8%
	Peripheral Vascular Disease	540,283	23.6%	70.8%	-0.4%	10.3%	1.5%	18.8%	0.7%
	Cystic Fibrosis	610	0.0%	69.1%	-2.9%	8.6%	-15.7%	22.3%	19.4%
	chron Obstructive Pulmonary Disease	596,802	26.1%	68.5%	-3.8%	10.6%	4.5%	20.9%	11.9%
	Aspiration/Spec Bacterial Pneumonias	67,194	2.9%	70.6%	-0.8%	10.4%	1.9%	19.1%	2.1%
	Pneumococcal Pneumonia/Empyema/Lung Abc	24,192	1.1%	71.0%	-0.3%	10.3%	1.3%	18.7%	0.3%
	Prolif Diab Retinop/Vitreous Hmrg	24,005	1.0%	69.9%	-1.7%	10.3%	1.1%	19.8%	5.8%
	Dialysis Status	31,882	1.4%	57.3%	-19.4%	12.3%	20.4%	30.4%	62.7%
	Renal Failure	507,686	22.2%	68.2%	-4.2%	10.4%	2.3%	21.4%	14.6%
	Nephritis	5,303	0.2%	69.2%	-2.7%	10.7%	5.1%	20.1%	7.4%
	Decubitus Ulcer of Skin	79,859	3.5%	68.0%	-4.5%	9.7%	-4.4%	22.3%	19.4%
	Chronic Ulcer of Skin, Exc Decubitus	104,206	4.6%	69.7%	-2.0%	9.6%	-5.7%	20.7%	10.8%
	Extensive Third-Degree Burns	249	0.0%	73.8%	3.8%	11.8%	16.2%	14.4%	-23.2%
	Severe Head Injury	1,096	0.0%	74.2%	4.4%	10.1%	-0.6%	15.6%	-16.3%
	Major Head Injury	37,999	1.7%	70.9%	-0.4%	11.3%	11.2%	17.8%	-4.6%
	Vertebral Fract w/out Spinal Cord Injury	79,565	3.5%	67.9%	-4.5%	11.4%	12.1%	20.6%	10.5%
	Hip Fracture/Dislocation	142,102	6.2%	75.8%	6.6%	9.4%	-7.3%	14.8%	-21.0%
	Traumatic Amputation	8,325	0.4%	71.4%	0.4%	9.4%	-7.6%	19.1%	2.5%
	Maj Comp of Medical Care/Trauma	201,680	8.8%	70.0%	-1.6%	10.8%	5.8%	19.2%	3.0%
	Major Organ Transplant Status	7,477	0.3%	68.5%	-3.7%	9.3%	-8.9%	22.2%	18.8%
	Artif Opens for Feeding/Elimination	41,491	1.8%	66.3%	-6.9%	11.7%	14.7%	22.1%	18.1%
	Amput Status/Lower Limb/Amput Compl	18,242	0.8%	68.2%	-4.1%	10.3%	1.1%	21.5%	15.0%

Multinomial Logistic	Outcome 1 = ER Use without Hospitalization						Outcome 2 = Acute Care Hospitalization					
	Coef.	Std. Err	z	P>z	95% CI		Coef.	Std. Err	z	P>z	95% CI	
Prior Care Setting (omitted category: Community)												
Inpatient, 0-3 days	0.164	0.009	19.23	0	0.147	0.181	0.228	0.007	31.84	0	0.214	0.242
Inpatient, 4-8 days	0.079	0.006	12.99	0	0.067	0.091	0.323	0.005	66.09	0	0.313	0.332
Inpatient, 9+ days	0.153	0.009	17.14	0	0.135	0.170	0.647	0.006	99.81	0	0.634	0.659
Skilled Nursing, 0-13 days	0.016	0.011	1.37	0.17	-0.007	0.038	0.206	0.009	23.28	0	0.188	0.223
Skilled Nursing, 14-41days	-0.043	0.008	-5.06	0	-0.059	-0.026	0.200	0.007	30.58	0	0.187	0.213
Skilled Nursing, 42+ days	0.036	0.011	3.18	0.001	0.014	0.058	0.252	0.009	28.78	0	0.235	0.269
Age, Gender (omitted category: 65-74, Male)												
<65, Female	0.510	0.011	46.39	0	0.488	0.531	0.164	0.009	17.95	0	0.146	0.182
<65, Male	0.311	0.012	26.1	0	0.288	0.334	0.100	0.010	10.37	0	0.081	0.119
65-75, Female	0.050	0.010	5.28	0	0.032	0.069	-0.063	0.007	-8.71	0	-0.078	-0.049
75-85, Female	0.103	0.009	11.51	0	0.085	0.120	0.015	0.007	2.2	0.028	0.002	0.028
75-85, Male	0.059	0.010	5.95	0	0.039	0.078	0.104	0.007	14.22	0	0.090	0.118
85+, Female	0.204	0.009	22.05	0	0.186	0.223	0.142	0.007	20.05	0	0.129	0.156
85+, Male	0.206	0.011	18.81	0	0.184	0.227	0.230	0.008	28.01	0	0.214	0.246
Dual Eligible	0.177	0.005	32.73	0	0.166	0.187	0.088	0.004	20.15	0	0.080	0.097
HCCs												
HIV/AIDS	0.035	0.036	0.97	0.333	-0.036	0.106	0.094	0.030	3.13	0.002	0.035	0.153
Septicemia/Shock	-0.033	0.011	-3.16	0.002	-0.054	-0.013	0.062	0.007	8.34	0	0.047	0.076
Opportunistic Infections	0.037	0.028	1.34	0.181	-0.017	0.092	0.246	0.019	13.12	0	0.210	0.283
Metastatic Cancer and Acute Leukemia	0.244	0.013	19.01	0	0.219	0.270	0.670	0.009	76.79	0	0.653	0.687
Lung/Upper Digestive/Oth Sev Cancer	0.159	0.016	9.84	0	0.127	0.190	0.369	0.011	32.36	0	0.346	0.391
Lymphatic/Head/Neck/Brain/Maj Cancer	0.093	0.015	6.25	0	0.064	0.122	0.280	0.011	26.09	0	0.259	0.302
Breast/Prostate/Colorectal/Oth Cancer	-0.020	0.008	-2.37	0.018	-0.037	-0.003	-0.012	0.007	-1.79	0.074	-0.025	0.001
Diabetes with Renal Manifestation	0.068	0.010	7.16	0	0.050	0.087	0.172	0.007	24.43	0	0.159	0.186
Diabs w/ Neurol/Periph Circ Manifest	0.114	0.009	12	0	0.095	0.132	0.123	0.007	16.6	0	0.109	0.138
Diabetes with Acute Complications	0.092	0.038	2.39	0.017	0.016	0.167	-0.042	0.031	-1.36	0.174	-0.104	0.019
Diab w/ Ophthalmologic Manifestation	0.010	0.017	0.58	0.565	-0.024	0.044	0.004	0.014	0.32	0.748	-0.022	0.031
Diabetes w/ No/Unspecified comp	0.020	0.006	3.39	0.001	0.008	0.031	-0.007	0.005	-1.48	0.14	-0.016	0.002
Protein-Calorie Malnutrition	0.055	0.010	5.35	0	0.035	0.075	0.135	0.007	18.28	0	0.121	0.150
End-Stage Liver Disease	0.170	0.026	6.43	0	0.118	0.221	0.568	0.018	31.67	0	0.533	0.604
Cirrhosis of Liver	0.083	0.026	3.19	0.001	0.032	0.135	0.250	0.019	13	0	0.212	0.287
Chronic Hepatitis	0.213	0.030	7.08	0	0.154	0.272	0.171	0.025	6.71	0	0.121	0.220
Intestinal Obstruction/Perforation	0.040	0.011	3.77	0	0.019	0.060	0.038	0.008	4.85	0	0.022	0.053
Pancreatic Disease	0.150	0.014	10.52	0	0.122	0.178	0.203	0.011	19.17	0	0.182	0.224
Inflammatory Bowel Disease	0.056	0.021	2.67	0.008	0.015	0.097	0.183	0.015	11.9	0	0.153	0.213
Bone/Joint/Muscle Infect/Necrosis	-0.020	0.014	-1.39	0.164	-0.047	0.008	0.097	0.010	9.41	0	0.077	0.117
Rheum Arthritis/Inflam Conn Tissue	0.107	0.009	12.29	0	0.090	0.124	0.097	0.007	13.96	0	0.083	0.111
Severe Hematological Disorders	0.071	0.016	4.44	0	0.040	0.103	0.289	0.011	26.49	0	0.268	0.311
Disorders of Immunity	0.018	0.021	0.9	0.37	-0.022	0.059	0.203	0.014	14.63	0	0.176	0.230
Drug/Alcohol Psychosis	0.266	0.017	15.67	0	0.233	0.300	0.053	0.014	3.69	0	0.025	0.081
Drug/Alcohol Dependence	0.347	0.018	19.65	0	0.312	0.381	0.228	0.015	15.05	0	0.199	0.258
Schizophrenia	0.293	0.016	18.78	0	0.262	0.323	0.007	0.015	0.46	0.642	-0.023	0.037
Major Depressive, Bipolar, Paranoid	0.228	0.008	27.68	0	0.212	0.244	0.086	0.007	12.24	0	0.073	0.100
Quadriplegia, Oth Extens Paralysis	0.091	0.029	3.11	0.002	0.034	0.149	0.093	0.024	3.9	0	0.046	0.140
Paraplegia	0.057	0.030	1.9	0.057	-0.002	0.116	0.137	0.024	5.84	0	0.091	0.183
Spinal Cord Disorders/Injuries	0.118	0.019	6.38	0	0.082	0.155	0.058	0.015	3.9	0	0.029	0.088
Muscular Dystrophy	-0.049	0.069	-0.71	0.476	-0.184	0.086	-0.071	0.058	-1.21	0.225	-0.186	0.044
Polyneuropathy	0.074	0.008	9.57	0	0.058	0.089	0.039	0.006	6.39	0	0.027	0.050
Multiple Sclerosis	-0.004	0.024	-0.15	0.879	-0.051	0.044	0.035	0.021	1.68	0.092	-0.006	0.076
Parkinson's and Huntington's Disease	0.264	0.011	23.12	0	0.241	0.286	0.096	0.010	9.81	0	0.077	0.116
Seizure Disorders and Convulsions	0.253	0.010	26.33	0	0.234	0.272	0.200	0.008	24.94	0	0.184	0.216
Coma, Brain Compression/Anoxic Damage	0.085	0.025	3.35	0.001	0.035	0.134	0.108	0.019	5.6	0	0.070	0.146
Resp Depend/Tracheostomy Status	0.039	0.023	1.68	0.094	-0.007	0.084	-0.048	0.017	-2.76	0.006	-0.082	-0.014
Respiratory Arrest	-0.010	0.049	-0.21	0.832	-0.107	0.086	0.013	0.035	0.37	0.711	-0.056	0.082
Cardio-Respiratory Failure and Shock	0.003	0.007	0.46	0.643	-0.011	0.018	0.076	0.005	14.19	0	0.065	0.086
Congestive Heart Failure	0.070	0.006	12.47	0	0.059	0.081	0.278	0.004	64.92	0	0.269	0.286
Acute Myocardial Infarction	0.147	0.012	12.31	0	0.124	0.170	0.193	0.008	22.84	0	0.177	0.210
Unstable Angina/Oth ac Ischemic Heart	0.194	0.011	17.53	0	0.172	0.215	0.140	0.008	16.5	0	0.123	0.156
Angina Pectoris/Old Myocardial Infect	0.151	0.008	18.32	0	0.135	0.167	0.088	0.006	13.66	0	0.076	0.101
Specified Heart Arrhythmias	0.092	0.006	16.59	0	0.081	0.103	0.123	0.004	29.21	0	0.115	0.131
Cerebral Hemorrhage	0.132	0.019	6.91	0	0.095	0.170	0.055	0.016	3.54	0	0.025	0.086
Ischemic or Unspecified Stroke	0.107	0.008	13.16	0	0.091	0.123	0.047	0.006	7.3	0	0.035	0.060
Hemiplegia/Hemiparesis	0.068	0.012	5.6	0	0.044	0.092	0.039	0.010	3.98	0	0.020	0.058
Cerebral Palsy, Other Paralytic Syndromes	0.032	0.031	1.05	0.293	-0.028	0.093	-0.080	0.027	-2.96	0.003	-0.134	-0.027
Peripheral Vascular Disease with Complications	0.101	0.010	10.2	0	0.081	0.120	0.184	0.007	25.44	0	0.169	0.198
Peripheral Vascular Disease	0.025	0.005	4.63	0	0.015	0.036	0.016	0.004	3.83	0	0.008	0.025
Cystic Fibrosis	-0.139	0.139	-1	0.319	-0.411	0.134	0.217	0.097	2.23	0.026	0.026	0.407
chron Obstructive Pulmonary Disease	0.115	0.005	21.49	0	0.105	0.126	0.224	0.004	54.44	0	0.216	0.232
Aspiration/Spec Bacterial Pneumonias	0.029	0.014	2.11	0.035	0.002	0.055	0.031	0.010	3.19	0.001	0.012	0.051
Pneumococcal Pneumonia/Empyema/Lung Abc	0.015	0.022	0.71	0.476	-0.027	0.058	0.006	0.016	0.36	0.716	-0.025	0.036
Prolif Diab Retinop/Vitreous Hmrg	0.029	0.022	1.35	0.176	-0.013	0.072	0.078	0.016	4.74	0	0.046	0.110
Dialysis Status	0.422	0.018	22.84	0	0.386	0.458	0.754	0.013	56.16	0	0.728	0.780
Renal Failure	0.087	0.006	14.87	0	0.076	0.099	0.255	0.004	58.38	0	0.246	0.263
Nephritis	0.080	0.045	1.79	0.074	-0.008	0.167	0.104	0.035	2.97	0.003	0.035	0.173
Decubitus Ulcer of Skin	0.005	0.013	0.41	0.68	-0.020	0.030	0.245	0.009	26.98	0	0.227	0.262
Chronic Ulcer of Skin, Exc Decubitus	-0.038	0.011	-3.46	0.001	-0.060	-0.017	0.135	0.008	16.34	0	0.119	0.151
Extensive Third-Degree Burns	0.109	0.190	0.58	0.565	-0.263	0.481	-0.314	0.172	-1.82	0.068	-0.652	0.024
Severe Head Injury	-0.053	0.096	-0.56	0.578	-0.241	0.134	-0.231	0.082	-2.82	0.005	-0.391	-0.071
Major Head Injury	0.112	0.018	6.23	0	0.077	0.147	-0.045	0.015	-2.99	0.003	-0.075	-0.016
Vertebral Fract w/out Spinal Cord Injury	0.170	0.012	14.4	0	0.147	0.193	0.160	0.009	17.02	0	0.141	0.178
Hip Fracture/Dislocation	-0.155	0.010	-15.45	0	-0.174	-0.135	-0.334	0.008	-40.87	0	-0.350	-0.318
Traumatic Amputation	-0.084	0.038	-2.22	0.026	-0.158	-0.010	0.020	0.027	0.77	0.441	-0.032	0.073
Maj Comp of Medical Care/Trauma	0.081	0.008	9.95	0	0.065	0.097	0.053	0.006	8.66	0	0.041	0.065
Major Organ Transplant Status	-0.053	0.040	-1.32	0.187	-0.132	0.026	0.221	0.027	8.34	0	0.169	0.273
Artif Opens for Feeding/Elimination	0.218	0.016	13.33	0	0.186	0.250	0.256	0.012	20.93	0	0.232	0.280
Amput Status/Lower Limb/Amput Compl	0.057	0.025	2.27	0.023	0.008	0.106	0.193	0.018	10.74	0	0.158	0.228
Constant	-2.461	0.009	-277.58	0	-2.479	-2.444	-2.138	0.007	-309.77	0	-2.151	-2.124

Risk Adjustment of Medicare Capitation Payments Using the CMS-HCC Model

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This article describes the CMS hierarchical condition categories (HCC) model implemented in 2004 to adjust Medicare capitation payments to private health care plans for the health expenditure risk of their enrollees. We explain the model's principles, elements, organization, calibration, and performance. Modifications to reduce plan data reporting burden and adaptations for disabled, institutionalized, newly enrolled, and secondary-payer subpopulations are discussed.

INTRODUCTION

Medicare is one of the world's largest health insurance programs, with annual expenditures exceeding $200 billion. It provides health insurance to nearly 40 million beneficiaries entitled by elderly age, disability, or ESRD. Approximately 11 percent of Medicare beneficiaries are enrolled in private managed care health care plans, with the rest in the traditional FFS program. The 1997 BBA modified the Medicare managed care (MMC) and other capitated programs, collectively called M+C.[1] Medicare pays private plans participating in M+C a monthly capitation rate to provide health care services to enrolled beneficiaries.

Historically, capitation payments to MMC 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 non-aged disabled (under 65 years), and at the State-level only (due to small numbers), for ESRD-entitled beneficiaries.

The AAPCC payment methodology explains only about 1-percent of the variation in expenditures for Medicare beneficiaries, and does not pay more for sicker people. Thus, research showed that the managed care program was increasing total Medicare Program expenditures, because its enrollees were healthier than FFS enrollees, and the AAPCC did not account for this favorable selection (Brown et al., 1993; Riley et al., 1996; Mello et al.,

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[1] The Medicare Prescription Drug, Improvement and Modernization Act of 2003 (MMA) renames the M+C program Medicare Advantage. However, since this renaming does not officially take place until 2006, we continue to use M+C.

2003). Also, more money was not directed to plans enrolling sicker beneficiaries, or to plans specializing in treating high-cost populations, such as beneficiaries with particular chronic diseases or high levels of functional impairment.

The M+C program fundamentally changed the MMC payment method, including a mandate for health-based Medicare capitation payments by 2000. To support this mandate, the BBA required managed care organizations (MCOs) to report inpatient encounter data (i.e., records for each inpatient admission of a plan's enrollees noting, among other things, the beneficiaries' diagnoses) beginning in 1998. In 2000 CMS, which administers the Medicare Program, implemented the PIP-DCG model as a health-based payment adjuster (Pope et al., 2000a). This model estimates beneficiary health status (expected cost next year) from AAPCC-like demographics and the worst principal inpatient diagnosis (principal reason for inpatient stay) associated with any hospital admission. PIP-DCG-based payments were introduced gradually, with only 10 percent of total Medicare capitation payments adjusted by PIP-DCG factors in 2000. The other 90 percent of payments were still adjusted using a purely demographic (AAPCC-like) model.

The PIP-DCG model was intended as a transition, a feasible way to implement risk adjustment based on the readily available, already audited inpatient diagnostic data. Relying on inpatient diagnoses is the PIP-DCG model's major shortcoming, since only illnesses that result in hospital admissions are counted; MCOs that reduce admis-sions (e.g., through good ambulatory care) can end up with apparently healthier patients and lower payments. Congress's 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 at 30, 50, 75, and 100 percent of total payments. CMS began collecting encounter data from MCOs for the physician office and hospital outpatient settings (i.e., records of each enrollee visit to these providers with dates, procedures performed, diagnoses, etc.) in October 2000 and April 2001, respectively. However, following complaints from MCOs about the burden of reporting encounter data, CMS suspended data collection in May 2001, ultimately adopting a drastically streamlined data reporting strategy (discussed later).

CMS evaluated several risk-adjustment models that use both ambulatory and inpatient diagnoses, including ACGs (Weiner et al., 1996), the chronic disease and disability payment system (CDPS) (Kronick et al., 2000), clinical risk groups (CRGs) (Hughes et al., 2004), the clinically detailed risk information system for cost (CD-RISC) (Kapur et al., 2003), and DCG/HCCs (Pope et al, 2000b). CMS chose the DCG/HCC model for Medicare risk-adjustment, largely on the basis of transparency, ease of modification, and good clinical coherence. The DCG/HCC model, part of the same DCG family of models as the PIP-DCG, was developed with CMS funding by researchers at RTI International[2] and Boston University, with clinical input from physicians at Harvard Medical School.[3]

Prior to implementing Medicare risk-adjustment in 2004, the DCG/HCC model developers and CMS staff adapted the original model for consistency with CMS' simplified data collection, and for customized fit for Medicare subpopulations. The resulting CMS-HCC model reflects these

2 The early development of the DCG/HCC model was done by Health Economics Research, Inc. while under contract to CMS. However, RTI International acquired Health Economics Research, Inc. in 2002.

