Analysis of the Accuracy of the CMS-Hierarchical Condition Category Model

January 2016

Avalere Health | An Inovalon Company
1350 Connecticut Ave, NW Suite 900
Washington, DC 20036
202.207.1300 | Fax 202.467.4455
avalere.com

Avalere®

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Since 2000, the Centers for Medicare & Medicaid Services (CMS) has adjusted Medicare Advantage (MA) capitated payments for demographic characteristics and health status (also known as "risk adjustment"). In 2004 CMS adopted the Hierarchical Condition Category (HCC) risk adjustment model, which includes a series of patient diagnoses that impact healthcare spending. The 2004 CMS-HCC model included a subset of all chronic conditions, 70 in total (hereafter referred to as the "original model"). In 2014, CMS introduced a new version of the model that removed certain conditions, added others, and made additional modifications (hereafter referred to as the "2014 model").

In this project, Avalere assessed the accuracy of the 2014 model for beneficiaries in the traditional Medicare program with certain common chronic conditions by using Medicare fee-for-service (FFS) claims data to compare predicted healthcare costs with actual healthcare costs. These beneficiaries include individuals with multiple chronic conditions; specific chronic conditions (e.g., rheumatoid arthritis, depression); and chronic conditions removed from the model in 2014 (e.g., lower levels of chronic kidney disease [CKD]). In addition, Avalere examined the highest spending individuals within each chronic condition.

In summary, we estimate that the 2014 model under-predicts costs for individuals with multiple chronic conditions by $2.6 billion on an annual basis (see **Table 1**). As a result, because the model is "zero sum"—that is, the values for each condition are relative to the average cost across all individuals—under-prediction for individuals with multiple chronic conditions is balanced by over-prediction of costs for individuals with no chronic conditions. In addition, the model under-predicts costs for beneficiaries with specific chronic conditions, such as rheumatoid arthritis (included in the 2014 model), as well as dementia and lower levels of CKD (excluded from the 2014 model), and substantially under-predicts costs for high utilizers within each chronic condition category.

On October 28, 2015, CMS announced proposed changes to the MA risk adjustment model that the agency believes will improve its predictive power for low-income beneficiaries. Specifically, CMS intends to further refine the model by accounting for both dual eligible/low-income subsidy (LIS) eligible and disabled status. While this announcement could be a positive step in improving the model's accuracy, the proposed changes will not necessarily address concerns about how the model performs among dual/LIS-eligibles with multiple chronic conditions, or the dual/LIS-eligibles with the greatest disease burden in each chronic condition category. However, CMS did not release detailed information (i.e., the model coefficients) that would allow us to analyze the predictive accuracy of these new models for individuals with specific or multiple chronic conditions. Until CMS releases additional data or information on the actual coefficients for the HCCs, this analysis continues to inform stakeholders of the predictive accuracy of the 2014 model for high cost individuals with specific chronic conditions.

Limitations

Our analysis focused only on how well the 2014 model predicts costs. We did not assess how well the original model fares, nor did we assess the CMS-HCC model that CMS uses to adjust payments for the Program of All-inclusive Care for the Elderly (PACE) plans. Furthermore, we intentionally used a different disease classification system from the HCC model groupings in order to independently assess how well the model predicts costs for specific chronic diseases. In some cases, the disease itself—for example, lower levels of CKD—was not included in the CMS-HCC 2014 model.

Results

Analysis for Multiple and Single Chronic Conditions

Our analysis found that total under-predicted expenditures to MA plans for all members with multiple chronic conditions are about $2.6 billion (3.3 percent of total expenditures for all members) per year.[1] Under-predicted expenditures for dual/LIS-eligible individuals with multiple chronic conditions account for about $400 million (1.6 percent of total expenditures for these dual/LIS-eligible individuals) of this total. Note our results combine findings for full dual eligibles—for whom CMS recently stated the model under-predicts costs—and for partial dual eligibles, for whom the model significantly over-predicts costs according to the agency.[2] Further, we find that because the model (due to its construction) calculates costs for a given condition relative to the average cost for all individuals, it over-predicts the disease burden for individuals without chronic conditions relative to individuals with chronic conditions. Among chronic conditions, rheumatoid arthritis (RA) and osteoarthritis have the largest percentage difference between predicted and actual expenditures (15 percent, or $2.3 billion, for RA and 12 percent, or $4.4 billion, for osteoarthritis).

Table 1 summarizes the prediction error (the difference between predicted and actual expenditures) for all individuals with multiple chronic conditions (overall and for dual/LIS-eligibles), and **Table 2** summarizes the prediction error for all beneficiaries with CKD stages 1 through 3 (conditions removed in the 2014 model), osteoarthritis, and RA (conditions found to have the largest percentage of under-predictions of expenditures). Specifically, these tables present the percent over- or under-prediction in the 2014 model for these conditions, as well as the estimated total under-predicted expenditures to MA plans for members in these eligibility and condition groups. These results suggest that MA plans will be underpaid for beneficiaries with multiple chronic conditions, and in particular for beneficiaries with certain chronic conditions, relative to the cost of services these populations are currently utilizing.