3 The original version of the DCG/HCC model is described in Ellis et al. (1996). The DCG/HCC model has been refined as described in Pope et al., 1998 and 2000b.

Medicare-specific adaptations of the DCG/HCC model and provides a comprehensive framework for Medicare risk-adjustment.

This article describes the DCG/HCC and CMS-HCC models. The next section describes the DCG/HCC model, including the principles and elements of its diagnostic classification system and how its performance compares to earlier models. We then describe the modifications to accommodate the simplified data that lead to the CMS-HCC model. The final section describes the CMS-HCC model adaptations for subpopulations.

DCG/HCC MODEL PRINCIPLES

Diagnostic Classification System

The following ten principles guided the creation of the 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, 2004). 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. (In this article we present prospective models predicting future 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.

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 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). Since 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 our models did not originally satisfy monotonicity, we imposed constraints 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, non-specific codes are common. If these codes are excluded from the classification system, substantial predictive power is sacrificed. Similarly, excluding discretionary codes (principle 10) can also lower predictive power (principle 2). We 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 the judgment of the authors on incentives and likely provider responses to the classification system. The DCG/HCC models balance these competing goals to achieve a feasible health-based payment system.

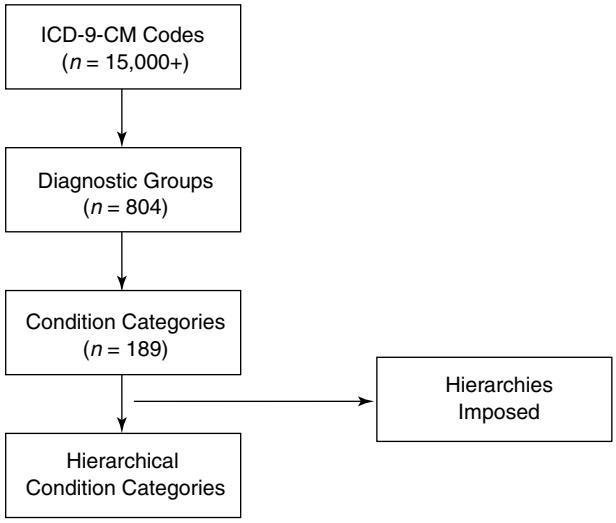
Elements and Organization

As shown in Figure 1, the HCC diagnostic classification system first classifies each of over 15,000 ICD-9-CM codes into 804 diagnostic groups, or DxGroups. Each ICD-9-CM code maps to exactly one DxGroup, which represents a well-specified medical condition, such as DxGroup 28.01 Acute Liver Disease. DxGroups are further aggregated into 189 Condition Categories, or CCs.[4] CCs describe a broader set of similar diseases, generally organized into body systems, somewhat like ICD-9-CM major diagnostic categories.

[4] Most CCs are assigned entirely with ICD-9-CM codes. But CCs 185-189 are assigned by beneficiary utilization of selected types of DME, such as wheelchairs. CC 173, Major Organ Transplant, is defined by procedure codes only. CC 129, ESRD is defined by Medicare entitlement status. None of these CCs are included in the CMS-HCC model.

Figure 1

Hierarchical Condition Categories Aggregations of ICD-9-CM Codes



NOTE: ICD-9-CM is *International Classification of Diseases, Ninth Revision, Clinical Modification.*
SOURCE: (Pope et al., 2000b.)

Although they are not as homogeneous as DxGroups, CCs are both clinically- and cost-similar. An example is CC 28 Acute Liver Failure/Disease that includes DxGroups 28.01 and 28.02 Viral Hepatitis, Acute or Unspecified, with Hepatic Coma.

Hierarchies are imposed among related CCs, so that a person is only coded for the most severe manifestation among related diseases. For example (Figure 2), ICD-9-CM Ischemic Heart Disease codes are organized in the Coronary Artery Disease hierarchy, consisting of 4 CCs arranged in descending order of clinical severity and cost, from CC 81 Acute Myocardial Infarction to CC 84 Coronary Athlerosclerosis/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.[5]

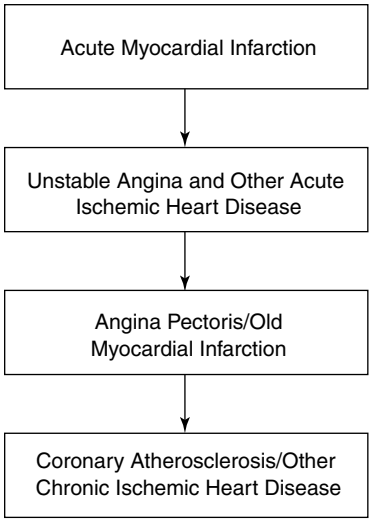
Although HCCs reflect hierarchies among related disease categories, for unrelated diseases, HCCs accumulate. For example, a male with heart disease, stroke, and cancer has (at least) three separate HCCs coded, and his predicted cost will reflect increments for all three problems. The HCC model is more than simply additive because some disease combinations interact. For example, the presence of both Diabetes and Congestive Heart Failure (CHF) could increase predicted cost by more (or less) than the sum of the separate increments for people who have diabetes or CHF alone.

We tested 35 two- and three-way interactions among six common and high-cost chronic diseases defined by HCCs or

[5] The full list of hierarchies used in the CMS-HCC model is available on request from the authors.

Figure 2

Hierarchical Condition Categories Coronary Artery Disease Hierarchy



SOURCE: (Pope et al., 2000b.)

groups of HCCs: diabetes, cerebrovascular disease, vascular disease, or chronic obstructive pulmonary disease (COPD), CHF, and coronary artery disease (Pope et al., 2000b), as well as three interactions of several of these conditions with renal failure.[6] Simple additivity yields most of the explanatory power, in the sense that adding all 38 interactions barely increased the base DCG/HCC model's R^2 (from 11.10 to 11.13 percent). However, six interactions were substantial in magnitude, statistically significant, and clinically plausible. Hence, to improve clinical face validity and predictive accuracy for important subgroups of beneficiaries, we include them in the DCG/HCC model. For example, the simultaneous presence of CHF and COPD leads to higher expected costs than would be calculated by adding the separate increments for CHF and COPD alone.

Because a single beneficiary may be coded for none, one, or more than one DxGroup or HCC, the DCG/HCC model can individually price tens of thousands of distinct clinical profiles using fewer than 200 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) principal hospital inpatient; (2) secondary hospital inpatient; (3) hospital outpatient; (4) physician; and (5) clinically-trained non-physician (e.g., psychologist, podiatrist). The DCG/HCC model does not distinguish among sources; in particular, it places no premium on diagnoses from inpatient care. Using Medicare 5-percent sample FFS data, we investigated adding diagnoses from other sources (Pope et al., 2000b). Adding diagnoses from home health providers raised the explanatory power of the base model from

[6] In later work unpublished work, we also examined all two-way interactions of cancer with the other six diagnoses, but did not find any significant effects.

11.15 to 11.65 percent. Further adding diagnoses from DME suppliers raised the explanatory power from 11.65 to 11.85 percent. All other sources of diagnoses either add no predictive power (SNF, ASC, or hospice) or detract from predictive power (clinical laboratory and radiology/imaging clinics). Diagnoses assigned by home health and DME providers are likely to be less reliable than those assigned by physicians or other providers with greater clinical training. Diagnoses from laboratory and imaging tests are also problematic given the significant proportion of rule-out diagnoses. In implementing the CMS-HCC model, potential gains in predictive power from using additional sources were balanced against the costs of collecting and auditing these data; the decision was to only ask MCOs to collect diagnoses from the five baseline sources previously listed.

Consistent with principle 10, we excluded discretionary diagnostic categories (HCCs) from the preliminary prospective payment model. We excluded diagnoses that were vague/non-specific (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). We also excluded HCCs that did not (empirically) add to costs, and finally, the five HCCs that were defined by the presence of procedures or use of DME, because, as much as possible, we wanted payments to follow what medical problems were present as opposed to what services were offered.[7] Altogether, we excluded 88 of the 189 HCCs, leaving 101 HCCs in the preliminary prospective payment model. As discussed further, additional HCCs were excluded from the final, 70-category CMS-HCC model.

The DCG/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 age cells distinguish beneficiaries currently entitled to Medicare by age (65 or over) versus disability (under 65); a separate, explicit aged versus disabled entitlement status indicator would be redundant. The originally disabled indicator distinguishes beneficiaries who are currently age 65 or over, but were first entitled to Medicare before age 65 by disability. The age/sex, Medicaid, and originally disabled categories add to each other and to the HCC diagnostic categories.[8] The demographic variables are the same as have been used in the PIP-DCG model, and are discussed at greater length elsewhere (Pope et al., 2000a).

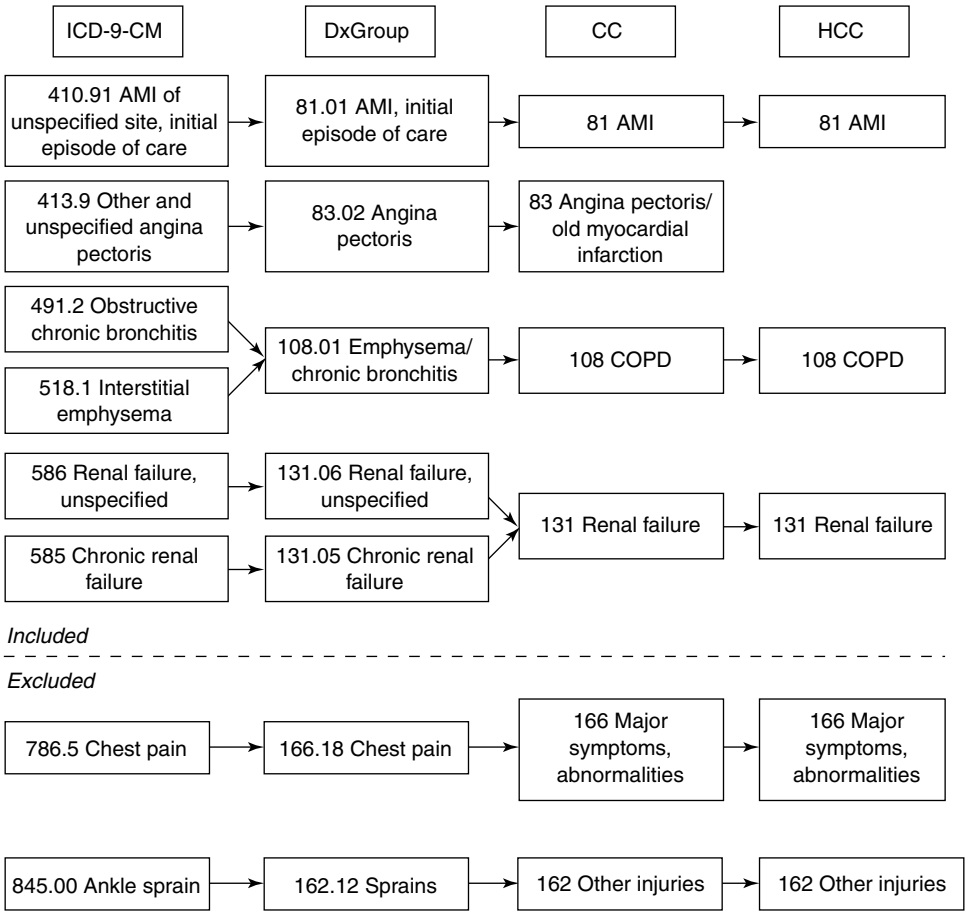
Figure 3 displays a hypothetical clinical vignette of a female age 79, eligible for Medicaid and diagnosed with acute myocardial infarction (AMI), angina pectoris, COPD, renal failure, chest pain, and an ankle sprain. Note that although this female receives CCs for both AMI and angina, she receives no HCC for angina because AMI is a more severe manifestation of coronary artery disease. Also note that while payment includes additive increments for females age 75-79 (demographic categories not shown in Figure 3), Medicaid, AMI, COPD, and renal failure, the HCCs for major symptoms and other injuries are 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 transitory, with minimal implications for next year's cost.

[7] The DME HCCs were developed to predict costs associated with functional impairment not captured by diagnoses. Although they did improve prediction for the functionally impaired, substantial under-prediction remained (Pope et al., 2000b; Kautter and Pope, 2001).

[8] We did not systematically investigate interactions of age and sex with HCCs (diagnoses). This is a subject for future research.

Figure 3

Clinical Vignette for Hierarchical Condition Categories Classification 79 Year Old Female with AMI, Angina Pectoris, COPD, and Renal Failure



NOTES: AMI is acute myocardial infarction. COPD is chronic obstructive pulmonary disease.

SOURCE: (Pope et al., 2000b.)

PERFORMANCE OF DCG/HCC AND PIP-DCG MODELS

The predictive accuracy of risk-adjustment models is typically judged by the R^2 statistic (percentage of variation explained) to measure predictive accuracy for individuals and predictive ratios (ratios of mean predicted to mean actual expenditures for subgroups of beneficiaries) to measure predictive accuracy for groups. The R^2 of age/sex, PIP-DCG, and DCG/HCC models as measured on 1996-1997 Medicare's 5-percent sample FFS data are: age/sex, 1.0 percent; PIP-DCG, 6.2 percent; and DCG/HCC, 11.2 percent.

Adding PIP-DCG to demographic predictors (age/sex) increases predictive power sixfold. Adding secondary inpatient and ambulatory diagnoses (hospital outpatient and physician), and arraying them in a multi-condition cumulative model (DCG/HCC) nearly doubles the power again. Besides the R^2, another interesting summary statistic is the percentage of payments based on demographic variables: 100

Table 1

Predictive Ratios[1] for Alternative Risk-Adjustment Models

Category	Model		
Quintiles of Expenditures	Age/Sex	PIP-DCG	DCG/HCC
First (Lowest)	2.66	2.09	1.23
Second	1.93	1.54	1.23
Third	1.37	1.10	1.14
Fourth	0.95	0.84	1.02
Fifth (Highest)	0.44	0.75	0.86
Top 5 Percent	0.28	0.61	0.77
Top 1 Percent	0.17	0.47	0.69
Hospitalizations			
None	1.33	1.07	1.03
1	0.63	1.02	1.02
2	0.44	0.91	0.98
3 or More	0.26	0.69	0.82
Diagnoses[2]			
Heart Failure	0.47	0.74	0.97
Heart Attack	0.45	0.78	0.98
COPD	0.59	0.79	0.99
Hip Fracture	0.56	0.83	0.99
Depression	0.54	0.77	0.92
Colorectal Cancer	0.60	0.78	0.98
Cerebral Hemorrhage	0.44	0.73	1.04

[1] Mean predicted cost divided by mean actual cost.

[2] From either inpatient or ambulatory setting.

NOTES: Expenditures, hospitalizations, and diagnoses are measured in the base year. COPD is chronic obstructive pulmonary disease.

SOURCE: (Pope et al., 2000b.)

percent in a demographic model, 81 percent in the PIP-DCG model, but only 43 percent in the DCG/HCC model (Pope et al., 2001). With over one-half of payments determined by diagnoses, the DCG/HCC model moves decisively away from the AAPCC demographic-based payment system.

Table 1 shows predictive ratios for selected groups of Medicare beneficiaries. Ratios close to 1.0 indicate accurate prediction of costs; less than 1.0, under prediction; and, more than 1.0, over prediction. The PIP-DCG model improves substantially on age/sex, and in almost all cases, the DCG/HCC model improves significantly on the PIP-DCG model. This is true even for hospitalizations, where the PIP-DCG model distinguishes between those hospitalized or not, while the DCG/HCC model makes no distinction by source of diagnosis.[9] Despite the DCG/HCC model's impressive gains over the age/sex and PIP-DCG models, it still under-predicts for the most expensive and most often hospitalized beneficiaries.

[9] The DCG/HCC model captures multiple conditions that might be diagnosed in multiple inpatient stays, whereas the PIP-DCG model captures only the single principal inpatient diagnosis most predictive of future costs if multiple inpatient stays occur.

CMS-HCC MODEL

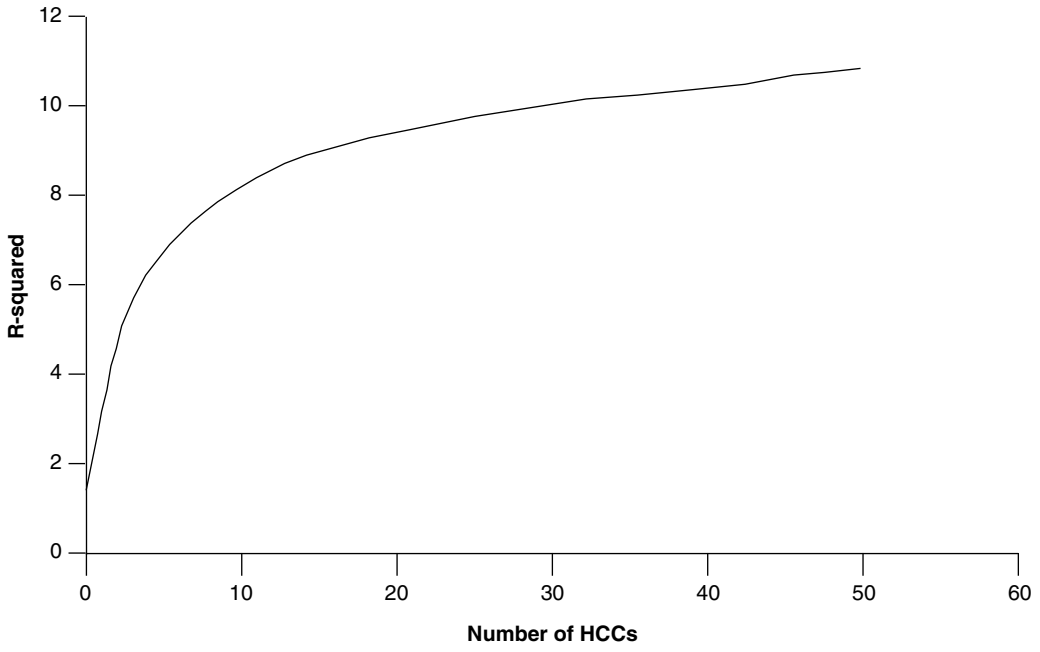
This section describes how the DCG/HCC model was modified before implementation as the M+C risk adjuster for capitation payments in 2004. We will refer to the modified model as CMS-HCC.

DCG/HCC Model Modification to Simplify Data Collection

When several MCOs withdrew from the M+C program around the year 2000, CMS sought to improve plan retention. Since some MCOs had complained of the burden of collecting encounter data for risk-adjustment, CMS sought to develop risk adjustment models that predict well and rely on ambulatory data, but with reduced data col-

Figure 4

Model Explanatory Power as a Function of Number of Hierarchical Condition Categories (HCC)



NOTES: All models, including the one with zero HCCs, include 24 age/sex cells, and Medicaid and originally disabled status. Results based on stepwise regression analysis.

SOURCE: (Pope et al., 2001.)

lection requirements. One measure of the data collection burden imposed by a model is its number of diagnostic categories.[10]

We investigated the relationship between number of diagnostic categories used in the DCG/HCC model and its predictive power (Pope et al., 2001). Figure 4 plots the relationship between number of diagnostic categories and model explanatory power measured by R^2. Diagnostic categories (HCCs) were entered into the model in descending order of their incremental explanatory power using stepwise regression. The base model (with zero HCCs) includes 26 demographic variables, the 24 age/sex cells, and Medicaid and originally disabled status. Its R^2 is 1.69 percent.