1 As chronic conditions were identified using the Chronic Condition Warehouse (CCW) and Medication Therapy Management (MTM) definitions, the categorization of beneficiaries into multiple vs. single chronic conditions could differ from the HCC definition.

2 The 5% LDSSAF Medicare claims data used to conduct this analysis does not contain a variable that distinguishes between full and partial dual eligibles, and therefore we were unable to validate CMS's statement.

Table 1. Predictive Accuracy for Beneficiaries with Multiple Chronic Conditions

Beneficiary Group	Percent Over (+) / Under (-) Prediction per Member	Total Estimated MA Over/Under-Prediction of Expenditures ($ millions)
Multiple Chronic Conditions (All)	**-3.3%**	**$ (2,613.7)**
Multiple Chronic Conditions (Dual/LIS-eligibles)	**-1.6%**	**$ (401.8)**

Notes: Boldface indicates differences statistically significantly different from zero. Under-predictions of expenditures are shown as negative numbers, in parentheses.

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

Table 2. Predictive Accuracy for Beneficiaries with Specific Chronic Conditions

Beneficiary Group	Percent Over (+) / Under (-) Prediction per Member	Total Estimated MA Over/Under-Prediction of Expenditures ($ millions)
Chronic Kidney Disease Stages 1-3	**-4.0%**	**$ (396.1)**
Osteoarthritis	**-11.8%**	**$ (4,370.0)**
Rheumatoid Arthritis	**-15.3%**	**$ (2,323.9)**

Notes: Boldface indicates differences statistically significantly different from zero. Under-predictions of expenditures are shown as negative numbers, in parentheses.

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

Analysis for Single Chronic Conditions Removed from the 2014 Model

For CKD stages 1 through 3, which were removed from the CMS-HCC model in 2014, total under-predicted expenditures are about $400 million in the 2014 model or 4 percent of total expenditures for these members (see **Figure 3**).[3] Furthermore, expenditures appear to be substantially under-predicted for Alzheimer's disease and related disorders, including senile dementia, by nearly $1.1 billion. Dementia is not included in the 2014 CMS-HCC model but is included in the PACE model (see **Figure 1**).

3 The prediction error for expenditures for CKD stages 4 and 5, which remain in the model, is much smaller (on a percentage basis) than for stages 1 through 3, suggesting that the prediction error (difference between predicted and actual expenditures) for stages 1 through 3 would be reduced were they returned to the model.

Analysis for High Cost Individuals within Each Specific Chronic Condition[4]

We also identified high cost individuals within each disease group (those with costs in the top 10 percent among individuals with the particular condition), and assessed how well the model predicts costs for these beneficiaries. We find that the 2014 model substantially under-predicts costs for the highest cost beneficiaries. Because health costs are highly skewed—for example, among individuals with CKD (stages 1 through 5), average costs are $15,204, but are $80,923 for the top 10 percent—this inaccuracy on the top end of the cost range may lead to a misalignment of payments and costs for these members (see **Table 5**). In fact, the under-predicted expenditures for the high cost individuals are substantial. We estimate the model under-predicts expenditures for these high cost individuals with CKD stages 1 through 5 by almost $4 billion. We find similar patterns among high cost individuals with other chronic conditions. For example, we find that the model under-predicts expenditures for high cost individuals with chronic non-cancer pain ($14.3 billion), osteoarthritis ($13.4 billion), and RA ($5.3 billion) (see **Table 4**).

Implications

The purpose of risk adjustment is to anticipate systematic differences in costs for groups of individuals so that plans are reasonably compensated for the financial risks they bear. If plans are not accurately compensated for taking on the risk associated with a particular group, it creates a misalignment between payments and costs for higher cost beneficiaries, and under-compensates plans that enroll many chronically ill members. For any particular individual, the model may over- or under-predict actual costs, in some cases by a wide margin; every dollar of under-predicted cost is balanced by a dollar of over-predicted cost. However, when under-predicted cost can be identified systematically (e.g., for individuals with CKD or RA), Medicare beneficiaries with these conditions may lose access to coverage options that other beneficiaries may enjoy.

A description of the methodology used in this paper can be found in the Appendix.

4 Note: Individuals within each specific chronic condition are not mutually exclusive and may have multiple chronic conditions.

BACKGROUND

The development of the current CMS-HCC model began in 1984 with the Diagnostic Cost Group (DCG) models by researchers at Boston University and Brandeis University in work sponsored by the Health Care Financing Administration (HCFA).[5] In the 1990s, HCFA research identified that plans were not paid appropriately because the demographic payment adjustment HCFA used, based on age, gender, Medicaid, and institutional and working aged status, did not account properly for healthcare costs. As a result, the Balanced Budget Act of 1997 required the U.S. Department of Health and Human Services (HHS) to risk adjust payments to Medicare managed care plans beginning in 2000.

HCFA evaluated various risk adjustment models, settling on using DCG models to risk adjust payments. From 2000 to 2003, CMS used the Principal Inpatient Diagnostic Cost Group (PIP-DCG) model. This model predicted healthcare costs using only the principal diagnosis from an inpatient stay. Since 2004, the CMS-HCC model has been used to risk adjust payments to MA plans. In contrast to the PIP-DCG model, the CMS-HCC model uses diagnoses from inpatient, outpatient, and physician encounters. This risk adjustment model is deemed "prospective" in that the diagnoses used to identify the predictors (the HCCs) are from the year prior to the payment year, not from the payment year.

CMS uses two statistics to determine how well the model performs. The first is the R^2 statistic, which measures the amount of variation in healthcare costs predicted by the model. The R^2 statistic is about 12 percent, which means that the model only predicts 12 percent of the variation in healthcare costs.

The second statistic CMS uses is the "predictive ratio," or the ratio of average predicted costs to average actual costs. CMS calculates the average predicted and actual costs for specific subgroups. A ratio of 1.0 means that the average predicted costs equal the average actual costs; a higher ratio (above 1.0) means the model has over-predicted costs; and a lower ratio (below 1.0) means the model has under-predicted costs. CMS analyzes predictive ratios for individuals with multiple chronic conditions by disease types and by levels of predicted spending. Importantly, the use of a single ratio, stratified by levels of predicted expenditures, hides the variation of prediction errors (differences between predicted and actual expenditures) within these strata.

In previous years, CMS has also reported predictive ratios based on healthcare utilization in the prior year as well as the current year. However, recently, only overall R^2 statistics and predictive ratios for various groups of beneficiaries have been reported.

5 CMS was called the Health Care Financing Administration until 2002.

DETAILED FINDINGS

As outlined in the Executive Summary, Avalere conducted this study to evaluate the accuracy of the new CMS-HCC model in predicting costs for individuals with:

1. Multiple and single chronic conditions;
2. Single chronic conditions removed from the model; and
3. Individuals with high costs within each disease group.

Analysis for Multiple Chronic Conditions

We reviewed how well the model predicts expenditures for individuals with multiple chronic conditions in order to determine how well payments to MA plans would be risk adjusted for the clinical severity of their patient populations under the 2014 model. As shown in **Table 3**, we find that the model under-predicts costs by approximately $2.6 billion for individuals with three or more chronic conditions. We also find that the model over-predicts disease burden for individuals without chronic conditions.

We also evaluated how well the model performs for the dual/LIS-eligible population with multiple chronic conditions. Studies have shown that the dual/LIS-eligible population tends to have higher costs than non-duals. As a result, how well the model predicts costs for these individuals is critical in ensuring that plans' financial risks are adequately determined. Recognizing this concern, CMS includes an adjustment for Medicaid status in the CMS-HCC model. We find that for dual/LIS-eligibles with three or more chronic conditions, the model under-predicts costs by approximately $400 million, even with this Medicaid adjustment. This under-prediction reflects the combined impacts of full dual eligibles and partial dual eligibles.[6]

6 The 5% LDS SAF Medicare claims data used to conduct this analysis does not contain a variable that distinguishes between full and partial dual eligibles.

Table 3. Predictive Accuracy for Members with Chronic Conditions; All Members and Dual/LIS-Eligibles

	Percent of Population	Actual Annualized Payment per Member	Percent Over (+) / Under (-) Prediction per Member	Total Estimated MA Over/Under-Predictions ($ millions)
All Members				
Multiple (3+) Chronic Conditions	57.4%	$11.044	**-3.3%**	**$ (2,613.7)**
Few (1-2) Chronic Conditions	26.5%	$5,462	**5.1%**	**$ 936.2**
No Chronic Conditions	16.2%	$3,028	**26.9%**	**$ 1,677.50**
Dual/LIS-Eligibles				
Multiple (3+) Chronic Conditions	56.7%	$13,973	**-1.6%**	**$ (401.8)**
Few (1-2) Chronic Conditions	25.5%	$6,519	**11.4%**	**$ 599.8**
No Chronic Conditions	17.8%	$3,514	**29.3%**	**$ 582.9**

Notes: Boldface indicates differences statistically significantly different from zero. The chronic conditions reported use the Chronic Condition Warehouse (CCW) definition; results are similar using the Medication Therapy Management (MTM) definition. Please see the Appendix for additional clarification about these definitions. Under-predictions shown as negative numbers, in parentheses.