The incremental contribution to predictive power declines rapidly with the number of diagnostic categories added to the model. The first diagnostic category entered by the stepwise regression is CHF, which more than doubles the demographic model R^2 to 4.11 percent. The second condition category entered is COPD, raising the R^2 to 4.94 percent. This is an incremental gain of 0.83 percentage points, substantial, but much less then the increment of 2.42 percentage points due to CHF. With 5 HCCs included, 61 percent of the maximum explanatory power of the full (101 HCC) model is attained; with 10 HCCs, 74 percent of the maximum is achieved; with 20, 85 percent, and with 30, 90 percent. The incremental R^2 from adding a diagnostic category is 0.48 percentage points at 5 HCCs; 0.26 percentage points at 10 HCCs; 0.08 percentage points at 20 HCCs; and 0.05 percentage points at 30 HCCs.

[10] The relationship between number of diagnostic categories and data collection burden is controversial. Some MCOs seemed to feel that it would be less burdensome to report all diagnoses, which CMS allows.

This analysis shows that a parsimonious risk-adjustment model with a substantially reduced number of diagnostic categories is almost as predictive as a full model. But parsimony has a cost. In limiting the number of conditions that affect payment, many serious, high-cost diagnoses—especially rare ones—will be ignored. MCOs enrolling beneficiaries with excluded diagnoses will be disadvantaged, and beneficiaries with such conditions may not be well served by MCOs.

CMS considered these results, and consulted with clinicians, on the tradeoff between number of diagnostic categories and predictive power, and also other criteria for diagnostic categories to include in risk adjustment, such as well-defined diagnostic criteria and clinical coherence and homogeneity. It was important that the HCC hierarchies not be disrupted by deletion of higher-ranked HCCs while lower-ranked HCCs were retained. After this process, CMS selected 70 HCCs to include in the CMS-HCC model. The choices reflect a balance among the competing considerations of reducing data collection burden, maximizing predictive power, including rare, high-cost conditions, and selecting only well-defined and clinically coherent conditions. Generally, the higher-cost, more severe conditions at the top of the HCC disease hierarchies were retained, while some lower-cost, more frequent and more discretionary conditions at the bottom of the hierarchies were pruned. For example, in the coronary artery disease hierarchy, AMI (heart attack), other acute IHD (e.g., unstable angina), and angina pectoris/old myocardial infarction were retained, but chronic IHD (e.g., coronary atherosclerosis) was excluded.

After the CMS-HCC model was finalized, a list of approximately 3,000 of the more than 15,000 ICD-9-CM diagnosis codes was identified that are sufficient to define the model's 70 HCCs. In addition, because the CMS-HCC model does not give extra credit for multiple reports of the same diagnosis, MCOs need only report a single encounter during the relevant year of data collection that establishes the diagnosis. The information required for the single encounter is: (1) beneficiary identification number, (2) date (to establish that the diagnosis was made during the relevant reporting period), (3) setting (to establish that the diagnosis was made in one of the allowed hospital or physician settings), and (4) ICD-9-CM diagnosis code. In short, MCOs are required to report only the minimum.

Concern about the quality of diagnostic reporting is the greatest in physician offices, where diagnoses have not heretofore affected payment, and recording of diagnoses is less rigorously practiced than in hospitals. The auditing standard that CMS has promulgated for reporting of physician office diagnoses is that a physician has established the diagnosis in the medical record, and that medical coders have recorded it in accordance with ICD-9-CM rules. CMS will conduct coding audits, but not clinical audits. That is, CMS will require MCOs to demonstrate that a diagnosis is present in the medical record on the specified date and has been coded according to ICD-9-CM. CMS will not require clinical verification of these diagnoses, such as diagnostic test results.

CMS-HCC Model Calibration

We calibrated the CMS-HCC model to 1999-2000 Medicare 5-percent sample FFS data for beneficiaries entitled by age or disability (beneficiaries entitled by ESRD were excluded). The model is prospective, meaning that diagnoses collected in a base year (1999) are used to predict expenditures in the following year (2000). An

important operational change from the PIP-DCG model is that the data lag will be eliminated, making the application of the model consistent with its calibration. With the PIP-DCG model, the data collection period for a payment year ended 6 months before the start of the year, i.e., on June 30 of the previous year, so that final capitation rates could be published by January 1 of the payment year. With the CMS-HCC model, provisional rates will be established by January 1 based on 6-month lagged data, and final rates will be available by June 30 of the payment year based on the previous calendar year's diagnoses. A reconciliation process will adjust the first 6 months of payments to the final rates, if necessary.

A standard set of sample restrictions was employed to ensure a population of beneficiaries with complete 12-month base year diagnostic profiles and complete payment year Medicare expenditures from the FFS claims for aged and disabled beneficiaries (Pope et al., 2000b). Decedents are included in the payment year for their eligible period. Complete FFS claims are not available for months of M+C enrollment or when Medicare is a secondary payer, and M+C plans are not responsible for hospice care, so these months were excluded from our sample. The final sample size is 1,337,887 beneficiaries.

We summed all Medicare payments for a beneficiary for months in 2000 satisfying our sample restrictions, excluding (1) deductibles and copayments paid by the beneficiary; (2) hospice payments; and (3) indirect medical education payments. Hospice and indirect medical education payments are excluded because they were not included in M+C capitation rates, but were paid directly to hospices and teaching hospitals utilized by M+C enrollees. Payments were annualized by dividing them by the fraction of months in 2000 that satisfy our sample restrictions; all analyses are weighted by this eligibility fraction. In general, annualization and weighting ensures that monthly payments are correctly estimated for all beneficiaries, including those who died (Ellis et al., 1996).[11]

The model was calibrated using weighted least squares multiple regression. The CMS-HCC regression model estimated for the combined aged and disabled Medicare population is shown in Table 2.

The elements of the model are:

- Age/sex cells (24).
- Medicaid interacted with sex and age/disabled entitlement status.
- Originally disabled status interacted with sex.
- HCC diagnostic categories (70).
- Interactions of diagnostic categories with entitlement by disability (5).
- Disease interactions (6).

The R^2 for this model is 9.8 percent. Several coefficients are constrained because the unconstrained coefficients violate the principle that higher-ranked conditions in a hierarchy should have higher predicted costs, or for other reasons.[12]

As an example of expenditure prediction, consider our hypothetical scenario in Figure 3 of a female age 79 eligible for Medicaid diagnosed with AMI, angina pectoris, COPD, renal failure, chest pain, and an ankle sprain. The female receives the following incremental cost predictions: female, 75 to 79, $2,562; aged, female, Medicaid, $616; AMI (HCC 81), $1,885; angina pectoris, $0; COPD (HCC 108), $1,936; renal failure (HCC 131), $2,908;

[11] In our calibration, we did not make any geographic adjustments to Medicare payments. In past work, we have found that deflating payments by a geographic input price index had little effect on estimated risk-adjustment model parameters.

[12] Clinical consultants to CMS suggested that metastatic cancer is not consistently correctly coded, so HCCs 7 and 8 were constrained to have equal coefficients. HCCs 81 and 82 were constrained to have equal coefficients because the ICD-9-CM diagnostic detail CMS collects from health plans is not sufficient to distinguish them.

Table 2

Centers for Medicare & Medicaid Services-Hierarchical Condition Categories (CMS-HCC) Combined, Community, and Institutional Models

		Models					
		Combined		Community		Institutional	
Number of Observations		1,337,887		1,291,308		65,593	
R^2		0.0977		0.0976		0.0596	
Adjusted R^2		0.0977		0.0976		0.0589	
Dependent Variable Mean		5,352		5,213		8,937	
Root Mean Square Error		13,407		13,337		15,954	
Model Parameters		105		105		50	
Variable		Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio	
Female								
0-34 Years		678	3.81	598	3.36	5,457	11.72	
35-44 Years		1,110	8.82	1,012	8.03	5,457	11.72	
45-54 Years		1,177	11.20	1,096	10.40	5,457	11.72	
55-59 Years		1,463	11.87	1,360	11.00	5,457	11.72	
60-64 Years		1,996	17.26	1,924	16.56	5,457	11.72	
65-69 Years		1,648	42.11	1,572	40.15	5,970	11.73	
70-74 Years		2,061	60.25	1,970	57.42	6,049	17.09	
75-79 Years		2,562	71.59	2,475	68.56	5,089	19.63	
80-84 Years		2,998	71.39	2,936	68.34	4,813	22.51	
85-89 Years		3,360	63.45	3,408	61.01	4,515	23.28	
90-94 Years		3,683	46.81	4,077	46.25	4,048	19.08	
95 Years or Over		3,128	23.27	4,130	25.32	2,980	10.34	
Male								
0-34 Years		405	2.72	346	2.32	5,664	13.77	
35-44 Years		701	6.63	617	5.81	5,664	13.77	
45-54 Years		1,059	12.15	973	11.14	5,664	13.77	
55-59 Years		1,460	13.42	1,386	12.68	5,664	13.77	
60-64 Years		1,824	17.90	1,755	17.13	5,664	13.77	
65-69 Years		1,827	41.47	1,774	40.28	7,435	13.24	
70-74 Years		2,380	59.66	2,323	58.17	6,350	14.34	
75-79 Years		3,031	69.04	2,960	67.13	6,210	16.45	
80-84 Years		3,454	62.03	3,372	59.83	6,201	17.67	
85-89 Years		4,129	52.24	4,050	49.80	6,366	17.40	
90-94 Years		4,505	32.20	4,620	31.08	5,378	11.29	
95 Years or Over		4,753	15.83	5,307	15.89	4,287	5.34	
Medicaid and Originally Disabled Interactions with Age and Sex								
Medicaid-Female-Disabled		1,141	11.31	1,133	11.18	—	—	
Medicaid-Female-Aged		616	12.91	940	18.18	—	—	
Medicaid-Male-Disabled		632	6.80	592	6.31	—	—	
Medicaid-Male-Aged		788	10.33	944	11.62	—	—	
Originally Disabled-Female		1,231	17.34	1,213	16.44	—	—	
Originally Disabled-Male		809	11.66	757	10.73	—	—	
Disease Coefficients	**Label**							
HCC1	HIV/AIDS	3,587	13.16	3,514	12.88	6,893	5.42	C1
HCC2	Septicemia/Shock	4,365	34.74	4,563	32.92	4,854	13.89	
HCC5	Opportunistic Infections	3,643	10.43	3,346	9.29	6,893	5.42	C1
HCC7	Metastatic Cancer and Acute Leukemia	7,438	81.16	7,510	81.00	2,771	4.54	
HCC8	Lung, Upper Digestive Tract, and Other Severe Cancers	7,438	81.16	7,510	81.00	2,771	4.54	
HCC9	Lymphatic, Head and Neck, Brain, and Other Major Cancers	3,540	35.91	3,539	35.51	2,319	3.50	
HCC10	Breast, Prostate, Colorectal and Other Cancers and Tumors	1,209	26.35	1,194	25.79	1,330	4.01	

Refer to NOTES at end of table.

Table 2—Continued

Centers for Medicare & Medicaid Services-Hierarchical Condition Categories (CMS-HCC) Combined, Community, and Institutional Models

Variable		Models						
		Combined		Community		Institutional		
		Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio	
Disease Coefficients	**Label**							
HCC15	Diabetes with Renal or Peripheral Circulatory Manifestation	3,827	37.71	3,921	36.90	3,137	10.49	
HCC16	Diabetes with Neurologic or Other Specified Manifestation	2,931	30.09	2,833	28.43	3,137	10.49	
HCC17	Diabetes with Acute Complications	2,056	7.84	2,008	7.41	3,137	10.49	
HCC18	Diabetes with Ophthalmologic or Unspecified Manifestation	1,839	18.35	1,760	17.32	3,137	10.49	
HCC19	Diabetes without Complication	1,055	26.10	1,024	25.02	1,308	5.32	
HCC21	Protein-Calorie Malnutrition	3,818	27.52	4,727	29.77	2,193	6.49	
HCC25	End-Stage Liver Disease	4,496	14.91	4,616	14.92	1,375	5.09	
HCC26	Cirrhosis of Liver	2,727	11.93	2,645	11.37	1,375	5.09	
HCC27	Chronic Hepatitis	1,839	6.73	1,841	6.71	1,375	5.09	
HCC31	Intestinal Obstruction/ Perforation	1,997	21.69	2,094	21.62	1,375	5.09	
HCC32	Pancreatic Disease	2,336	17.30	2,281	16.61	1,375	5.09	
HCC33	Inflammatory Bowel Disease	1,574	10.25	1,575	10.16	1,375	5.09	
HCC37	Bone/Joint/Muscle Infections/ Necrosis	2,629	19.68	2,546	18.41	2,539	4.42	
HCC38	Rheumatoid Arthritis and Inflammatory Connective Tissue Disease	1,683	27.72	1,653	26.93	1,463	3.61	
HCC44	Severe Hematological Disorders	5,055	30.80	5,188	30.69	2,299	4.08	
HCC45	Disorders of Immunity	4,224	26.77	4,260	26.64	2,299	4.08	
HCC51	Drug/Alcohol Psychosis	1,571	6.57	1,810	6.99	1,131	6.06	
HCC52	Drug/Alcohol Dependence	1,477	6.15	1,361	5.44	1,131	6.06	
HCC54	Schizophrenia	2,592	26.75	2,786	27.04	1,131	6.06	
HCC55	Major Depressive, Bipolar, and Paranoid Disorders	2,024	30.00	2,209	30.85	1,131	6.06	
HCC67	Quadriplegia, Other Extensive Paralysis	5,665	27.45	6,059	27.20	504	3.94	
HCC68	Paraplegia	5,665	27.45	6,059	27.20	504	3.94	
HCC69	Spinal Cord Disorders/ Injuries	2,484	17.77	2,526	17.45	504	3.94	
HCC70	Muscular Dystrophy	2,239	3.82	1,981	3.27	504	3.94	
HCC71	Polyneuropathy	1,480	19.74	1,377	18.06	504	3.94	
HCC72	Multiple Sclerosis	2,329	11.44	2,654	12.19	504	3.94	
HCC73	Parkinson's and Huntington's Diseases	1,954	19.69	2,436	22.04	504	3.94	
HCC74	Seizure Disorders and Convulsions	1,334	17.25	1,381	16.68	504	3.94	
HCC75	Coma, Brain Compression/ Anoxic Damage	2,396	7.88 C1	2,912	8.62 C1	504	3.94 C2	
HCC77	Respirator Dependence/ Tracheostomy Status	10,417	29.54	10,783	28.46	7,259	8.19	
HCC78	Respiratory Arrest	7,543	20.23	7,327	18.79	7,259	8.19	
HCC79	Cardio-Respiratory Failure and Shock	3,451	42.70	3,550	42.39	1,481	4.31	
HCC80	Congestive Heart Failure	2,055	38.48	2,141	38.54	903	4.16	
HCC81	Acute Myocardial Infarction	1,885	31.23	1,785	29.13	1,476	5.75	
HCC82	Unstable Angina and Other Acute Ischemic Heart Disease	1,885	31.23	1,785	29.13	1,476	5.75	
HCC83	Angina Pectoris/Old Myocardial Infarction	1,246	22.82	1,205	21.76	1,476	5.75	

Refer to NOTES at end of table.

Table 2—Continued

Centers for Medicare & Medicaid Services-Hierarchical Condition Categories (CMS-HCC) Combined, Community, and Institutional Models

Variable		Models						
		Combined		Community		Institutional		
		Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio	
Disease Coefficients	**Label**							
HCC92	Specified Heart Arrhythmias	1,362	31.73	1,363	30.95	961	4.62	
HCC95	Cerebral Hemorrhage	1,901	10.05	2,011	9.88	774	4.01	
HCC96	Ischemic or Unspecified Stroke	1,498	20.90	1,569	20.34	774	4.01	
HCC100	Hemiplegia/Hemiparesis	1,678	13.96	2,241	16.61	504	3.94	
HCC101	Cerebral Palsy and Other Paralytic Syndromes	767	3.34	840	3.42	504	3.94	C2
HCC104	Vascular Disease with Complications	3,432	36.22	3,473	35.49	2,612	6.30	
HCC105	Vascular Disease	1,662	39.94	1,832	41.72	583	3.72	
HCC107	Cystic Fibrosis	1,936	45.73	1,929	44.87	1,180	4.69	
HCC108	Chronic Obstructive Pulmonary Disease	1,936	45.73	1,929	44.87	1,180	4.69	
HCC111	Aspiration and Specified Bacterial Pneumonias	3,010	20.47	3,556	21.53	2,377	6.82	
HCC112	Pneumococcal Pneumonia, Empyema, Lung Abscess	1,151	6.55	1,034	5.68	2,377	6.82	
HCC119	Proliferative Diabetic Retinopathy and Vitreous Hemorrhage	1,975	13.36	1,791	11.96	5,102	5.46	
HCC130	Dialysis Status	15,926	26.97	15,778	25.96	15,959	5.82	
HCC131	Renal Failure	2,908	23.20	2,954	22.73	2,152	6.26	
HCC132	Nephritis	1,541	6.95	1,401	6.23	2,152	6.26	
HCC148	Decubitus Ulcer of Skin	3,888	32.32	5,285	37.28	1,628	5.98	
HCC149	Chronic Ulcer of Skin, Except Decubitus	2,381	26.76	2,485	26.65	1,346	3.98	
HCC150	Extensive Third-Degree Burns	4,427	2.36	4,935	2.54	1,274	3.37	
HCC154	Severe Head Injury	2,396	7.88	C1 2,912	8.62	C1 1,274	3.37	
HCC155	Major Head Injury	1,211	8.43	1,239	8.08	1,274	3.37	C3
HCC157	Vertebral Fractures w/o Spinal Cord Injury	2,462	20.64	2,514	20.23	504	3.94	C2
HCC158	Hip Fracture/Dislocation	1,301	13.37	2,010	18.51	0	—	
HCC161	Traumatic Amputation	3,965	17.86	C2 4,322	17.92	C2 1,274	3.37	C3
HCC164	Major Complications of Medical Care and Trauma	1,438	18.25	1,346	16.60	1,347	3.66	
HCC174	Major Organ Transplant Status	3,790	8.55	3,702	8.37	4,523	11.13	
HCC176	Artificial Openings for Feeding or Elimination	3,810	23.84	4,054	22.39	4,523	11.13	
HCC177	Amputation Status, Lower Limb/Amputation Complications	3,965	17.86	C2 4,322	17.92	C2 1,274	3.37	C3
Disabled/Disease Interactions								
D-HCC5	Disabled Opportunistic Infections	3,965	5.49	4,047	5.52	—	—	
D-HCC44	Disabled Severe Hematological Disorders	4,649	9.98	4,580	9.72	—	—	
D-HCC51	Disabled Drug/Alcohol Psychosis	2,830	7.12	2,608	6.32	—	—	
D-HCC52	Disabled Drug/Alcohol Dependence	2,160	6.90	2,122	6.61	—	—	
D-HCC107	Disabled Cystic Fibrosis	9,691	6.70	9,547	6.63	—	—	

Refer to NOTES at end of table.

Table 2—Continued

Centers for Medicare & Medicaid Services-Hierarchical Condition Categories (CMS-HCC) Combined, Community, and Institutional Models

Variable		Models					
		Combined		Community		Institutional	
		Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio	Parameter Estimate	*t*-ratio
Disease Interactions							
INT1	DM-CHF1	1,265	14.62	1,296	14.46	1,064	2.91
INT2	DM-CVD	490	4.05	639	4.89	—	—
INT3	CHF-COPD	1,261	14.82	1,238	14.06	1,906	4.95
INT4	COPD-CVD-CAD	316	1.49	406	1.82	—	—
INT5	RF-CHF1	857	3.94	1,202	5.24	—	—
INT6	RF-CHF-DM1	4,185	18.48	4,433	18.71	—	—

NOTES: Beneficiaries with the three-way interaction RF-CHF-DM are excluded from the two-way interactions DM-CHF and RF-CHF. DM is diabetes mellitus (HCCs 15-19). CHF is congestive heart failure (HCC 80). COPD is chronic obstructive pulmonary disease (HCC 108). CVD is cerebrovascular disease (HCCs 95-96, 100-101). CAD is coronary artery disease (HCCs 81-83). RF is renal failure (HCC 131). "|" means coefficients of HCCs are constrained to be equal. C1, C2, and C3 denote non-contiguous constraints.