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

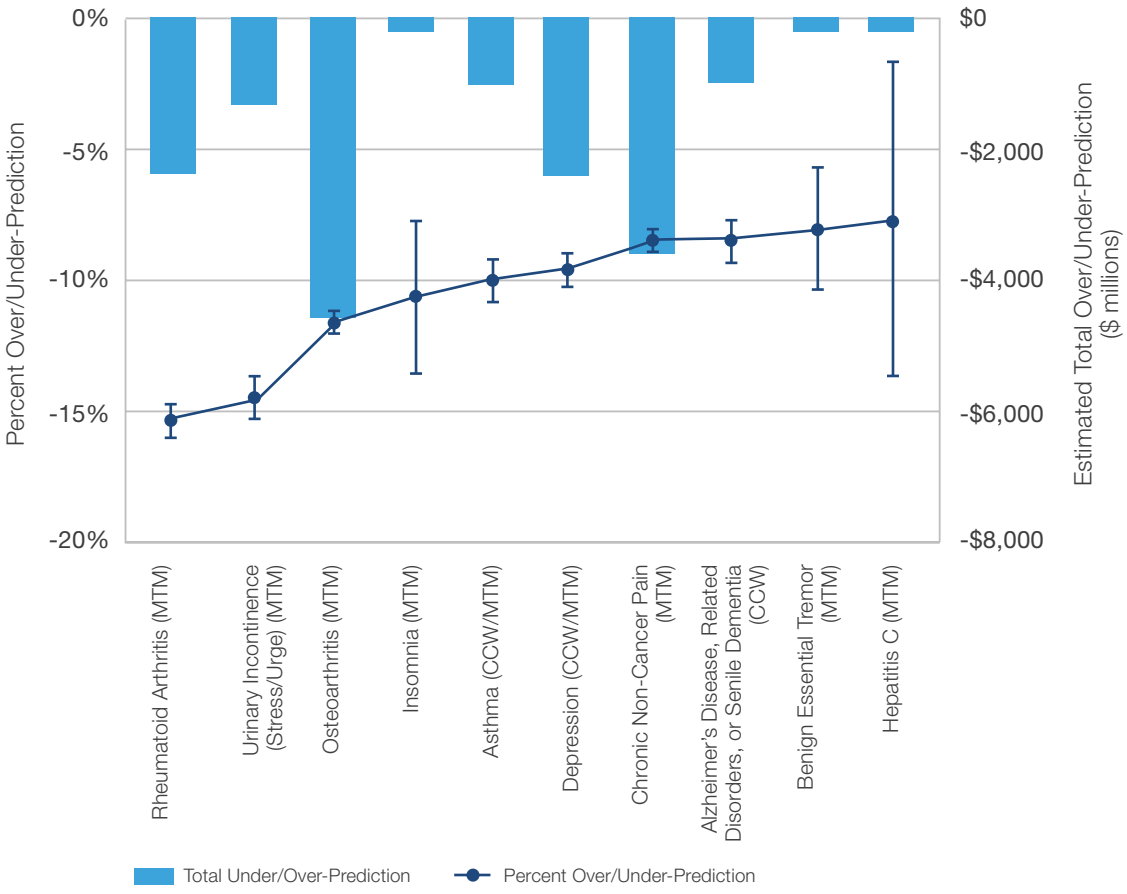
Analysis for Individuals with Single Chronic Conditions

We also examined how well the model predicts costs for individuals with each of 55 chronic conditions (the Appendix displays a full list of conditions).[7] We find that a majority of these particular 55 individual conditions exhibited under-prediction of expenditures. However, for some conditions, there was a statistically significant over-prediction (including transplants by 15 percent, and acute myocardial infarction by 11 percent).

Figure 1 displays predictive accuracy percentages for the 10 conditions with the largest percentage of under-predictions (the percentages by which predictions are over or under actual expenditures), with 95 percent confidence intervals, and estimated total underpayments to plans for the 10 conditions with the largest percentage of under-predictions of expenditures. None of the confidence intervals for these predicted versus actual ratios include zero; therefore, all of these percent under-predictions are statistically significant.

7 Any individual beneficiary can have more than one chronic condition. However, for this particular analysis, we considered each chronic condition individually, so the population with each condition consists of those with only that condition plus others with that condition and also other chronic conditions.

Figure 1. Predictive Accuracy for 10 Conditions with Largest Percentage Under-Predictions; All Medicare Beneficiaries



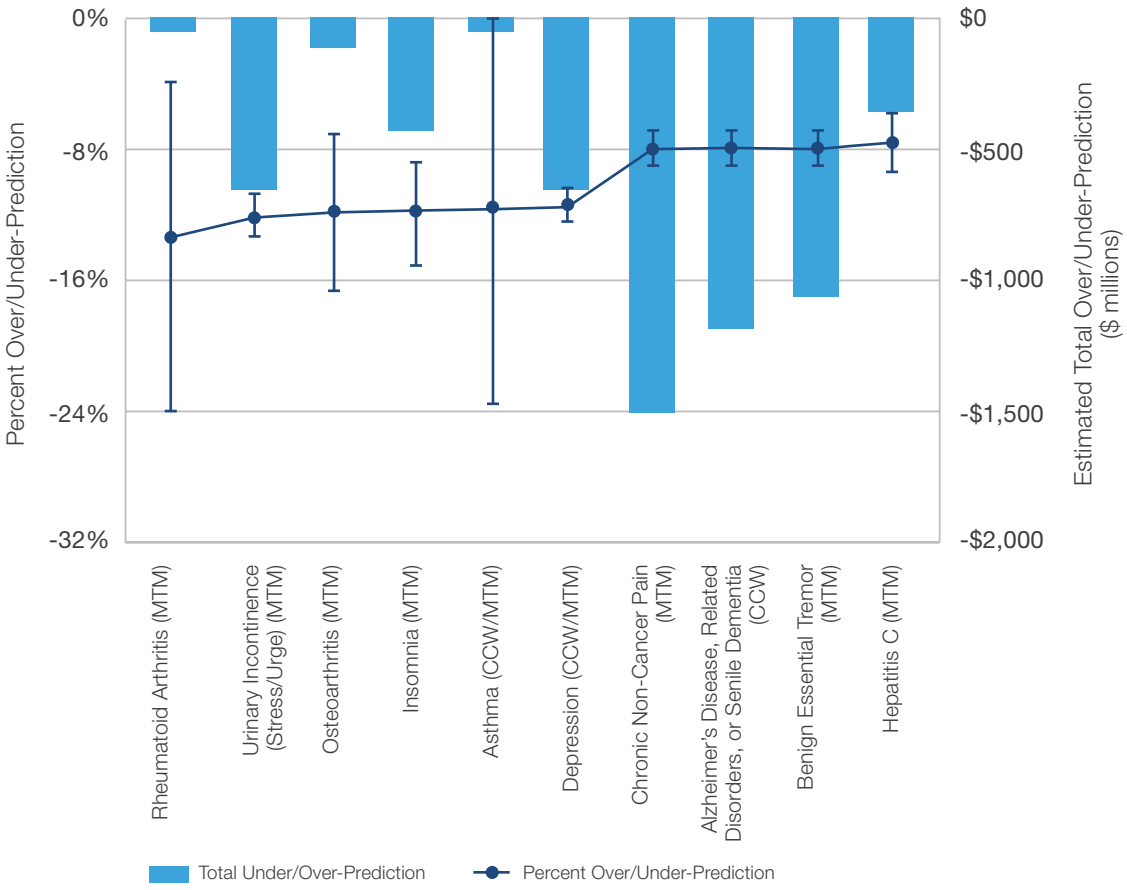
Notes: Vertical lines represent 95% confidence intervals for the predictive accuracy percentages estimates. (CCW: Chronic Condition Warehouse; MTM: Medication Therapy Management)

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

Despite being included in a HCC, patients with RA or osteoarthritis have large percentage under-predictions of expenditures (RA by 15 percent, and osteoarthritis by 12 percent). Other conditions with notable percentage under-predictions are urinary incontinence (by 14 percent), depression (by 9 percent), and chronic pain (by 8 percent).

Among dual/LIS-eligibles, the 10 conditions with the largest percentage under-predictions are similar to those for the overall results, with some notable differences (see **Figure 2**). RA, urinary incontinence, and osteoarthritis are also conditions having individuals with large total under-predictions. But the conditions among dual/LIS-eligibles representing individuals with the largest percentage under-predictions are CKD stage 5, asthma, and insomnia.

Figure 2. Predictive Accuracy for 10 Conditions with Largest Percentage Under-Predictions; Dual/LIS-Eligibles



Notes: Vertical lines represent 95% confidence intervals for the predictive accuracy percentage estimates. (CCW: Chronic Condition Warehouse; MTM: Medication Therapy Management)

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

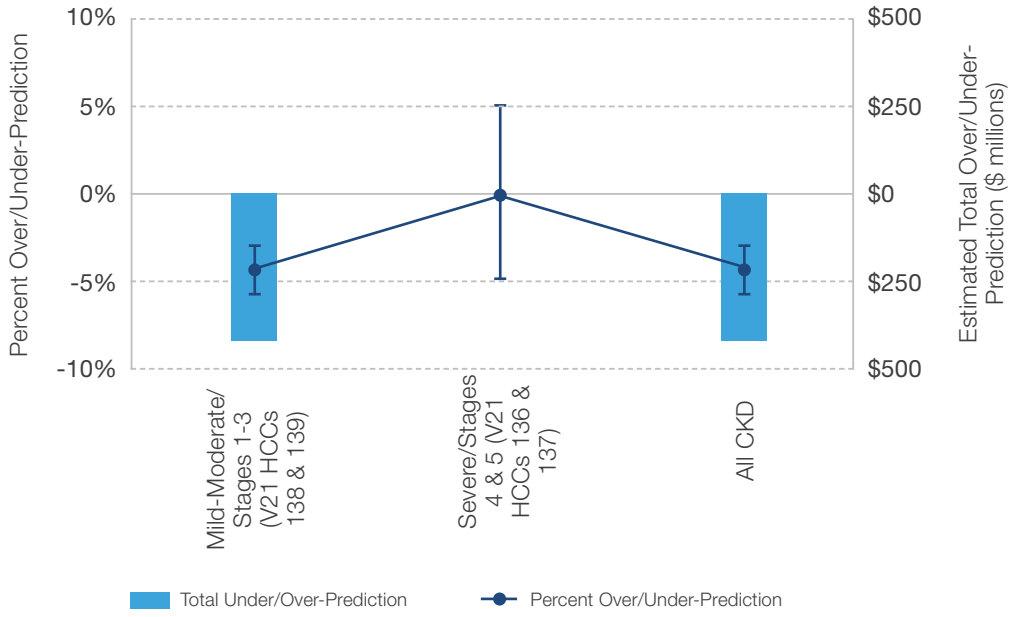
Analysis for Single Chronic Conditions Removed from the Model in 2014