SOURCE: Pope, G.C. and Kautter, J., RTI International, Ellis, R.P. and Ash, A.S., Boston University, Ayanian, J.Z., Harvard Medical School and Brigham and Women's Hospital, Iezzoni, L.I., Harvard Medical School and Beth Israel Deaconess Medical Center, Ingber, M.J., Levy, J.M., and Robst, J., Centers for Medicare & Medicaid Services, Analysis of 1999-2000 Medicare 5% Standard Analytic File (SAF).

chest pain, $0; and ankle sprain, $0[13] (Table 2). Her total cost prediction is the sum of these increments, or $9,907.

Calibration of DCG/HCC models on several years of data reveals increasingly thorough diagnostic coding. For example, if 1999 diagnoses are used to predict expenditures with a model calibrated on 1996/1997 data, mean expenditures will be over predicted. If more complete coding over time is not accounted for, MCOs will be overpaid by the use of current diagnoses with a model calibrated on historical data. CMS makes a slight downward adjustment in HCC-predicted expenditures to account for this.

CMS-HCC Models for Subpopulations

Medicare beneficiaries differ along characteristics that are important for risk adjustment. First, they may be entitled to Medicare in one of three ways: age, disability, or ESRD. Second, some beneficiaries reside in institutions rather than in the community. Third, some enrollees are new to Medicare and do not have complete diagnostic data. Fourth, Medicare is a secondary payer for some beneficiaries. To account for the different cost and diagnostic patterns of these disparate subgroups of beneficiaries, the CMS-HCC model was adapted for Medicare subpopulations. This section describes models for subpopulations.[14]

Beneficiaries Entitled by Disability

Approximately 12 percent of Medicare beneficiaries are entitled to Medicare because they are under age 65 and have a medical condition that prevents them from working (the disabled). Models calibrated on the full Medicare population (excluding ESRD eligibles), mostly reflect cost patterns among the elderly, the other 88 percent of the population. The implications of some diagnoses might differ between the elderly and disabled. For example, a diagnosis that is disabling may be more severe, and the cost of treating a disease may vary by age. We considered allowing differences in incremental expenditure weights for some diagnoses (HCCs) for the disabled (Pope et al., 1998; 2000b).

[13] The female receives no incremental cost prediction for angina pectoris because AMI is higher-ranked in the coronary artery disease hierarchy and excludes angina. No incremental prediction is made for chest pain and ankle sprain because these diagnoses are not included in the CMS-HCC model.

[14] Risk-adjustment models for ESRD-entitled and functionally-limited beneficiaries are not described in this article.

Using Medicare's 5-percent sample FFS data (1996-1997), we estimated the DCG/HCC model separately on aged and disabled subsamples. We evaluated differences in age versus disabled parameter estimates according to their statistical significance, magnitude, clinical plausibility, and frequency of occurrence in the disabled population (Pope et al., 2000b). Based on these considerations, we chose nine diagnostic categories to receive incremental payments when they occur among disabled beneficiaries. Five of these categories remained significantly different for the disabled when the CMS-HCC model was re-estimated on 1999-2000 data: opportunistic infections, severe hematological disorders (e.g., hemophilia, sickle cell anemia), drug/alcohol psychosis, drug/alcohol dependence, and cystic fibrosis. Incremental annual payments for these conditions among the disabled (in addition to base payments for the elderly) are substantial, ranging from $2,160 to $9,691.

Other than for these five conditions, disease risk-adjustment weights are the same for the aged and disabled populations. The CMS-HCC model is estimated on a combined sample of aged and disabled beneficiaries, with disabled interactions for these five diagnostic categories. The combined aged/disabled model is shown in Table 2.

Community and Institutional Residents

Using the newly available Medicare MDS, we identified long–term nursing home residents in the current (i.e., payment) year. Long-term nursing home residence was defined as continuously residing in a nursing home for at least 90 days, as indicated by a 90-day clinical assessment reported by the nursing facility through the MDS. In our prospective risk-adjustment modeling sample of 1,337,887 beneficiaries, 65,593 beneficiaries, or 5 percent, had at least 1 month of long-term nursing facility residence in 2000.[15]

Table 3 compares sample sizes and mean expenditures by demographic categories for community and institutional residents, and shows predictive ratios from the CMS-HCC model calibrated on the combined community/institutional sample (Table 2). Nearly one-half (49 percent) of long-term nursing facility residents are age 85 or over. Facility residents are only 2 percent of the combined community plus institutional population for females age 70 to 74, but fully 37 percent of the combined population for females age 95 or over.

Overall, institutional residents are 71 percent more expensive than community residents, $8,937 in mean annualized expenditures compared to $5,213. The age profiles of expenditures are quite different. Among community residents, mean expenditures rise steadily with age in the under 65 disabled population and then again in the elderly population, except for a slight decline for the oldest females. In contrast, among the institutionalized, mean expenditures are fairly constant across all ages until they decline significantly among the oldest old. For all age/sex cells except the oldest old, mean expenditures for the institutionalized are substantially higher than for community-dwelling beneficiaries.

However, although not shown in Table 3, among beneficiaries diagnosed with particular HCCs, mean expenditures for the institutionalized are often similar to those of community residents. For example, among all beneficiaries with CHF (HCC 80), expenditures for the institutionalized are $11,719, which is $255 less than for community residents. More generally, when classifying people by the presence of

[15] Beneficiaries with both community and long-term institutional months in the same year are included in both samples, weighted by the fraction of their total months alive in the year in each status.

Table 3

Descriptive Statistics for Community and Institutionalized Residents

Variable	Community			Institutional		
	Observations	Mean Annualized Expenditures	Predictive Ratio[1]	Observations	Mean Annualized Expenditures	Predictive Ratio[1]
Overall	1,291,308	5,213	0.99	65,593	8,937	1.12
Demographics						
Female						
0-34 Years	7,007	3,623	1.00	49	9,251	0.99
35-44 Years	15,566	4,332	1.00	199	9,395	0.94
45-54 Years	22,077	4,692	1.00	473	8,869	1.07
55-59 Years	14,023	5,254	1.00	343	10,168	0.91
60-64 Years	15,793	5,993	1.00	501	9,906	1.04
65-69 Years	129,970	3,714	1.00	1,380	10,961	0.99
70-74 Years	171,775	4,372	1.00	3,098	10,901	0.97
75-79 Years	157,586	5,260	1.00	6,260	9,458	1.08
80-84 Years	111,303	6,101	0.99	9,801	8,797	1.13
85-89 Years	66,301	6,882	0.97	12,294	8,054	1.19
90-94 Years	26,852	7,606	0.92	9,535	7,146	1.29
95 Years or Over	8,074	7,338	0.83	4,729	5,734	1.42
Male						
0-34 Years	10,272	2,868	1.00	106	10,622	0.95
35-44 Years	22,913	3,666	1.00	384	9,596	0.92
45-54 Years	29,377	3,968	1.00	606	10,186	0.91
55-59 Years	16,391	4,651	1.00	438	10,340	0.96
60-64 Years	18,581	5,214	1.00	588	10,486	1.00
65-69 Years	105,856	4,018	1.00	1,132	12,432	0.88
70-74 Years	128,874	5,014	1.00	1,921	11,501	0.99
75-79 Years	106,402	6,207	1.00	2,842	11,411	1.04
80-84 Years	64,263	7,083	1.00	3,404	11,049	1.06
85-89 Years	30,765	8,144	0.99	3,116	10,754	1.08
90-94 Years	9,343	8,731	0.97	1,783	9,489	1.20
95 Years or Over	1,944	9,062	0.92	611	8,096	1.37
Medicaid	196,604	6,523	0.97	33,074	8,895	1.17
Originally-Disabled	81,894	7,614	0.99	7,415	10,606	1.11

[1] Ratio of mean expenditures predicted by the Centers for Medicare & Medicaid Services - Hierarchical Condition Categories (CMS-HCC) model for combined community/institutional samples to mean actual expenditures.

SOURCE: Pope, G.C. and Kautter, J., RTI International, Ellis, R.P. and Ash, A.S., Boston University, Ayanian, J.Z., Harvard Medical School and Brigham and Women's Hospital, Iezzoni, L.I., Harvard Medical School and Beth Israel Deaconess Medical Center, Ingber, M.J., Levy, J.M., and Robst, J., Centers for Medicare & Medicaid Services, Analysis of 1999-2000 Medicare 5% Standard Analytic File (SAF).

a single diagnosis, expenditures for the institutionalized may be higher, lower, or about the same.

Thus, the main reason that people in facilities cost more is that they have more medical problems, a distinction that is fully accounted for by the HCCs. In fact, the predictive ratios from the combined CMS-HCC model for community and institutional beneficiaries are, respectively, 0.99 and 1.12 (Table 3). This means that the combined model, on average, under predicts expenditures for community residents by 1 percent, and over predicts expenditures for long–term nursing home residents by 12 percent. Lower expenditures among facility residents adjusting for disease burden could result from substituting non-Medicare for Medicare-reimbursed services; since most nursing home service are not reimbursed by Medicare. Also, greater monitoring of nursing home than community residents may identify and prevent problems leading to hospitalization. The under-prediction for community residents and over-prediction for facility residents is most severe for the oldest age groups, most likely due to decisions to limit

aggressive care for very old residents in nursing homes. The over-prediction of the costs of the institutionalized, together with their different cost patterns by age and diagnosis, led us to consider differentiating the CMS-HCC model for community and institutional populations.

Within a multiple regression model estimation framework, we investigated alternative approaches to allowing differences in the model between community and institutional residents, ultimately choosing to estimate separate models. This properly calibrates the prediction of each group's costs, while allowing all demographic and disease coefficients to differ between community and institutional populations.

In addition to the combined model, Table 2 shows the CMS–HCC community and institutional models. Not surprisingly, the community model R^2 and most of the demographic and disease coefficients are very similar to the combined model, because community residents comprise 95 percent of the combined sample. A few coefficients show greater differences. The community coefficients for the oldest age cells are significantly larger than the combined model coefficients because the lower-cost very old institutionalized have been removed from these cells. The community coefficients for the aged enrolled in Medicaid are also significantly higher, as are several HCC coefficients.

The institutional model R^2 is considerably lower than the community model. But some of the community model's predictive power comes from distinguishing beneficiaries who are healthy (no diagnoses) versus sick (with diagnoses), while the institutional model is explaining cost variations among a population comprised entirely of impaired individuals. Diagnoses help explain why someone might be institutionalized (i.e., distinguish healthy from sick), but are not as powerful in explaining expenditure differences among the institutionalized. Disease (HCC) coefficients tend to be smaller in the institutional model than in the community model (Table 2). Diagnoses are less predictive of incremental costs among the more uniformly expensive institutional population than they are among the community population.

We constrained certain groups of demographic and diagnostic coefficients in the institutional model to be equal (Table 2), because the small available sample of institutionalized beneficiaries resulted in their low prevalence in some diagnostic categories (HCCs) and made it difficult to obtain stable estimates of each separate parameter. For the same reason, we included no disabled interaction terms, and only two of the disease interaction terms in the institutional model. Also, HCC 158 Hip Fracture/Dislocation was excluded because its coefficient was negative.

The age/sex coefficients for the institutionalized are much higher than for community residents except for the oldest ages. This implies that institutionalized beneficiaries are predicted to be expensive regardless of their diagnostic profile (e.g., even lacking any of the diagnoses included in the CMS-HCC model), whereas community residents are predicted to be expensive only if diagnosed with at least one of the serious diseases included in the CMS-HCC model. This makes sense since institutionalization itself is a marker of poor health, aside from diagnostic profile, but the institutionalized age/sex coefficients decline for the oldest ages, and fall below the community coefficients. Medical treatment may be less aggressive for old, frail beneficiaries who are institutionalized.

Among the institutional population, the coefficient for Medicaid was negative and the coefficients for originally disabled was statistically insignificant. These variables

were excluded from the institutional model. Beneficiaries often qualify for Medicaid after spending down their personal assets to pay for a lengthy nursing home stay. Thus, Medicaid may be a proxy for beneficiaries in the later portion of their stays, when they are less expensive than in the earlier, post-acute phase of their nursing home tenure.

New Medicare Enrollees

The CMS–HCC model requires a complete 12-month base year diagnostic profile to predict the next year's expenditures. Beneficiaries without 12 months base year Medicare enrollment, but at least 1 month of prediction year enrollment, are defined as new enrollees. About two–thirds of new enrollees are age 65.[16] New enrollees may be under age 65 if they become eligible for Medicare by disability; they may be over age 65 if they delay Medicare enrollment or are not originally enrolled in both Parts A and B.[17] We developed a demographic model to predict expenditures for new enrollees who lack the data needed to apply the CMS-HCC model.

Table 4 presents frequencies and mean annualized expenditures from the 5-percent FFS sample data for new enrollees and continuing enrollees. Continuing enrollees are defined as beneficiaries having 12 months of Parts A and B Medicare enrollment in the base year and at least 1 month in the prediction year. For female and male new enrollees age 65, mean annualized expenditures are $2,729 and $2,900, respectively, less than one-half of costs of continuing enrollees ($6,952 for female and $6,055 for male). For almost all new enrollees age 65, the original reason for Medicare entitlement is age.[18] In contrast, continuing enrollees age 65 were originally entitled to Medicare by disability, and hence are much more expensive. For other ages, mean expenditures of new and continuing enrollees are much more similar. To achieve sufficient sample sizes in all age ranges to calibrate the new enrollees model, we merged the new and continuing enrollees samples, which resulted in a sample size of 1,495,225 with mean expenditures of $5,184. For age 65, actual new enrollees dominate the combined sample, and the cost weight reflects their (low) relative costs. Continuing enrollees age 65 are included in the sample to calibrate the originally disabled coefficient for age 65. For other than age 65, the sample is dominated by continuing enrollees, but their costs appear to proxy actual new enrollee costs reasonably well for younger or older ages.

Beneficiaries for Whom Medicare is a Secondary Payer

Working aged beneficiaries are Medicare beneficiaries, age 65 or over, with private group health insurance coverage from their or their spouse's employer. By law, Medicare is a secondary payer for these beneficiaries. The primary private health plan must pay for medical expenses to the extent of its defined benefits. Only if Medicare covers services not covered by the private plan, or has more generous coverage (e.g., lower deductibles or copayments) for Medicare-covered services, is Medicare responsible for payment, and then only to the extent of the difference in

[16] To simplify the new enrollees model, we recoded new enrollees age 64 on February 1 with an original reason for Medicare entitlement of aged to age 65. Thus, the age 65 cell in the new enrollees model combines new enrollees ages 64 and 65 on February 1 of the prediction year whose original reason for entitlement is aged.

[17] For example, a beneficiary might be entitled to Part A (hospital insurance) by age at age 65 or over, but might not pay Part B (physician insurance) premium until an older age.

[18] Some age 65 new enrollees might have originally been entitled to Medicare by disability when under age 65, but then have rejoined the work force and lost their Medicare eligibility, only to re-enroll at age 65.

Table 4

Descriptive Statistics for New and Continuing Medicare Enrollees[1]

Age/Sex Category	New Enrollees[2] Observations	New Enrollees[2] Mean Annualized Expenditures	Continuing Enrollees[3] Observations	Continuing Enrollees[3] Mean Annualized Expenditures
Female				
0-34 Years	2,540	3,532	7,037	3,653
35-44 Years	3,685	4,341	15,717	4,385
45-54 Years	5,891	4,814	22,431	4,767
55-59 Years	4,029	4,903	14,277	5,354
60-64 Years	3,310	5,705	16,159	6,094
65 Years	58,946	2,729	3,336	6,952
66 Years	1,448	3,319	29,534	3,401
67 Years	845	3,349	31,560	3,684
68 Years	531	3,116	32,578	3,740
69 Years	504	3,608	33,893	3,905
70-74 Years	1,311	4,672	173,829	4,461
75-79 Years	471	5,063	161,843	5,387
80-84 Years	200	6,043	118,144	6,276
85-89 Years	95	8,111	75,186	7,035
90-94 Years	46	5,931	34,135	7,500
95 Years or Over	15	6,457	11,886	6,795
Male				
0-34 Years	3,434	3,089	10,342	2,934
35-44 Years	4,281	3,690	23,172	3,746
45-54 Years	5,820	4,099	29,814	4,074
55-59 Years	4,120	4,603	16,677	4,772
60-64 Years	4,196	4,775	18,986	5,346
65 Years	46,262	2,900	3,940	6,055
66 Years	1,546	3,205	24,472	3,644
67 Years	872	2,976	25,279	3,933
68 Years	570	3,501	25,915	4,145
69 Years	490	3,638	27,009	4,295
70-74 Years	1,223	5,700	130,148	5,087
75-79 Years	429	6,476	108,214	6,307
80-84 Years	144	5,916	66,505	7,231
85-89 Years	63	8,028	32,848	8,326
90-94 Years	19	13,027	10,601	8,827
95 Years or Over	2	3,221	2,420	8,867

[1] Aged and disabled beneficiaries. Excludes working aged and ESRD beneficiaries.

[2] Enrollees with less than 12 months of base year eligibility.

[3] Enrollees with 12 months of base year eligibility.

SOURCE: Pope, G.C. and Kautter, J., RTI International, Ellis, R.P. and Ash, A.S., Boston University, Ayanian, J.Z., Harvard Medical School and Brigham and Women's Hospital, Iezzoni, L.I., Harvard Medical School and Beth Israel Deaconess Medical Center, Ingber, M.J., Levy, J.M., and Robst, J., Centers for Medicare & Medicaid Services, Analysis of 1999-2000 Medicare 5% Standard Analytic File (SAF).

coverage. Medicare expenditures for working aged beneficiaries are lower for this reason, as well as because working may be a proxy for better health.[19] Estimation of a separate model for the working aged is not feasible with the sample sizes available from the Medicare's 5-percent FFS sample. A simple adjustment to CMS–HCC model predictions is a multiplier that scales cost predictions to be lower for these beneficiaries.

We defined the working aged as beneficiaries otherwise satisfying the requirements of our 1999-2000 aged/disabled prospective modeling sample who had at least 1 month of working aged status in the prediction year (2000). There are 19,057 beneficiaries in our working aged sample, or about 1.4 percent as many individuals as in our aged/disabled sample. The mean annualized expenditures of the working aged are $966, less than one-fifth as much as for the aged/disabled community sample ($5,213). The CMS–HCC community

[19] Throughout this section, we use the terms working and working aged to include both those who are actually working, and the spouses of those who are working.

model over-predicts mean working aged expenditures by a factor of 3.66. Essentially, we define the working aged multiplier as the ratio of mean actual to mean predicted expenditures for the working aged sample, where expenditures are predicted by the CMS-HCC community model. With an adjustment for beneficiaries who have a mixture of working aged and non-working-aged months in the payment year, the working aged multiplier is 0.215.

CONCLUSIONS

CMS' adaptation of the DCG/HCC model makes substantially more accurate predictions of medical costs for M+C enrollees than has previously been possible. Its use is intended to redirect money away from MCOs that cherry-pick the healthy, while providing the MCOs that care for the sickest patients the resources to do so. The ultimate purpose of the CMS-HCC payment model is to promote fair payments to MCOs that reward efficiency and encourage excellent care for the chronically ill. The CMS-HCC model will continue to evolve. Additional diagnoses may be needed to predict drug expenditures incurred under the drug benefit enacted by MMA (2003). The model may need to be recalibrated to reflect new treatment patterns and disease prevalence. Diagnosis-based risk adjustment may need to be coordinated with disease management programs and incentives for quality of care.