The new model introduced in 2014 removed CKD levels 1, 2, and 3 from receiving additional payment; however, the PACE model includes these codes. In other words, although many CKD stage 1 through 3 MA plan members remain outside of PACE programs, only the PACE model includes an adjustment for CKD stages 1 through 3. **Figure 3** shows results for beneficiaries with CKD stages 1 through 3, which were removed from the 2014 model. We estimate that the model under-predicts total expenditures for beneficiaries with these conditions by 4 percent, or approximately $400 million per year.[7] The model over-predicts

8 The over/under-payment is calculated as the predicted annualized spending per beneficiary less the actual annualized spending per beneficiary, then multiplied by the total beneficiary years (beneficiary months divided by 12).

for CKD stage 4 and under-predicts for CKD stage 5, but the effects for each are negligible and not statistically significant, and the net effect on predictive accuracy to plans is small. An adjustment for CKD stages 4 and 5 remains in the 2014 model.

Figure 3. Predictive Accuracy for CKD; All Members

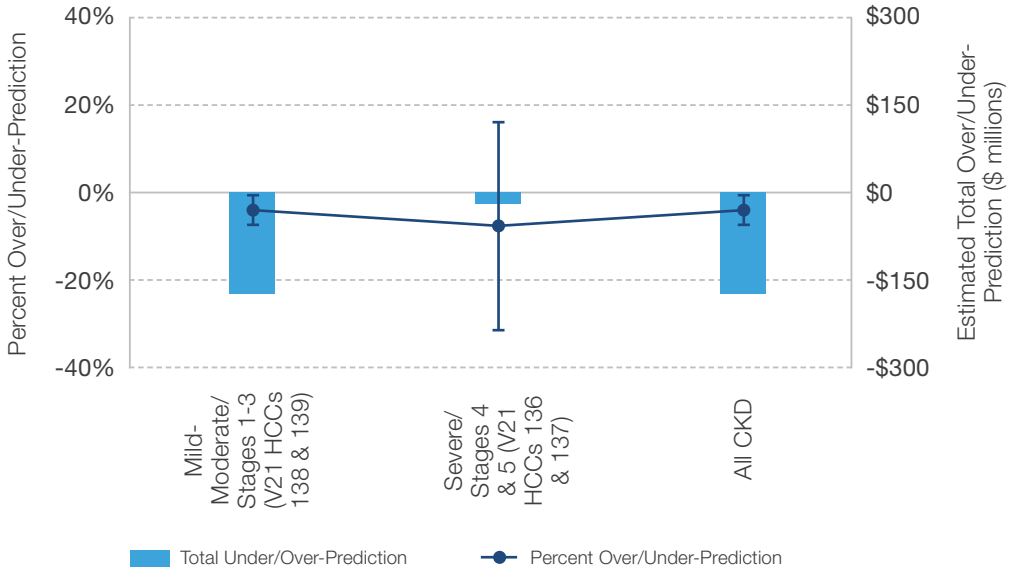


Notes: Vertical lines represent 95% confidence intervals for the predictive accuracy percentage estimates. CKD stages identified using HCC V21, as CKD stages 1-3 were not included in V22. (HCC: Hierarchical Condition Category)

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

For dual/LIS-eligibles with CKD, the under-predictions are proportionately larger (**Figure 4**). The model under-predicts by 5.3 percent for those with CKD stages 1 through 3. The model under-predicts costs for dual/LIS-eligible beneficiaries with CKD stages 4 or 5 by 8.2 percent (the under-prediction for CKD stage 5 is a statistically significant 14 percent). We estimate that the under-prediction for dual/LIS-eligibles with all stages of CKD will be close to $200 million per year.