The model has evolved over two decades of research,[20] with careful attention to clinical credibility, real-world incentives and feasibility tradeoffs. Continuous feedback between government technical staff and policymakers at CMS on the one hand, and research organization and academic researchers on the other, has shaped the CMS-HCC model. Much of the recent research reported in this article has related to adapting the model for Medicare subpopulations. The use of a single modeling framework—the CMS-HCC model—provides unity and organization to the subgroup models with the unique features specific to certain types of beneficiaries. Comprehensive risk adjustment, based on ambulatory as well as inpatient diagnoses, is just beginning to be implemented. Thus, it is too early to tell whether it will achieve its goals. As risk adjustment continues to be incorporated in Medicare payments to MCOs, it will be important to evaluate its impact on these organizations and the beneficiaries they serve, especially organizations that care for the chronically ill and their enrollees. This will tell us a great deal about the feasibility and consequences of matching health care resources to needs.

[20] The DCG line of risk-adjustment research dates back to the report by Ash et al. (1989), based on research begun in 1984.

ACKNOWLEDGMENT

The authors would like to thank Helen Margulis for her exceptional computer programming assistance.

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March 2011

Evaluation of the CMS-HCC Risk Adjustment Model

Final Report

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CMS Contract No. HHSM-500-2005-00029I TO 0006

March 2011

This project was funded by the Centers for Medicare & Medicaid Services under contract no. HHSM-500-2005-00029I. The statements contained in this report are solely those of the authors and do not necessarily reflect the views or policies of the Centers for Medicare & Medicaid Services. RTI assumes responsibility for the accuracy and completeness of the information contained in this report.

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CONTENTS

TABLES

FIGURES

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.

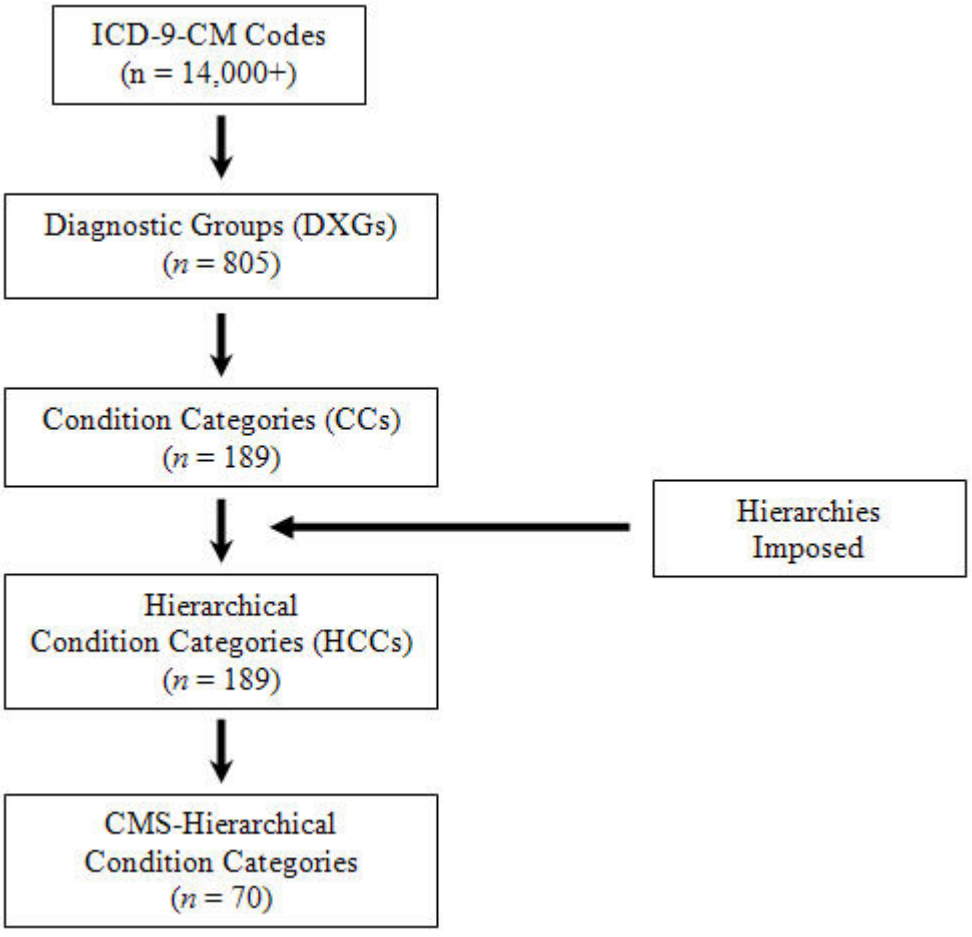
In designing the diagnostic classification, principles 7 (monotonicity), 8 (transitivity), and 9 (exhaustive classification) were followed absolutely. For example, if the expenditure weights for the models did not originally satisfy monotonicity, constraints were imposed to create models that did. Judgment 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



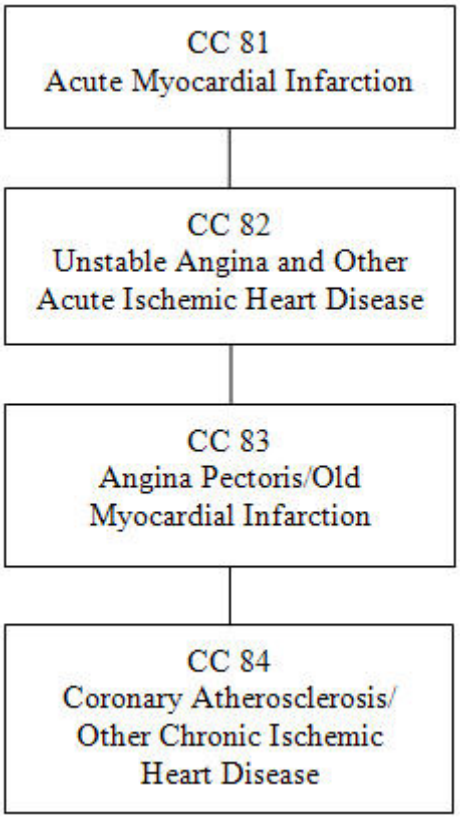
NOTE: ICD-9-CM is International Classification of Diseases, Ninth Revision, Clinical Modification.

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.

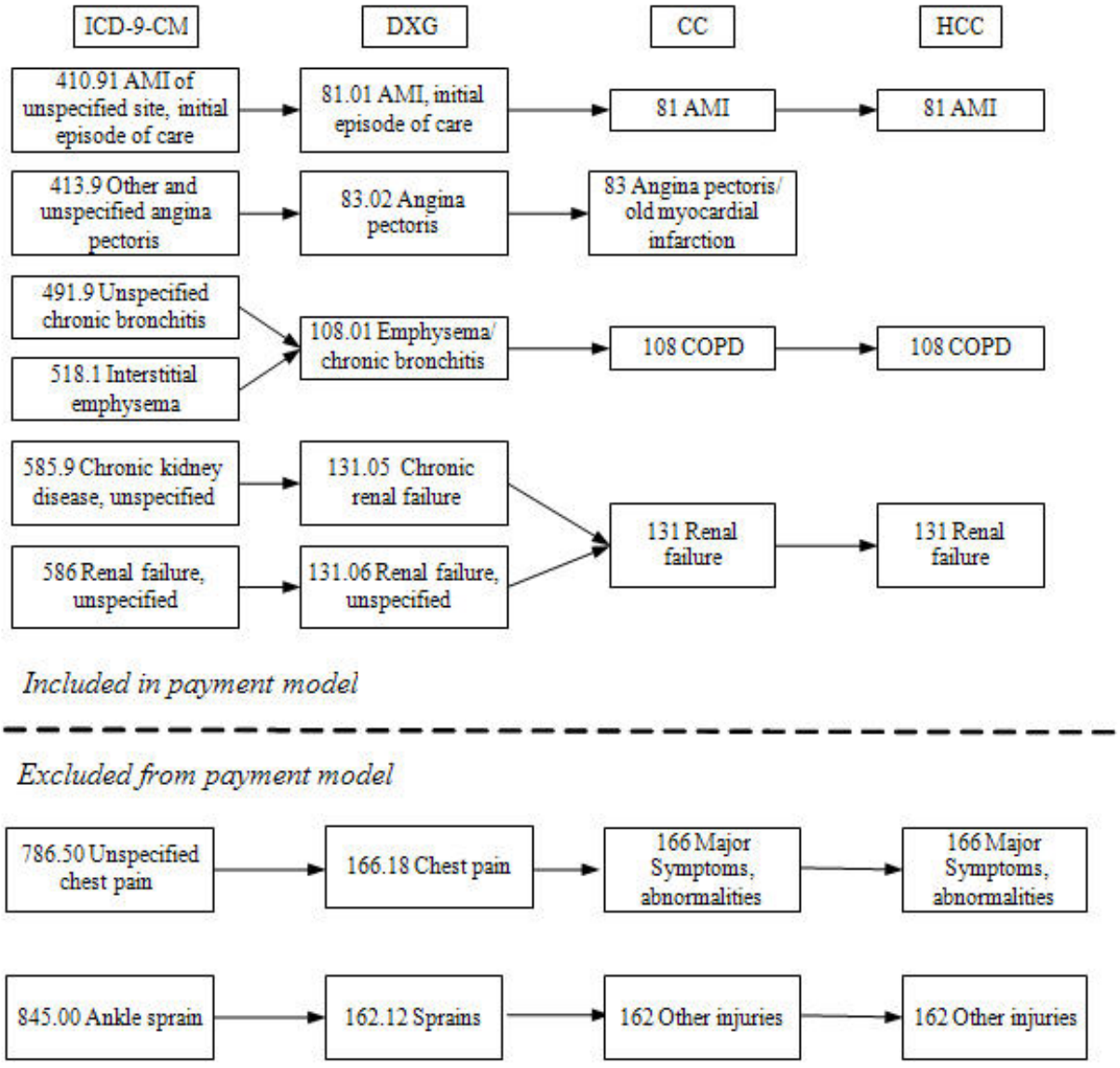
The CMS-HCC model also relies on demographics. Demographic adjusters included in the model are 24 mutually exclusive Age-Sex cells (e.g., female, age 65–69), an indicator for at least 1 month of Medicaid enrollment in the base year (a poverty indicator), and an indicator of originally disabled status. 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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Medicare Fee-For-Service
2010 Improper Payment Report

FOREWORD

The 2010 Medicare Fee-for-Service (FFS) improper payment rate of 10.5 percent, as published in the 2010 Medicare FFS Improper Payment Rate Report, represented $34.3 billion in improper payments. However, the 2010 published rate does not include the late documentation/appeals adjustment that was introduced during the 2011 report period. Information on the 2011 Medicare FFS improper payment rate and the late documentation/appeals adjustment will be presented in the 2011 Medicare FFS Improper Payment Rate Report.

Medicare Fee-For-Service
2010 Improper Payment Report

EXECUTIVE SUMMARY

The Improper Payments Information Act (IPIA) of 2002, amended by the Improper Payments Elimination and Recovery Act (IPERA) of 2010 , requires the heads of Federal agencies, including the Department of Health and Human Services (HHS) to annually review programs it administers to:

- Identify programs that may be susceptible to significant improper payments,
- Estimate the amount of improper payments in those programs that are determined to be susceptible to significant improper payments,
- Submit those estimates to Congress, and
- Describe the actions the Agency is taking to reduce improper payments in those programs.[1]

The Centers for Medicare & Medicaid Services (CMS) has identified the Medicare Fee-for-Service (FFS) program as a program at risk for significant erroneous payments. In 2010, the Medicare FFS paid claims error rate was 10.5 percent, or $34.3 billion in improper payments. In 2010, CMS continued to review claims according to a significantly revised and improved methodology implemented in 2009. As a result of these improvements and a more complete accounting of improper payments, the 2009 and 2010 overall error rates were higher than the 2008 improper payment rate; 12.4 percent and 10.5 percent in 2009 and 2010 respectively, compared to 3.6 percent in 2008.

Between 2009 and 2010 CMS reduced the Medicare FFS error rate by 1.9 percent or $1.1 billion. Had the error rate remained at 12.4 percent in 2010, there would have been $40.5 billion in improper payments in Medicare FFS, $6 billion more in improper payments than experienced. For purposes of setting an estimated baseline for future

[1] OMB M-06-23, Appendix C to OMB Circular A-123, August 10, 2006.
[2] The HHS 2009 Agency Financial Report (AFR) shows the Medicare FFS error rate as 7.8 percent, or $24.1 billion in improper payments; however this rate reflects a combination of two different review methodologies; 1) that included errors determined using the old review process (which most of the claims were reviewed) and 2) that included errors determined using the newer more stringent review process. After publication of the 2009 AFR, HHS decided to use the error rate using the newer more stringent review process as the 2009 rate.

goals, as well as for consistency and comparability of data, CMS uses 12.4 percent as the 2009 improper payment rate throughout this report.[2]

During the analysis of improper payments identified in 2010, CMS found that the improper payments error rate for inpatient hospital claims had increased significantly from last year. A large number of the payment errors were due to clinical care and procedures provided in an acute inpatient hospital that should have been provided in an outpatient hospital or another less intensive setting, meaning the clinical service was medically necessary but the place of service was incorrect. Under the current Medicare statute, these claims must be denied in full. These inappropriate "place of service" errors accounted for projected improper payments of $5.1 billion.

For inpatient hospital claims, a large percentage of medically unnecessary errors are related to hospital stays of short duration. In many cases, those services could have been rendered at a lower level of care, such as outpatient observation services. A smaller, but persistent amount of medically unnecessary payment errors are for inpatient hospital stays of three to five days, many of which resulted in a transfer to a skilled nursing facility (SNF). Some of these patients may have been admitted solely to satisfy the requirement for a minimum of three days as an inpatient in order to qualify for a SNF stay.

A portion of medical necessity errors for inpatient hospital claims is related to the denial of an invasive procedure that affected the Diagnosis Related Group (DRG) payment. If an invasive procedure did not meet the requirements of a Local Coverage Determination (LCD) or National Coverage Determination (NCD) and affected the DRG payment, the procedure was denied as a medically unnecessary service. In these cases, the DRG was reclassified after removing the medically unnecessary procedure. If the inpatient hospital stay included other Medicare covered services the improper payment amount was the difference between the billed DRG and the reclassified DRG; if no other covered services were provided the entire payment was considered improper.

We also found some notable decreases in certain areas due to enhanced educational efforts and policy clarifications related to Medicare signature requirements. The Part B error rate decreased from 18.9 percent in 2009 to 12.9 percent. The error rate for Part A non-inpatient hospital claims dropped from 8.8 percent in 2009 to 4.2 percent. While we are pleased with the decreases, we recognize that more is needed to further reduce errors throughout the Medicare FFS program.

Pursuant to the President's directive to reduce improper payments, CMS established a goal to reduce the 2009 error rate by 50 percent, or 6.2 percent, by 2012. CMS strives to eliminate improper payments in the Medicare program, maintain the Medicare trust funds and protect its beneficiaries. To better account for improper payments, CMS refined the Comprehensive Error Rate Testing (CERT) process beginning in 2009 and required that medical review procedures adhere to a more strict enforcement of medical documentation and coverage policies. In addition, CMS continued to analyze the improper payment data

garnered from the CERT program to make changes in areas where programmatic weaknesses exist. CMS also works with its contractors to ensure that Medicare FFS claims receive a more vigilant review before being processed. To further reduce errors, CMS will continue its efforts to work closely with the healthcare industry to ensure that providers and suppliers understand and follow CMS' policies and medical record requirements.

CMS will also analyze the improper payment data to determine if there are geographic trends that will result in further refining corrective actions and/or developing new procedures that will address programmatic weaknesses that may exist. CMS will review trends by types of service to locate potential vulnerabilities. CMS will use this knowledge to design innovative approaches to reduce improper payments, particularly in high risk areas such as durable medical equipment and home health. The error rate is not a measure of fraud; however, it may be an indication of program weaknesses and vulnerabilities that require more monitoring, oversight and diligence by CMS.

Reducing improper payments is a high priority for CMS. We are working on multiple fronts to attack this issue in order to meet our goals including increased prepayment medical review, enhanced analytics, expanded education and outreach to the provider/supplier communities, and expanded review of paid claims by our Recovery Auditors. CMS will continue to assess error rate measurement procedures and will make improvements and modifications as necessary to ensure the most accurate accounting of improper payments. Together these efforts will result in more accurate claims payment and a reduction of waste and abuse in the Medicare FFS program. This report describes the Medicare FFS improper payments in 2010, and steps CMS is taking to address these errors.

OVERVIEW

Background

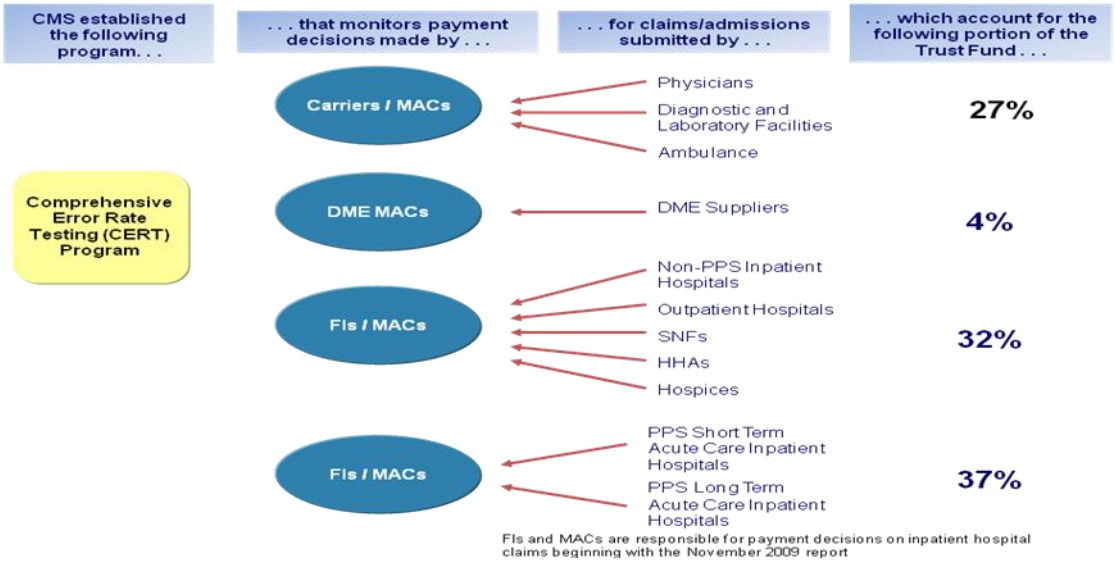
The Social Security Act established the Medicare program in 1965. Medicare currently covers the health care needs of people aged 65 or older, people under age 65 with certain disabilities, people of all ages with End Stage Renal Disease (ESRD), and certain others who elect to purchase Medicare coverage. Both Medicare costs and the number of Medicare beneficiaries have increased dramatically since 1965. In fiscal year (FY) 2009, approximately 46 million beneficiaries were enrolled in the Medicare program, and the total Medicare benefit outlay (both Medicare FFS and managed care payments) was

estimated at about $454 billion[2]. The Medicare budget represents almost 15 percent of the total Federal budget.

The Centers for Medicare & Medicaid Services (CMS) uses several types of contractors to prevent improper payments in the Medicare program including:
Medicare Administrative Contractors (MACs), Carriers, and Fiscal Intermediaries (FIs).

The following figure depicts the flow of claims by provider and supplier types through the Medicare contractor claims processing entities.

Figure 1: Flow of Claims by Provider and Supplier Types through the Medicare Contractor Claims Processing Entities



The primary goal of each Medicare contractor is to "Pay it Right" - that is, to pay the right amount to the right provider for covered and correctly coded services. Contractors cannot medically review every claim that comes through; thus, they must choose carefully which claims to review. It is through the detailed review of medical records that errors and non-compliance with CMS policies are detected. To improve provider compliance, contractors must also determine how best to educate providers about Medicare rules and implement the most effective methods for accurately answering coverage and coding questions.

As part of our IPIA[3] compliance efforts, and to better assist the Medicare FFS contractors in focusing their review and education efforts, CMS established the Comprehensive Error

[2] 2010 CMS Statistics: U.S. Department of Health and Human Services, CMS Pub. No. 03455, June 2010
[3] The Improper Payments Information Act of 2002 (IPIA) was amended by the Improper Payments Elimination and Recovery Act (IPERA) in July 2010.

Rate Testing (CERT) program to randomly sample and review claims submitted to and paid by the Medicare program. The CERT program considers any claim that was paid that should not have been paid or that was paid at an incorrect amount to be an improper payment, including both overpayments and underpayments. Since the IPIA requires the CERT program to use random claim selection, reviewers cannot develop provider billing patterns or trends that may indicate potential fraud. Thus the CERT program does not, and cannot, label a claim fraudulent.

History of Error Rate Measurement

The HHS Office of Inspector General (OIG) estimated the Medicare FFS error rate from 1996 through 2002. The OIG designed its sampling method to estimate a national Medicare FFS paid claims error rate. Due to the sample size – approximately 6,000 claims – the OIG was unable to produce error rates by contractor type, specific contractor, service type, or provider type. Following recommendations from the OIG, the sample size was increased for the CERT program when CMS began producing the Medicare FFS error rate for the November 2003 Report.

With the passage of the IPIA, CMS took responsibility for the error rate program beginning with FY 2003. One of the key tenets of the IPIA was that error rate measurement programs should be a critical part of an agency's internal controls. The IPIA also ushered in the notion that agencies should use this key internal control to inform decision makers about program vulnerabilities and drive corrective actions for reducing future errors. When the program was transitioned to CMS, the sample size for the CERT program was increased to approximately 120,000 claims. The increase in sample size allowed CMS to project not only a national error rate, but also allowed for contractor and service level error rates. It was believed that these additional error rates would allow CMS to develop more robust corrective actions and would provide CMS and its contractors with valuable information to assist in the development of specific corrective actions to reduce errors from occurring in the future.

CMS originally established two programs to monitor the accuracy of the Medicare FFS program: the CERT program and the Hospital Payment Monitoring Program (HPMP). The HPMP measured the error rate for inpatient hospital claims only and the CERT program measured the error rate for the other claim types, including outpatient hospital and durable medical equipment claims. Beginning with the FY 2009 reporting, the CERT program became fully responsible for sampling and reviewing **all** Medicare FFS claims, including inpatient and outpatient hospital claims, and durable medical equipment claims for purposes of measuring improper payments.

Each year the Medicare FFS error rate is reported in the annual financial reports of both CMS and HHS. The HHS Agency Financial Reports can be found at http://www.hhs.gov/afr. As part of the annual CMS Chief Financial Officer's (CFO) audit, the OIG conducts an audit of the CERT process and provides recommendations to

CMS for consideration in refining the error rate process. In 2010, the OIG performed a more extensive review of improper payments identified during the CERT program reviews in 2009. Based on the OIG's recommendations, CMS has incorporated a more in depth analysis in this report in order to identify specific reasons for errors, as well as potential vulnerabilities.

Table 1 summarizes the overpayments, underpayments, and error rates by year.

Table 1: National Error Rates by Year (Dollars in Billions) [4]

Year	Total Dollars Paid	Overpayments		Underpayments		Overpayments + Underpayments	
		Payment	Rate	Payment	Rate	Improper Payments	Rate
1996	$168.1	$23.5	14.0%	$0.3	0.2%	$23.8	14.2%
1997	$177.9	$20.6	11.6%	$0.3	0.2%	$20.9	11.8%
1998	$177.0	$13.8	7.8%	$1.2	0.6%	$14.9	8.4%
1999	$168.9	$14.0	8.3%	$0.5	0.3%	$14.5	8.6%
2000	$174.6	$14.1	8.1%	$2.3	1.3%	$16.4	9.4%
2001	$191.3	$14.4	7.5%	$2.4	1.3%	$16.8	8.8%
2002	$212.8	$15.2	7.1%	$1.9	0.9%	$17.1	8.0%
2003	$199.1	$20.5	10.3%	$0.9	0.5%	$12.7	6.4%
2004	$213.5	$20.8	9.7%	$0.9	0.4%	$21.7	10.1%
2005	$234.1	$11.2	4.8%	$0.9	0.4%	$12.1	5.2%
2006	$246.8	$9.8	4.0%	$1.0	0.4%	$10.8	4.4%
2007	$276.2	$9.8	3.6%	$1.0	0.4%	$10.8	3.9%
2008	$288.2	$9.5	3.3%	$0.9	0.3%	$10.4	3.6%
2009	$285.1	$34.2	12.0%	$1.2	0.4%	$35.4	12.4%
2010	$326.4	$33.2	10.2%	$1.1	0.3%	$34.3	10.5%

The error rate in 2009 is not comparable to previous years' error rates due to a change in review methodology, specifically a strict adherence to policy documentation requirements, the removal of claims history as a valid source for review information, and the determination that medical record documentation created by a supplier is insufficient to substantiate a claim. CMS continued this review methodology for 2010 and was successful in reducing the error rate by 1.9 percent or $1.1 billion between 2009 and 2010.

[4] Some columns and/or rows may not sum correctly due to rounding.

The CERT Process

Methodology Overview

The CERT contractor randomly selects a sample of claims submitted to the various Medicare contractors (Carriers, FIs, and MACs) during the reporting period. After the selected claims have been paid or denied, the CERT contractor requests supporting medical records from the health care providers and suppliers that submitted the claims in the sample.

When medical records are submitted by the provider, the CERT contractor reviews the claims in the sample and the associated medical records to see if the claims complied with Medicare coverage, coding, and billing rules. If not, the CERT contractor assigns the erroneous claims to the appropriate error category. When medical records are not submitted by the provider, the CERT contractor classifies the sampled claim as a no documentation claim and counts it as an error.

For any identified payment errors, the CERT contractor notifies the appropriate Medicare contractor that processed the claim so they may recoup the overpayment from the provider, or reimburse the provider for any underpayment. Finally, the CERT contractor calculates the projected improper payment rate based on the actual erroneous claims identified in the sample.

CERT reports a paid claims error rate which is based on the amount paid after the Medicare contractor made its payment decision on the claim. This rate includes fully denied claims. The paid claims error rate is the percentage of total dollars that all Medicare FFS contractors erroneously paid or denied and is a good indicator of how claim errors in the Medicare FFS program impact the trust fund. CMS calculated the gross rate by adding underpayments to overpayments and dividing that sum by the total dollars paid.

Medical Record Requests

The CERT contractor requested the associated medical records with the sampled claim from the provider that submitted the claim. The initial request for medical records is made via letter. If the provider fails to respond to the initial request after 30 days, the CERT contractor will sent at least three subsequent letters as well as place follow-up phone calls to the provider in order to attempt to collect the medical records.

In cases where no documentation was received from the provider after 75 days from the initial request, the case is considered to be a “no documentation” claim and counted as an error. Any documentation received after the 75th day is considered “late

documentation." If late documentation was received prior to the documentation cut-off date for this report, the records are reviewed and, if justified, the error in each rate is revised. If late documentation was received after the cut-off date for this report, the CERT contractor will make every effort to attempt to complete the review process before the final production of the report.

For durable medical equipment (DME) claims and Part A and Part B claims for clinical diagnostic laboratory services, additional documentation requests were made to the referring provider who ordered the item or service whenever the billing party does not have complete medical records to support the medical necessity of the services.

Sampling Methodology

For FY 2010 reporting, the CERT contractor randomly sampled approximately 82,000 claims; less than were sampled in previous years. Specifically, for each Medicare claims processing contractor (e.g. MACs), the CERT contractor conducted a random sample by claim type: Part A (excluding acute inpatient hospital services), Part A (acute inpatient hospital services only), Part B, and DME. On a daily basis, a random sample of claims, stratified by claim type, was selected from all of the claims submitted to a given Medicare claims processing contractor. A small portion of the claims sampled from the universe were unreviewable because they never completed the claim adjudication process (e.g., the claim was returned to the provider), leaving the final CERT sample comprised of claims that were either paid or denied by the Medicare claims processing contractor. This sampling methodology complies with all IPIA requirements and OMB guidance. The aggregate number of claims sampled and the number of claims reviewed for each claim type is provided below in Table 2.

Table 2: Sample Sizes by Claim Type

Claim Type	Number of Sampled Claims	Number of Claims Reviewed
Part A (Excluding Acute Inpatient Hospital)	35,313	34,458
Part A (Acute Inpatient Hospital)	2,454	2,453
Part B	31,766	30,965
DME	12,172	11,996
Total	81,705	79,872

Review of Claims

Upon receipt of medical records, the CERT contractor's clinicians conduct a review of the claims and submitted documentation to identify any improper payments. They check the CMS eligibility system, the Common Working File (CWF) to confirm that the person receiving the services was an eligible Medicare beneficiary; to determine whether the claim was a duplicate and to ensure that no other entity was responsible for paying the

claim (is Medicare the primary insurer). When performing these reviews, the CERT contractor follows Medicare regulations, billing instructions, National Coverage Determinations (NCDs), coverage provisions in interpretive manuals, and the respective Local Coverage Determinations (LCDs) and articles.

Error Categories

Based on the review of the medical records, claim errors are categorized into five different error categories. The five categories of error under the CERT program are described below.

No documentation—Claims are placed into this category when the provider fails to respond to repeated attempts to obtain the medial records in support of the claim or the provider responded that they do not have the requested records.

Insufficient documentation—Claims are placed into this category when the medical documentation submitted is inconclusive to support the rendered service (medical reviewers could not conclude that some of the allowed services were actually provided, provided at the level billed, and/or medically necessary).

Medically unnecessary service—Claims are placed into this category when claim review staff receive enough documentation from the medical records submitted to make an informed decision that the services billed were not medically necessary based on Medicare coverage policies.

Incorrect coding—Claims are placed into this category when providers submit medical documentation that supports a different code than the code /billed, the service was done by someone other than the billing provider, the billed service was unbundled, or a beneficiary was discharged to a site other than the one coded on a claim).

Other—This category includes claims that do not fit into any of the other categories (e.g., duplicate payment error, non covered or unallowable service).

Weighting and Determining the Final Results

The error rates were weighted so that each contractor's contribution to the error rate was in proportion to the percent of allowed charges for which they were responsible. The confidence interval is an expression of the numeric range of values into which CMS is 95 percent certain that the mean values for the improper payment estimates will fall. As required by the IPIA, the CERT program has included an additional calculation of the 90 percent confidence interval for the national error rate calculation. The size of the associated confidence interval, which represents the extent of variability, should always be considered when evaluating estimated payment error rates.

After the claims have been reviewed for improper payments, the sample is projected to the universe statistically using a combination of sampling weights and universe expenditure amounts.

Appeal of Claims

Providers can appeal denials (including no documentation denials) through the normal appeal processes by submitting documentation supporting their claims to the appropriate contractor. Appeals are tracked and all overturned final appeal determinations are entered into the appeals tracking system to ensure the accuracy of the error rates. After the calculation of the final error rate, appeal decisions cannot be considered. For FY 2010, $3.1 billion in projected appeals reversals were deducted from the national improper payment projections contained in this report.

Overpayments/Underpayments

In the CERT program, contractors are notified of detected overpayments and underpayments so they can implement the necessary payment adjustments. Sampled claims for which providers failed to submit documentation were considered overpayments.

Medicare contractors only recover actual overpayments identified in the CERT sample. The CERT program identified $5,057,759 in actual overpayments and, as of the publication date of this report, CMS has collected $3,814,177 of those overpayments. CMS and its contractors will never collect a small amount of the identified overpayments. The following lists the primary reasons why some overpayments cannot be collected; this list is not all inclusive:

- The provider appealed the overpayment and the outcome of the appeal overturned the CERT decision, however the decision was made after the error rate was final; or
- The provider has gone out of business and CMS cannot locate the provider after multiple attempts.

However, for all other situations, CMS' Medicare contractors continue their attempts to collect the overpayments identified during the CERT process.

Error Rate Reduction Targets

Based on the CERT program results for 2009, CMS established the following error rate goal under the Government Performance and Results Act (GPRA).

Reduce the percentage of improper payments made by the Medicare FFS program.

- By November 30, 2010, reduce the percent of improper payments under Medicare FFS to 9.5 percent.

  Status: This goal was not met. The national paid claims error rate for the November 2010 reporting period was 10.5 percent.

- By November 30, 2011, reduce the percent of improper payments under Medicare FFS to 8.5 percent.

- By November 30, 2012, reduce the percent of improper payments under Medicare FFS to 6.2 percent.

FINDINGS

National Medicare FFS Error Rate

As mentioned in the previous section, the estimated national paid claims error rate in the Medicare FFS program was 10.5 percent. The 95 percent confidence interval was 9.8 percent - 11.2 percent. The 90 percent confidence interval (required to be reported by IPIA) was 9.9 percent - 11.1 percent. The total amount projected to be in error was $34.3 billion**.**

Table 3 summarizes the overall improper payment error rates by claim types: Part A—Inpatient Hospital Services; Part B – Outpatient Services; and DME. Claims for DME supplies have the highest error rate—73.8 percent, while Part A has the most dollars in error--$16 billion.

Table 3: Error Rate and Projected Improper Payment by Claim Type (Dollars in Billions)[5]

Claim Type	Total Paid Amount	Overall Improper Payment		
		Improper Payment	Paid Claim Error Rate	95% Confidence Interval
Part A (total)	$232.0	$16.1	6.9%	6.0% - 7.9%
Part A (Excluding Acute Inpatient Hospital)	$112.6	$4.7	4.2%	3.7% - 4.7%
Part A (Acute Inpatient Hospital)	$119.4	$11.3	9.5%	7.8% - 11.2%
Part B	$84.5	$10.9	12.9%	12.1% - 13.8%
DME	$9.8	$7.3	73.8%	71.5% - 76.1%
Overall	$326.4	$34.3	10.5%	9.8% - 11.2%

[5] Some columns and/or rows may not sum correctly due to rounding.

Summarization of Errors Due to DME Supplies

The DME error rate (73.8 percent) was the highest among all of the claim types. While DME accounts for less than 4 percent of all Medicare FFS expenditures, these services resulted in 21 percent of total projected improper payments in 2010. Of the total DME errors, 45.3 percent were due to insufficient documentation and 27.3 percent were due to a lack of medical necessity for the item. Therefore, nearly half of all DME errors were the result of inadequate documentation—meaning the provider/supplier did not submit a complete medical record and we could not make an informed decision about medical necessity of the DME service. Approximately a quarter of the errors were "medically unnecessary"—meaning the medical records submitted contained adequate documentation to determine that the services billed and paid for were not medically necessary and the DME service should not have been provided.

Medicare pays for DME only if the patient's medical record contains sufficient documentation of the patient's medical condition to substantiate the necessity for the type or quantity of items ordered. In other words, the submitted documentation must support that the item(s) was medically necessary. CMS recently clarified that documentation created by the supplier alone is insufficient to warrant payment of the claim. It is often difficult to obtain proper documentation for DME claims because the supplier who billed for the item must obtain detailed documentation from the medical professional who ordered the item. As such, the involvement of multiple parties can contribute to situations of missing or incomplete documentation and delays in documentation receipt.

Insufficient documentation errors are found when the medical documentation does not include pertinent facts about the patient's condition that are necessary to make an informed decision about medical necessity. For the 2010 review cycle, the primary causes of insufficient documentation errors for DME claims included:

- Missing physician orders,
- Missing diagnostic laboratory test results (e.g., an arterial blood gas for home oxygen therapy), and
- Missing or incomplete documentation of the Face-to-Face examination for power wheelchairs.

With regard to medical necessity, errors of medical necessity are found when the submitted documentation does not support the beneficiary's need for the DME item based on criteria established by NCDs or LCDs. The lack of supporting documentation was most notable for power wheelchair claims. For example, the documentation supplied for the patient assessment should paint a picture of the patient's functional abilities and limitations on a typical day. It should contain as much objective data as possible. The physical examination should be focused on the body systems that are responsible for the patient's ambulatory difficulty or impact on the patient's ambulatory ability. Although patients who qualify for coverage of a power mobility device may use that device outside

the home, because Medicare's coverage of a wheelchair or power operated vehicle (scooter) is determined solely by the patient's mobility needs within the home, the examination must clearly distinguish the patient's abilities and needs within the home from any additional needs for use outside the home. In many cases, the submitted documentation did not validate that the beneficiary needed a wheelchair to support them in activities of daily living.

Given the importance of receiving medical record documentation to substantiate the necessity for DME items billed, beginning in 2011, CMS will notify the physician when a DME item ordered by that physician is selected for CERT review. The notification reminds physicians of their responsibility to maintain documentation of medical necessity for the DME item and submit requested documentation to the supplier. A more in-depth explanation of the primary causes of DME improper payments for the 2010 review cycle is provided in the next section.

Primary Causes of DME Improper Payments

Within DME, oxygen supplies, glucose monitoring supplies, and power wheelchairs have the highest improper payments, accounting for 3.6 percent, 3.3 percent, and 2.4 percent of the total projected improper payments in Medicare FFS, respectively. These three DME groups account for approximately 44 percent of the DME improper payments. The determination of improper payments for oxygen supplies, glucose monitoring supplies and power wheelchairs are discussed below.

Oxygen Supplies: Most of the errors are due to insufficient documentation to support the medical necessity for the home oxygen equipment. These oxygen supplies are generally provided on a monthly basis, given the nature of these supplies it is critical that the patient be closely monitored by the physician to ensure appropriate care and support the continued medical necessity of the oxygen supplies. The critical documentation required but **missing** from the medical records includes:

- Most recent Certificate of Medical Necessity (CMN) to document patient's condition;
- Test results from the qualifying oximetry or arterial blood gas test as required by the CMN;
- Documentation showing that the patient was seen by a physician 30 days prior to the initial certification date documenting the diagnosis for which the oxygen is prescribed;
- Documentation showing that the patient was seen by a physician 90 days prior to the recertification date (if applicable); and
- For claims subsequent to the recertification date, physician visit note supporting continued medical monitoring of oxygen use and needs.

Glucose Monitoring Supplies: Medicare pays for glucose monitors, test strips and lancets for all Medicare beneficiaries with diabetes. A prescription from an ordering doctor is

required for Medicare coverage of all diabetic supplies. The prescription must state the number of times per day a beneficiary should test his or her blood sugar. Medicare requires that an ordering physician must review the prescription every 6 months. Medicare does not pay for automatic shipment of glucose supplies; the beneficiary or beneficiary's caregiver must directly submit a request for a refill of all diabetic supplies.

Many improper payment errors for glucose monitoring supplies resulted from the fact that the ordering physician did not submit required documentation to support the need for the glucose supplies. These glucose supplies are generally provided on a monthly basis, given the nature of these supplies it is critical that the patient be closely monitored by the physician to ensure appropriate care and support the continued medical necessity of the glucose supplies. The critical documentation required but missing from the medical records includes:

- Physician's original order for the glucose supplies;
- Documentation from the physician regarding the patient's condition and the continued use or support of testing frequency for which Medicare was billed; and
- Documentation supporting the physician's 6-month review of the original order.

Improper payment errors for diabetic supplies were also attributed to medically unnecessary services. For example, in some cases, medical necessity errors for diabetic supplies were assigned because the beneficiary exceeded allowable utilization of their diabetic supplies by receiving diabetic supplies concurrently from multiple DME suppliers during over-lapping periods of time.

Power Wheelchairs: Medicare pays for power wheelchairs or scooters only when specific statutory requirements are met. These requirements are listed below.

- There must be an in-person visit with a physician specifically addressing the beneficiary's mobility needs.
- There must be a history and physical examination by the physician or other medical professional focusing on an assessment of the beneficiary's mobility limitation and needs. The results of this evaluation must be recorded in the beneficiary's medical record.
- A prescription must be written AFTER the in-person visit has occurred and the medical evaluation is completed. This prescription has seven required elements.
- The prescription and medical records documenting the in-person visit and evaluation must be sent to the DME supplier within 45 days after the completion of the evaluation.

If any of the requirements listed above are not documented by the DME supplier and ordering physician CERT denies the DME item as insufficiently documented.