Figure 4. Predictive Accuracy for CKD; Dual/LIS Eligibles



Notes: Vertical lines represent 95% confidence intervals for the predictive accuracy percentage estimates. CKD stages identified using HCC V21, as CKD stages 1-3 were not included in V22. (HCC: Hierarchical Condition Category)

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

Individuals with Specific Chronic Conditions with High Spending

We identified individuals who are high spenders within their respective condition category—defined as the top 10 percent highest spenders as measured by annualized expenditures—and assessed how well the model predicts costs for these individuals. Note that these estimates are for all people with these conditions, regardless of what other comorbid conditions they may (or may not) have. We find that the model substantially under-predicts costs for those individuals with the largest disease burden. **Table 4** presents the percent over/under-prediction and total estimated MA over/under-predicted payments for these individuals in the 10 conditions with the largest under-prediction of payment. We find that the model under-predicts expenditures for chronic non-cancer pain ($14.3 billion), osteoarthritis ($13.4 billion), depression ($8.9 billion), and RA ($5.3 billion).

Table 4. Predictive Accuracy of Model in Top 10 Percent (Highest Decile) of Actual Costs for 10 Conditions with Largest Percentage Under-Prediction; All Members

Condition	Actual Annualized Expenditures per Member	Percent Over (+) / Under (-) Prediction per Member	Total Estimated MA Over/Under-Prediction ($ millions)
Chronic Non-Cancer Pain	$71,938	**-69.6%**	**($14,275)**
Osteoarthritis	$64,517	**-71.6%**	**($13,374)**
Depression	$76,146	**-69.7%**	**($8,864)**
Rheumatoid Arthritis	$70,388	**-72.0%**	**($5,258)**
Alzheimer's Disease/Related & Senile Dementia	$85,815	**-73.4%**	**($3,768)**
Asthma	$80,531	**-68.6%**	**($3,089)**
Urinary Incontinence (Stress/Urge)	$77,815	**-71.3%**	**($2,690)**
Hepatitis C	$103,807	**-71.6%**	**($636)**
Benign Essential Tremor	$71,042	**-68.5%**	**($534)**
Insomnia	$67,231	**-68.6%**	**($439)**

Notes: Boldface indicates differences statistically significantly different from zero. Under-predictions of expenditures shown as negative numbers, in parentheses.

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

Table 5 shows that for the top 10 percent most costly individuals with CKD, the CMS-HCC model under-predicts costs by $4 billion. Expenditures for the top 10 percent of individuals with CKD are five times the average for all members with CKD. The percentage under-prediction for members with CKD stages 1 through 3, conditions no longer recognized in the 2014 CMS-HCC model, and whose expenditures are in the top 10 percent, are similar to those for stages 4 and 5.

Table 5. Predictive Accuracy of Model for Individuals with CKD in Top 10 Percent (Highest Decile) of Actual Costs; All Members

CKD Stage Group/V21 HCC	Actual Annualized Expenditures per Member	Percent Over (+) / Under (-) Prediction per Member	Total Estimated MA Over/Under-Prediction ($ millions)
Mild-Moderate/Stage 1-3 (V21 HCCs 138-139)	$80,358	**-68.5%**	**$ (3,847)**
Stage 4-5 (V21 HCCs 136-137)	$92,427	**-69.7%**	**$ (208)**
All CKD	$80,923	**-68.6%**	**$ (4,061)**

Notes: Boldface indicates differences statistically significantly different from zero. Under-predictions of expenditures shown as negative numbers, in parentheses. CKD stages identified using HCC V21, as these conditions were not included in V22. (CKD: Chronic Kidney Disease; HCC: Hierarchical Condition Category)

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

CONCLUSION

We reviewed the accuracy of the new CMS-HCC model at predicting costs for individuals with multiple chronic conditions, and paid particular attention to how well the model predicts costs for high cost individuals. We find that the CMS-HCC model substantially under-predicts costs for individuals with multiple chronic conditions, under-predicts costs for several specific chronic conditions, and does not accurately predict costs for high cost individuals within each chronic condition. Furthermore, the under-predictions for members with CKD stages 1 through 3 and dementia—which were excluded from the 2014 CMS-HCC model—are material.

These findings suggest the model may need improvements and modifications in order to appropriately pay for high cost members and individuals with multiple and certain single chronic conditions. In other words, the model may not be adequately compensating health plans for treating these individuals.

The latest release from CMS suggests that the agency is focused on making improvements to the model. On October 28, 2015, CMS proposed a modification to the 2014 model that would consider dual/LIS-eligible and disabled status to account for the impact of low-income and functional ability on healthcare costs. While this announcement could be a positive step in improving the model's accuracy overall, the proposed model changes will not necessarily address concerns about how the model performs among the dual/LIS-eligible population with multiple chronic conditions, or the dual/LIS-eligibles with the greatest disease burden in each chronic condition category. Without the new model coefficients, which CMS has not yet released, we cannot conduct a similar analysis of how well the proposed model predicts costs for individuals with specific and multiple chronic conditions.

America's Health Insurance Plans (AHIP) provided funding for this research.
Avalere maintained full editorial control.