In addition, the in-person visit and mobility evaluation together are often referred to as the "Face-to-Face examination." The complete history and physical examination of the beneficiary's mobility limitation(s) and needs, typically includes the following components:

- A history of the present condition(s) and past medical history that is relevant to the beneficiary's mobility needs in the home;
- Evaluation of symptoms that limit ambulation;
- Diagnoses that is responsible for these symptoms;
- Prescribing medications or other treatment for these symptoms;
- Assessment of the progression of ambulation difficulty over time;
- Determination of other diagnoses that may relate to ambulatory problems;
- Assessment of how far the beneficiary can walk without stopping; including the assistive device, (such as a cane or walker) that may be necessary;
- Assessment of the pace of ambulation;
- A history of falls, including frequency, circumstances leading to falls; and
- Assessment of whether a walker (or other mobility assistive device) is sufficient to meet the mobility of the beneficiary.

If the medical review by CERT shows that the physician's physical and history examination did not fully support the need for a power wheelchair, CERT denied the service as not medically necessary.

Errors Due to Services Provided in an Inappropriate Setting

Medicare pays for an acute inpatient hospital stay only if the beneficiary demonstrates signs and/or symptoms severe enough to warrant the need for medical care and must receive services of such intensity that they can be furnished safely and effectively only on an inpatient basis. An inpatient is a person who has been admitted to a hospital for bed occupancy for purposes of receiving inpatient hospital services. Generally, a patient is considered an inpatient if formally admitted as inpatient with the expectation that he or she will remain at least overnight and occupy a bed even though it later develops that the patient can be discharged or transferred to another hospital and not actually use a hospital bed overnight.

The physician or other practitioner responsible for a patient's care at the hospital is also responsible for deciding whether the patient should be admitted as an inpatient. Physicians are expected to use a 24-hour period as a benchmark, i.e., they should order admission for patients who are expected to need hospital care for 24 hours or more, and treat other patients on an outpatient basis. However, the decision to admit a patient is a complex medical judgment which can be made only after the physician has considered a number of factors, including the patient's medical history and current medical needs, the types of facilities available to inpatients and to outpatients, the hospital's by-laws and admissions policies, and the relative appropriateness of treatment in each setting.

There are situations where a patient was admitted as an inpatient but the clinical care and procedures should have been provided in an outpatient or other non-hospital based setting. Under Medicare statute these claims must be denied in full, even if the claim would be potentially payable in another setting. By law, CMS cannot partially deny the claim or allow the provider to re-bill using a different setting.

Based on a review of the claims in error, CMS determined that there were 2,453 inpatient hospital claims in the CERT sample totaling $25.1 million in actual overpayments where the claim was denied in full because the services provided were not medically necessary as an inpatient service and should have been provided as an outpatient service. These inpatient hospital errors project to $5.1 billion of improper payments in the Medicare universe. The projected net difference between what was called an error and what may have been payable had the service been billed in the appropriate outpatient setting was $3.2 B, or a difference in the error rate of -1.5 percent; 9.0 percent rather than 10.5 percent.

Corrective Actions

CMS strives to prevent and eliminate improper payments in the Medicare program to sustain the Medicare trust funds and protect beneficiaries. To better account for and identify improper payments, CMS refined the CERT process in 2009 by requiring a strict adherence to our policies. CMS continues to improve the error rate measurement process and has redesigned the CERT sampling methodology to provide additional error information on high risk areas, in accordance with the President's Executive Order 13520 "Reducing Improper Payments[6] issued in November 2009.

CMS continues to analyze the improper payment data garnered from the CERT program and make changes in areas that show programmatic weakness. CMS also uses the results of the CERT program as feedback to the Medicare contractors to inform and enhance their medical review efforts, as well as improve their overall operations in a comprehensive manner that includes their education and outreach efforts. CMS has several corrective actions in place or under development to reduce documentation errors and medical necessity errors. Additionally, CMS plans to make several programmatic changes that are expected to decrease improper payments and ensure the authenticity of the services billed for by providers and suppliers. The following provides additional details about some of the corrective actions CMS is taking to reduce improper payments in the future.

Documentation Errors- CMS implemented improvements to the Medicare FFS error rate measurement program to ensure that providers and suppliers submit the required documentation, as follows.

[6] The White House, Office of the Press Secretary, Executive Order-- Reducing Improper Payments and Eliminating Waste in Federal Programs, November 23, 2009 (http://www.whitehouse.gov/the-press-office/executive-order-reducing-improper-payments)

- CMS commenced a DME and A/B MAC provider outreach and education task forces in 2010. These task forces consist of contractor medical review professionals who meet regularly to develop strategies to address for provider education in error prone areas. The task force held several open door forums to discuss documentation requirements and answer providers/suppliers questions. The task force also issued several informational articles that have been distributed on an as-needed basis to promote education among providers. The articles are maintained on the Medicare Learning Network (MLN) and can be accessed at any time.
- CMS contacts the provider who ordered the DME at the same time a supplier is contacted for documentation to advise them of their responsibility to provide medical documentation in support of the supplier's DME claim.
- CMS revises the medical record request letters as needed to clarify for the provider/supplier the components of the medical record that are required for a CERT review. The letter services as a checklist for the provider/supplier to ensure that their record submission is complete. CMS also revised follow up medical record request letters to include information about the documentation that is missing to ensure the provider/supplier fully understands what documentation needs to be submitted.
- CMS contacts third party providers to request documentation when the billing provider indicated that a portion of the medical record is possessed by a third party. For example, such a third party provider may be a physician who orders a power wheelchair that is dispensed by the supplier that submits the claim.
- CMS staff regularly contacts providers to make additional attempts at collecting medical documentation to ensure insufficient documentation errors are accurate.
- CMS conducts ongoing education to inform providers about the importance of submitting thorough and complete documentation. This involves national training sessions, individual meetings with providers with high error rates, presentations at industry association meetings, and the dissemination of educational materials.
- CMS implementation of the Electronic Submission of Medical Documentation (esMD) into the CERT review process will create greater program efficiencies, allow a quicker response time to documentation requests, and provide better communication between the provider, the CERT contractors, and CMS. The first phase of esMD went live on September 15, 2011. Initially, CMS anticipates limited provider participation but as more Health Information Handlers (HIHs) begin to offer gateway services to providers and CMS and HIH provider outreach efforts take hold, CMS expects provider participation to increase.

Medical Necessity Errors- CMS is dedicated to reducing medical necessity errors and is conducting the following corrective actions.

- CMS implemented a National Fraud Prevention System (FPS) on June 30, 2011, as required by the Small Business Jobs Act of 2010. The FPS is an innovative risk scoring technology that applies proven predictive models to nationwide Medicare Fee-For-Service claims on a pre-payment basis. The risk-scores

identify highly suspect claims, and help target resources to the areas of Medicare's greatest risk.

- CMS is in the process of implementing enhanced medical review policies including a Face-to-Face requirement for DME in accordance with Section 6407 of the Affordable Care Act (Affordable Care Act) (Pub. L. 111-148). CMS published a final rule that implemented the Face-to-Face encounter requirements for Medicare home health on November 17, 2010 as required by Section 6407 of the Affordable Care Act.
- CMS developed Comparative Billing Reports (CBRs) to help Medicare non-hospital providers analyze administrative claims data. CBRs compare a provider's billing pattern for various procedures or services to their peers on a state and national level. CMS also uses the Program for Evaluating Payment Patterns Electronic Report (PEPPER). The PEPPER allows Medicare inpatient hospital providers to also analyze their billing patterns through a comparison to other providers in their state and in the nation.
- CMS is developing a Program Vulnerability Tracking System (PVTS) that will track vulnerabilities identified by internal and external sources; including the National Fraud Prevention program, the Recovery Auditors, and the Office of the Inspector General. CMS will use the PVTS to inventory and prioritize vulnerabilities, and track corrective actions.
- CMS is conducting a competition to procure private sector edits for implementation within the Medicare program. As part of this effort CMS will: 1) evaluate the accuracy of commercial products, 2) determine whether these products are feasible in the Medicare FFS environment, and 3) determine whether they can prevent errors and reduce improper payments in the Medicare FFS program.
- CMS requires Carriers, FIs, and MACs to develop Error Rate Reduction Plans that identify the specific causes of the improper payments in their jurisdiction and outlines corrective actions for the errors.
- CMS requires the Carriers, FIs, and MACs to review and validate the CERT results for their jurisdiction to determine the education needed to reduce medical necessity and incorrect coding errors.
- CMS developed and installed new correct coding edits in the claims processing systems.
- CMS issued the first Medicare Quarterly Provider Compliance Newsletter in October 2010 to physicians, providers and suppliers to educate them on common errors found in the Medicare program and actions providers can take to prevent them from occurring in the future.
- CMS developed medically unlikely auto-deny edits in the claims processing systems to catch those services where the level billed exceeds acceptable clinical limits. These edits are updated quarterly.
- CMS approved additional areas for Medicare FFS Recovery Auditors review including inpatient hospital stays and DME. CMS also increased medical record request limits for Recovery Auditors. Information about the results of the

Recovery Audit Program provides valuable information to providers about areas where improvements are needed.

- CMS continually updates Medicare FFS manuals to clarify requirements for the review of documentation to promote uniform application of our policies across all medical reviews performed by Medicare contractors.

Ensuring the Authenticity of Providers and Suppliers- CMS has implemented safeguards to better ensure that only legitimate providers and suppliers receive Medicare payments, including the following.

- CMS is undertaking numerous aggressive actions to tighten the provider enrollment process, provide more rigorous oversight and monitoring once a provider/supplier enrolls in the program, and to strengthen the provider revocation process. CMS implemented a DME Accreditation program to ensure the legitimacy of the DME suppliers that bill Medicare and to ensure those suppliers meet all the requirements for participation in the Medicare program.
- CMS established a surety bond requirement for most suppliers of durable medical equipment, prosthetics and orthotics.
- CMS issued a request for proposals for an automated screening solution in July 2011 that will support the revalidation of 1.5 million providers, as required by the Affordable Care Act. The award is targeted for September 2011. The enrollment screening solution will automate the multiple database checks that are currently manual, increasing the accuracy of results and decreasing application processing time.
- CMS, in collaboration with California provider groups, law enforcement and the Senior Medicare Patrol, hosted a series of events across the state to educate physicians on medical identify theft and other fraud related topics and how to protect their professional and medical identity from fraud in September 2011.
    - CMS published a final rule with comment titled, "Medicare, Medicaid and Children's Health Insurance Programs; Additional Screening Requirements, Application Fees, Temporary Enrollment Moratoria, Payment Suspensions and Compliance Plans for Providers and Suppliers" on February 2, 2011. This final rule implemented many of the program integrity provisions in the Affordable Care Act, including the requirement that State Medicaid programs terminate a provider or supplier who has been terminated from another State Medicaid program or from Medicare.
    - CMS published a final rule titled, "Medicare Program; Establishing Additional Medicare Durable Medical Equipment, Prosthetics, Orthotics, and Supplies (DMEPOS) Supplier Enrollment Safeguards (CMS-6036-F) in the Federal Register on August 27, 2010. This final rule clarified and expanded on the existing enrollment requirements

that DMEPOS suppliers must meet to establish and maintain billing privileges in the Medicare program.

- CMS has initiated the realignment of the Program Safeguard Contractors (PSC) with the MACs. When the realignment is completed, there will be seven zones to address fraud "hot spots" in the United States, thereby concentrating on areas of high fraud occurrence. The name for this entity is being changed from PSCs to Zone Program Integrity Contractor (ZPIC). Five of the seven ZPIC awards have been made.
- CMS has taken steps to fight DMEPOS fraud in the "high risk" states of Florida, California, Texas, Illinois, Michigan, North Carolina and New York. These efforts include more stringent reviews of new suppliers' applications; unannounced site visits; extensive pre- and post-payment review of claims; interviews with high volume ordering/referring physicians; and visits to high risk beneficiaries to ensure they are appropriately receiving items and services for which Medicare is being billed.
- CMS implemented the first phase of the DME competitive bidding program which will have a gradual impact on the DME error rate.

Appendix

Paid Claims Error Rate by Error Type

The national Medicare improper payment rate was higher in 2009 and 2010 than in previous years. These increases are due primarily to CMS' changes to medical review criteria. Documentation requirements became more stringent and conditions for medical necessity had to be met precisely. Table 4 shows the national error rates by year and error category. The greatest increases in the error rates are due to insufficient documentation and medically unnecessary errors. These types of errors are most impacted by the revised review criteria.

Table 4: **Summary of Error Rate by Year and by Category**

Year and Category		No Documentation Errors	Insufficient Documentation Errors	Medically Unnecessary Errors	Incorrect Coding Errors	Other Errors	Improper Payments	Correct Payments
1996	Net[1]	1.9%	4.5%	5.1%	1.2%	1.1%	13.8%	86.2%
1997	Net	2.1%	2.9%	4.2%	1.7%	0.5%	11.4%	88.6%
1998	Net	0.4%	0.8%	3.9%	1.3%	0.7%	7.1%	92.9%
1999	Net	0.6%	2.6%	2.6%	1.3%	0.9%	8%	92%
2000	Net	1.2%	1.3%	2.9%	1%	0.4%	6.8%	93.2%
2001	Net	0.8%	1.9%	2.7%	1.1%	-0.2%	6.3%	93.7%
2002	Net	0.5%	1.3%	3.6%	0.9%	0%	6.3%	93.7%
2003	Net	5.4%	2.5%	1.1%	0.7%	0.1%	9.8%	90.2%
2004	Gross[2]	3.1%	4.1%	1.6%	1.2%	0.2%	10.1%	89.9%
2005	Gross	0.7%	1.1%	1.6%	1.5%	0.2%	5.2%	94.8%
2006	Gross	0.6%	0.6%	1.4%	1.6%	0.2%	4.4%	95.6%
2007	Gross	0.6%	0.4%	1.3%	1.5%	0.2%	3.9%	96.1%
2008	Gross	0.2%	0.6%	1.4%	1.3%	0.1%	3.6%	96.4%
2009	Gross	0.2%	4.3%	6.3%	1.5%	0.1%	12.4%	87.6%
2010	Gross	0.1%	4.6%	4.2%	1.6%	0.1%	10.5%	89.5%

1FY 1996-2003 Improper payments were calculated Overpayments – Underpayments
[2]FY 2004-2010 Improper payments were calculated Overpayments + absolute value of Underpayments

Table 5 summarizes the percent of total dollars improperly paid by error category and claim type.

Table 5: Type of Error Comparison for 2009 and 2010[7]

Type of Error	2009 Report	2010 Report				
	Total	Total	Part A excl. Acute Inpatient Hospital	Part A Acute Inpatient Hospital	Part B	DME
No documentation	0.2%	0.1%	0.1%	0.0%	0.2%	0.7%
Insufficient Documentation	4.3%	4.6%	2.5%	0.9%	8.0%	45.3%
Medically Unnecessary	6.3%	4.2%	1.2%	6.8%	1.7%	27.3%
Incorrect Coding	1.5%	1.6%	0.4%	1.7%	3.0%	0.1%
Other	0.1%	0.1%	0.1%	0.0%	0.1%	0.3%
All Type of Error	12.4%	10.5%	4.2%	9.5%	12.9%	73.8%

Table 6 summarizes the overall improper payments, overpayments, underpayments and error rates by claim type.

Table 6: Error Rate and Projected Improper Payment by Claim Type and Over/Under Payments (Dollars in Billions)[8]

Claim Type	Total Paid Amount	Overall Improper Payment			Overpayment		Underpayment	
		Improper Payment	Paid Claim Error Rate	95% Confidence Interval	Improper Payment	Paid Claim Error Rate	Improper Payment	Paid Claim Error Rate
Part A (total)	$232.0	$16.1	6.9%	6.0% - 7.9%	$15.2	6.6%	$0.8	0.4%
Part A (Excluding Acute Inpatient Hospital)	$112.6	$4.7	4.2%	3.7% - 4.7%	$4.6	4.1%	$0.1	0.1%
Part A (Acute Inpatient Hospital)	$119.4	$11.3	9.5%	7.8% - 11.2%	$10.6	8.9%	$0.7	0.6%
Part B	$84.5	$10.9	12.9%	12.1% - 13.8%	$10.7	12.7%	$0.2	0.3%
DME	$9.8	$7.3	73.8%	71.5% - 76.1%	$7.3	73.8%	$0.0	0.0%
Overall	$326.4	$34.3	10.5%	9.8% - 11.2%	$33.2	10.2%	$1.1	0.3%

[7] Some columns and/or rows may not sum correctly due to rounding.

[8] Some columns and/or rows may not sum correctly due to rounding.

Summary of Error Rate Categories

(1) No Documentation Errors

Claims are placed into this category when the provider fails to respond to repeated attempts to obtain the medial records in support of the claim or the provider responded that they do not have the requested records.

No documentation errors accounted for 0.1 percent of the total dollars all Medicare FFS contractors allowed during the reporting period. The data breaks down by claim type as follows.

Part A (excluding Acute Inpatient Hospital)	Part A (Acute Inpatient Hospital)	Part B	DME	Overall
0.0%	0.0%	0.1%	0.0%	**0.1%**[9]

The following is an example of a no documentation error.

- An FI paid $172.00 to a hospital for an outpatient clinic visit. After multiple attempts to obtain the record, the CERT contractor received a letter which stated "Medical information you are requesting does not exist in the patient's medical record. No information available." The FI recouped the entire amount.

(2) Insufficient Documentation Errors

Claims are placed into this category when the medical documentation submitted is inconclusive to support the rendered service (medical reviewers could not conclude that some of the allowed services were actually provided, provided at the level billed, and/or medically necessary).

Insufficient documentation errors accounted for 4.6 percent of the total dollars allowed during the reporting period. The data breaks down as follows.

[9] Some columns and/or rows may not sum correctly due to rounding.

Part A (excluding Acute Inpatient Hospital)	Part A (Acute Inpatient Hospital)	Part B	DME	Overall
0.9%	0.3%	2.1%	1.4%	**4.6%**[10]

The following is an example of an insufficient documentation error.

- An FI paid $2,766.87 to a provider for an inpatient hospital stay. After multiple attempts to obtain the documentation, we received an initial history and physical and a brief discharge summary only. The CERT reviewer determined there was insufficient documentation to support the services billed. The FI recouped the entire payment.

See the section entitled *Types of Errors by Clinical Setting* for further information about insufficient documentation errors. Refer to page 25.

(3) Medically Unnecessary Services Errors

Claims are placed into this category when claim review staff receives enough documentation from the medical records submitted to make an informed decision that the services billed were not medically necessary based on Medicare coverage policies.

Medically unnecessary service errors accounted for 4.2 percent of the total dollars allowed during the reporting period. This data breaks down in the following manner.

Part A (excluding Acute Inpatient Hospital)	Part A (Acute Inpatient Hospital)	Part B	DME	Overall
0.4%	2.5%	0.4%	0.8%	**4.2%**[11]

For inpatient hospital claims, medically unnecessary services errors are often related to hospital stays of short duration where services could have been rendered at a lower level of care. A smaller, but persistent amount of medically unnecessary payment errors are for inpatient hospital stays of three to five days, many of which resulted in a transfer to a skilled nursing facility (SNF). Some of these patients may have been admitted solely to satisfy the requirement for a minimum of three days as an inpatient in order to qualify for a SNF stay.

A portion of medical necessity errors for inpatient claims is related to denying an invasive procedure that affected the DRG payment. If an invasive procedure did not

[10] Some columns and/or rows may not sum correctly due to rounding.
[11] Some columns and/or rows may not sum correctly due to rounding.

meet the requirements of an LCD or NCD and the invasive procedure affected the DRG payment, the invasive procedure was denied. In these cases, the DRG was reclassified after removing the medical unnecessary invasive procedure and the improper payment is attributed to medically unnecessary services.

The following is an example of a medically unnecessary services error.

- A DME MAC paid $140.46 for the monthly rental of a semi-electric hospital bed. Per the DME MAC's LCD, semi-electric hospital beds are covered by Medicare if the patient's medical condition requires one or more of the following: positioning of the body in ways not feasible with an ordinary bed; elevation of the head more than 30 degrees most of the time; traction equipment; or frequent changes in body position. The reviewer requested additional documentation from the supplier and ordering physician. The medical records received from the ordering physician failed to support the need for the hospital bed per the DMAC's LCD and Medicare requirements. The entire amount was recouped.

(4) Incorrect Coding Errors

Claims are placed into this category when providers submit medical documentation that supports a different code than the code billed, the number of units submitted was incorrect, the service was done by someone other than the billing provider, the billed service was unbundled, or a beneficiary was discharged to a site other than the one coded on a claim).

Incorrect coding errors accounted for 1.6 percent of the total dollars allowed during the reporting period.

Part A (excluding Acute Inpatient Hospital)	Part A (Acute Inpatient Hospital)	Part B	DME	Overall
0.1%	0.6%	0.8%	0.0%	**1.6%**[12]

The following is an example of an incorrect coding error.

- An FI paid a provider $136.48 for the drug Remicade; HCPCS code J1745, 10 mg per unit. The beneficiary received 500 mg or 50 units, but the hospital billed only 10 units. After CERT review, the underpayment of $343.56 was paid to the hospital.

[12] Some columns and/or rows may not sum correctly due to rounding.

(5) Other Errors

This category includes claims that do not fit into any of the other categories (e.g., duplicate payment error, non covered or unallowable service).

Other errors accounted for 0.1 percent of the total dollars allowed during the reporting period. This data breaks down as follows.

Part A (excluding Acute Inpatient Hospital)	Part A (Acute Inpatient Hospital)	Part B	DME	Overall
0.0%	0.0%	0.0%	0.0%	**0.1%**[13]

The following is an example of an 'other' error.

- A Carrier paid $152.95 for anesthesia used during the routine extraction of dental caries. Since services associated with a non-covered service (dental extraction) are not allowed, the entire amount was recouped.

Types of Errors by Clinical Setting

Examining the types of medical review errors and their impact on improper payments is a crucial step toward reducing improper payments in Medicare FFS. Table 7 shows that projected improper payments are driven by insufficient documentation errors, medically unnecessary errors, and to a lesser extent, incorrect coding errors. When the errors are analyzed by clinical setting, the data show that the most improper payments due to medically unnecessary errors are for inpatient hospitals and DME. Substantial improper payments are attributable to physicians and inpatient hospitals due to insufficient documentation and incorrect coding errors.

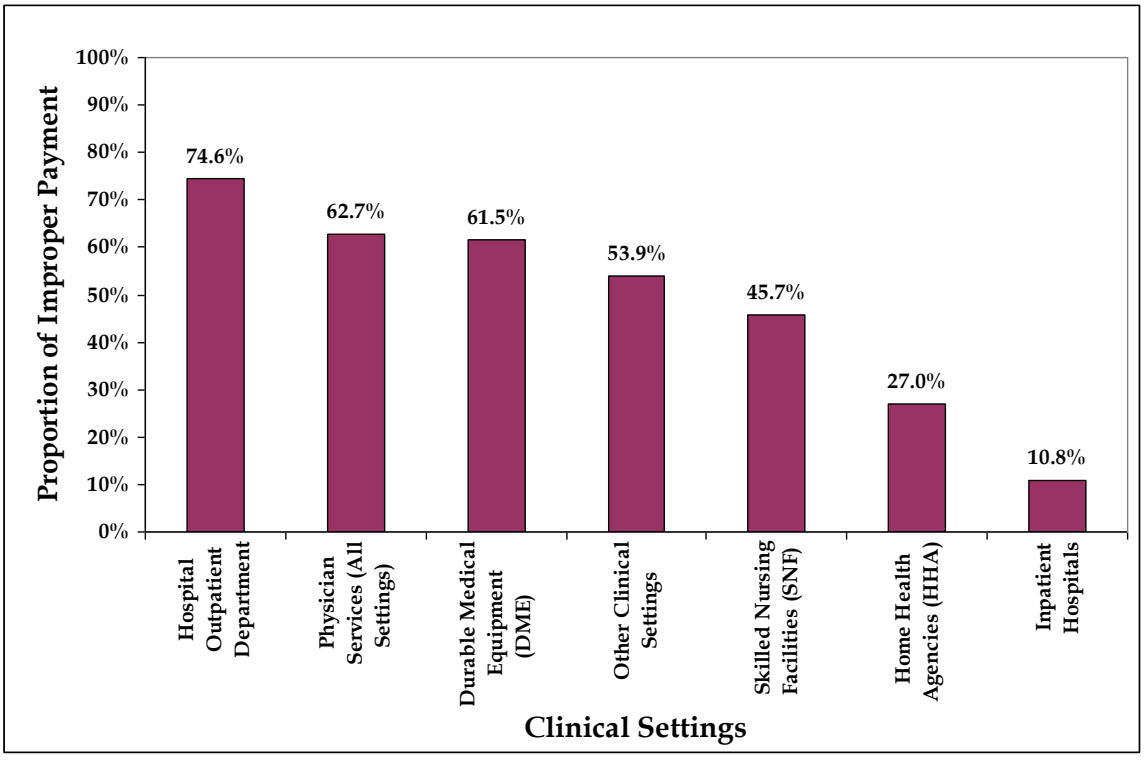
[13] Some columns and/or rows may not sum correctly due to rounding.

Table 7: Projected Improper Payments (in Billions of Dollars) by Type of Error and Clinical Setting[14]

Type of Error	Durable Medical Equipment (DME)	Home Health Agencies (HHA)	Hospital Outpatient Department	Acute Inpatient Hospitals	Physician Services (All Settings)	Skilled Nursing Facilities (SNF)	Other Clinical Settings	Overall
No Documentation	$0.07	$0.03	$0.03	$0.02	$0.14	$0.00	$0.02	$0.32
Insufficient Documentation	$4.46	$0.27	$1.97	$1.24	$6.22	$0.42	$0.55	$15.12
Medically Unnecessary	$2.69	$0.60	$0.53	$8.14	$1.08	$0.19	$0.37	$13.58
Incorrect Coding	$0.01	$0.06	$0.10	$2.08	$2.43	$0.30	$0.08	$5.07
Other	$0.03	$0.03	$0.01	$0.03	$0.05	$0.01	$0.00	$0.17
All Types of Errors	$7.25	$1.00	$2.64	$11.52	$9.92	$0.92	$1.02	$34.27

Figure 2 provides an analysis of the clinical settings where most insufficient documentation errors are occurring.

Figure 2: Share of Error Due to Insufficient Documentation by Clinical Setting



[14] Some columns and/or rows may not sum correctly due to rounding.

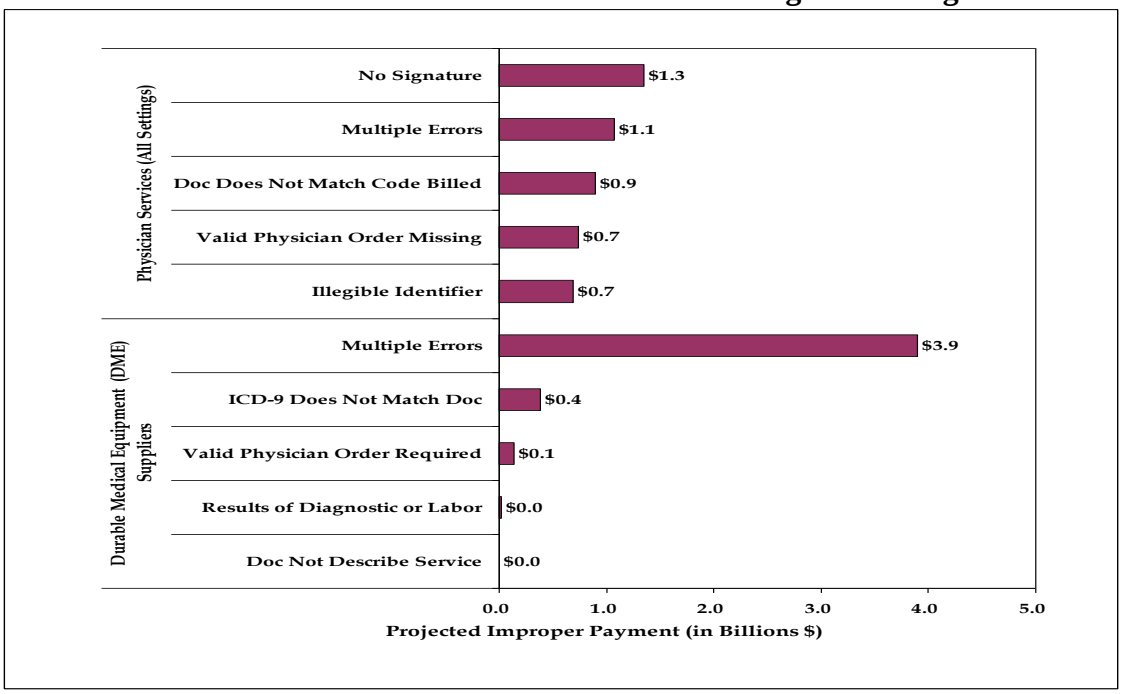
In several cases of insufficient documentation, it was clear that Medicare beneficiaries received services, but the physician's orders or documentation supporting the beneficiary's medical condition was incomplete. While CMS could not conclude that the services were not provided, these claims were counted as overpayments. In some instances, components of the medical documentation were maintained at a third party facility. For instance, although a lab may have billed for a blood test, the physician who ordered the lab test maintained the medical record. If the billing provider did not submit records maintained by a third party, the CERT contractor contacted the third party to request the missing documentation. If the third party failed to submit the documentation to the CERT contractor, CMS scored the inadequately documented items or services as insufficient documentation errors. If the medical documentation submitted for all items or services on a claim was inconclusive to support the billed item or service, the entire payment amount was considered improper. If the submitted medical documentation supported some, but not all, of the billed items or services, only those that were insufficiently documented were considered errors.

Figure 3 displays projected improper payments due to insufficient documentation for physicians and DME by the specific reason for the error. These two clinical settings account for 71 percent of the improper payments due to insufficient documentation. Within each clinical setting the specific reasons are in descending order of improper payments.

Physicians have a multitude of specific reasons that contribute heavily to insufficient documentation errors. These include documentation not describing service, valid physician order required, and no signature when required.

For DME, insufficient documentation errors are mainly categorized as "Multiple Errors" because the majority of the cases involved more than one reason for errors.

Figure 3: Projected Improper Payments (in Billions of Dollars) for Top 5 Reasons for Insufficient Documentation Error for 2 Clinical Settings with Largest Errors



The following are the subcategory descriptions for the physician service and DME insufficient documentation errors in Figure 3.

Physician Services

Insufficient Documentation/Subcategory - No signature

- Medicare requires that services provided / ordered be authenticated by the author, either hand written or electronically signed.

Insufficient Documentation/Subcategory – Documentation does not match code billed

- The submitted information documents a service which is different from the service described by the billed procedure code.

Insufficient Documentation/Subcategory - A valid physician order as required by regulation, interpretive manual or LCD missing (includes physician signature or date)

- For most items and services, a signed and dated physician order is required for payment.

Insufficient Documentation/Subcategory - Illegible identifier

- Medicare requires that services provided / ordered be authenticated by the author, either hand written or electronically signed. When written, the signature must be legible or otherwise identifiable (e.g., signed over the physician's printed name or via signature log). If the signature is illegible or missing, CMS gives the provider an opportunity to attest to their signature. If the attestation is not returned, it is considered an insufficient documentation-illegible identifier error.

Durable Medical Equipment

Insufficient Documentation/Subcategory – Multiple Errors

- Represents claims that have more than one reason for error.

Insufficient Documentation/Subcategory - Though a valid International Classification of Diseases Clinical Modification Volume 9 (**ICD-9) code was submitted, the ICD-9 code alone was insufficient information**

- A valid ICD-9-CM code (per the relevant LCD) was submitted, but there was no documentation to otherwise support the medical necessity of the service.

Insufficient Documentation/Subcategory - A valid physician order as required by regulation, interpretive manual or LCD missing

- For DME items, the supplier must have a detailed written order from the treating physician prior to submitting a claim. For certain items (e.g., power wheelchairs) the detailed written order is required prior to delivery.

Insufficient Documentation/Subcategory – Results of Diagnostic or Lab Tests Missing

- The medical necessity for an item is based on the result of a diagnostic test (e.g., an arterial blood gas for home oxygen therapy), but the result is not included in the documentation.

Insufficient Documentation/Subcategory – Documentation Does Not Describe Service

- The submitted information documents a service which is different from the service described by the billed procedure code.

Geographic Trends

Improper payments vary greatly by geographic location. Identifying the most problematic areas and the differentiating characteristics of those geographic locations can be useful for targeting improper payment reduction efforts.

Figure 4 displays the error rates by state and Figure 5 displays the projected improper payments by state. The states with very high error rates and extremely large expenditures are New York, California, Texas, and Florida. These four states constitute X percent of overall Medicare FFS payments, but 40 percent of total improper payments. New York has the highest error rate of 14.2 percent with $3.7 billion in improper payments. California has an 11.4 percent error rate and $3.4 billion in improper payments. If the improper payment rates for New York, California, Texas, and Florida were reduced halfway between their current error rate and a target error rate of 5 percent, national improper payments would be reduced by $8.2 billion, or 24 percent of total improper payments. Lowering improper payments in these states is critical to lowering the national error rate.

Figure 4: Improper Payment Error Rates by State

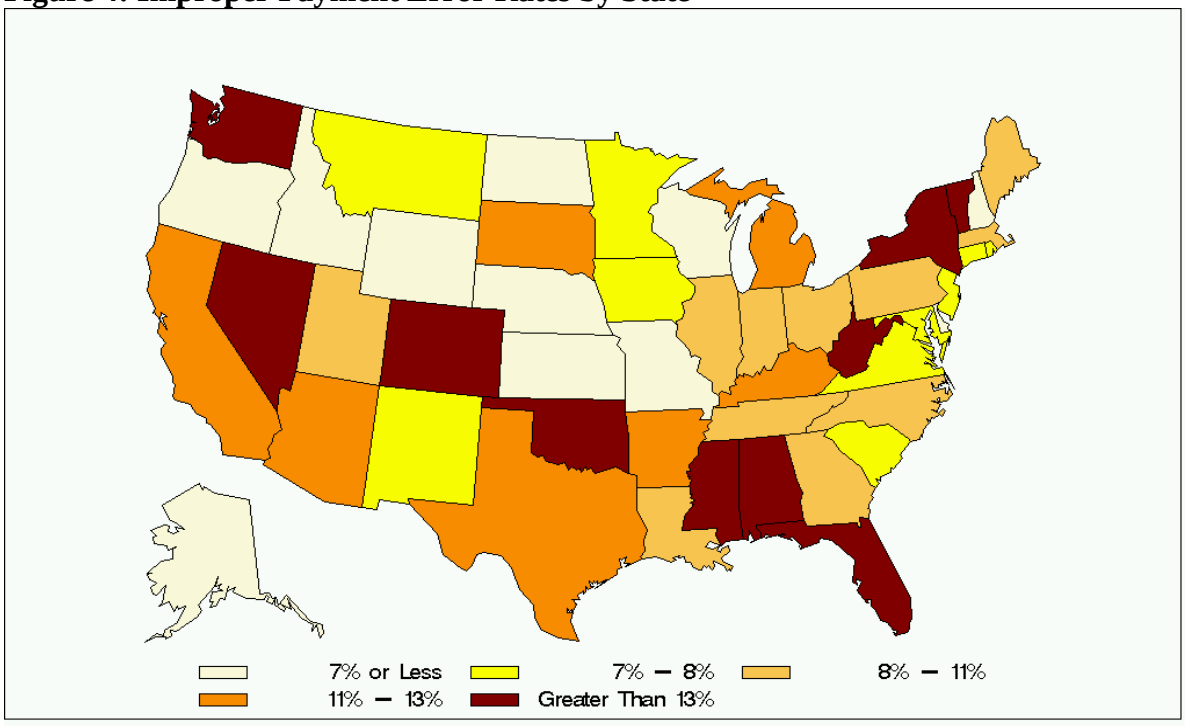


Figure 5: Improper Payments (in Millions of Dollars) by State

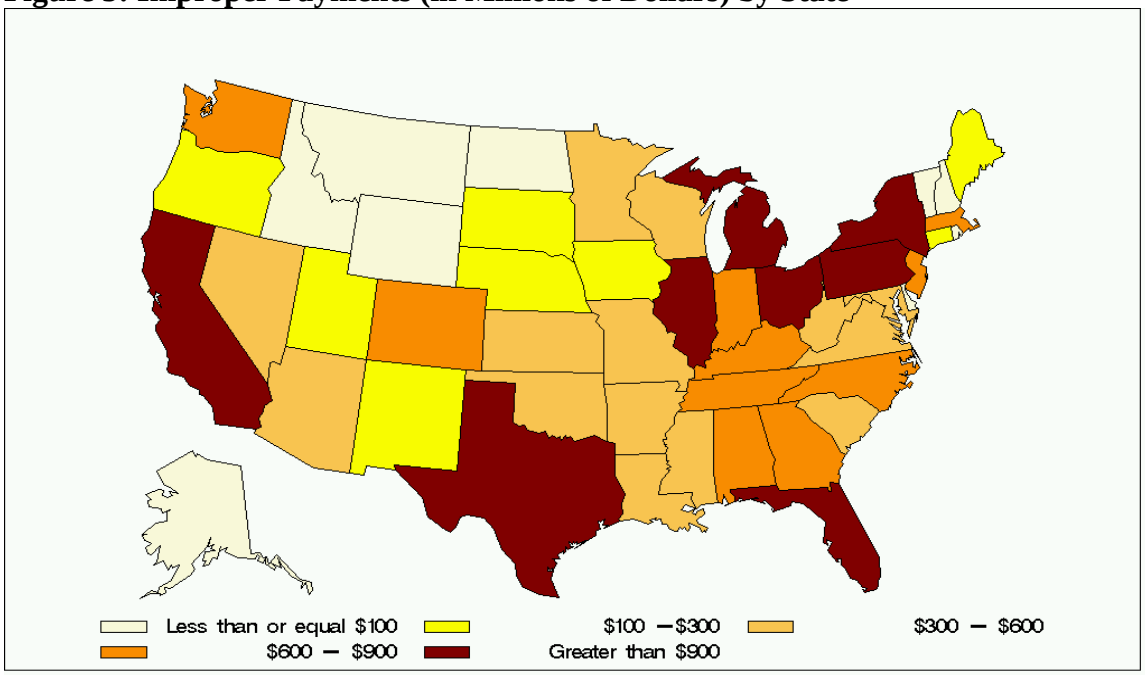


Table 8 displays the improper payments and error rates of the top 10 states for projected improper payments, as well as the breakdown by overpayments and underpayments. New York, California, Texas and Florida have very high overpayment error rates and extremely high overpayments.

Table 8: Projected Improper Payments, Overpayment and Underpayments by State (in Millions of Dollars)[15]

State	Overall		Overpayment		Underpayment	
	Improper Payment	Rate	Improper Payment	Rate	Improper Payment	Rate
Overall	**$34,268.7**	**10.5%**	**$33,208.3**	**10.2%**	**$1,060.4**	**0.3%**
NY	$3,668.7	14.2%	$3,643.5	14.1%	$25.2	0.1%
CA	$3,443.1	11.4%	$3,373.1	11.2%	$70.0	0.2%
FL	$3,350.8	13.4%	$3,247.1	13.0%	$103.7	0.4%
TX	$3,175.5	11.8%	$2,942.0	11.0%	$233.4	0.9%
MI	$1,320.5	12.7%	$1,296.3	12.5%	$24.2	0.2%
IL	$1,266.1	9.0%	$1,248.2	8.8%	$18.0	0.1%
PA	$1,245.6	8.8%	$1,222.6	8.6%	$23.0	0.2%
OH	$1,078.9	8.9%	$1,070.5	8.8%	$8.4	0.1%
NJ	$897.9	7.6%	$815.9	6.9%	$82.0	0.7%
NC	$873.5	9.0%	$851.7	8.8%	$21.8	0.2%

[15] Some columns and/or rows may not sum correctly due to rounding.

CMS Contact

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