APPENDIX: METHODS

To perform this analysis we used the 2012 and 2013 Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs), Medicare claims for a random 5 percent sample of Medicare fee-for-service (FFS) beneficiaries, and version 22 of the CMS-HCC model software. Conditions are identified using 2012 claims, and actual expenditures are computed from 2013 claims. We adopted the same approach to beneficiary selection and expenditure computation as CMS uses for model calibration. Furthermore, to calculate the applicable use of the institutional versus community segments of the CMS-HCC model (the institutional segment generally predicts somewhat lower program expenditures than would the community segment, given identical risk factors), we estimated the time period during 2013 when the person was a nursing home resident. Since there is no indicator in the available administrative data for when a beneficiary resided in an institutional setting, we imputed this using an algorithm described in a peer-reviewed article by Koroukian, et al. from 2008[9] that uses physician claims for nursing home evaluation and management (E&M) services.

We then constructed several subgroups of beneficiaries, mostly defined by having one or more chronic conditions. We selected chronic conditions from three sets of definitions: 1) CMS Chronic Conditions Warehouse (CCW), 2) the set of criteria for Part D Medication Therapy Management (MTM) programs, and 3) lower levels of chronic kidney disease (CKD) as defined by HCC version 21 (these HCCs were excluded from version 22). In addition, we stratified beneficiaries by dual eligible/low-income subsidy (LIS) status and also by specific stages of CKD. With the exception of CKD, we selected a set of conditions that aligned with HCCs, only by happenstance, in order to understand how well the model performs for groups with costs that the model did not intentionally attempt to identify.

For this analysis, we focus on the predictive ratio, the measure of predictive accuracy computed as the ratio of predicted versus actual expenditures. This measure indicates whether the model predicts total expenditures on average. This is also the measure that CMS principally focuses on for assessing predictive accuracy of subgroups of Medicare beneficiaries. For ease of interpretation, we converted these predictive ratios into estimated percentage over/under-payment. We also include confidence intervals in our model to test for statistical significance.

9 Koroukian SM, Xu F, Murray P. Ability of Medicare Claims Data to Identify Nursing Home Patients. Medical Care 2008 Nov; 46(11): 1184–7.

Table 6. Percentage of Beneficiaries with Corresponding Condition

Condition	Percent with Condition
All Beneficiaries	**100%**
Dual/LIS-Eligibles	**20.3%**
Multiple (3+) Chronic Conditions (CCW)	**57.4%**
Multiple (5+) Chronic Conditions (MTM)	**57.2%**
No Chronic Conditions (CCW)	**16.2%**
No Chronic Conditions (MTM)	**11.7%**
Alzheimer's Disease (CCW/MTM)	2.7%
Acquired Hypothyroidism (CCW)	20.6%
Acute Myocardial Infarction (CCW/MTM)	0.5%
Alzheimer's Disease, Related Disorders, or Senile Dementia (CCW)	6%
Anemia (CCW/MTM)	20.3%
Anticoagulation-Related Condition (MTM)	6.5%
Asthma (CCW/MTM)	4.9%
Atrial Fibrillation (CCW/MTM)	7.3%
Autoimmune Disorders (MTM)	12.5%
Benign Essential Tremor (MTM)	0.9%
Benign Prostatic Hyperplasia (CCW/MTM)	6.4%
Bipolar Disorder (MTM)	2.5%
Cancer (MTM)	11.8%
Cancer, Breast (CCW)	2.9%
Cancer, Colorectal (CCW)	1.1%
Cancer, Endometrial (CCW)	0.3%
Cancer, Lung (CCW)	0.7%
Cancer, Prostate (CCW)	3%
Cardiovascular Disorders (MTM)	72.6%
Cataract (CCW)	19.1%
Cerebrovascular Disease (MTM)	11.2%
Chronic Alcohol and Other Drug Dependence (MTM)	1.6%
Chronic Kidney Disease (CCW)	6.7%

Chronic Lung Disorders (MTM)	29.4%
Chronic Non-Cancer Pain (MTM)	24.8%
Chronic Obstructive Pulmonary Disease (CCW)	10.3%
Cirrhosis (MTM)	0.6%
Coronary Artery Disease (MTM)	19.9%
Depression (CCW/MTM)	14.8%
Diabetes (CCW/MTM)	23.4%
Dyslipidemia (MTM)	56.9%
End-Stage Liver Disease (MTM)	0.3%
GI/Reflux/Ulcer Conditions (MTM)	35.9%
Glaucoma (CCW)	10.3%
Heart Failure (CCW/MTM)	8.6%
Hepatitis C (MTM)	0.8%
Hip/Pelvic Fracture (CCW)	0.6%
HIV/AIDS (MTM)	0.4%
Hyperlipidemia (CCW)	48.3%
Hypertension (CCW/MTM)	56.6%
Insomnia (MTM)	0.8%
Ischemic Heart Disease (CCW/MTM)	16.9%
Multiple Sclerosis (MTM)	0.6%
Neurologic Disorders (MTM)	4.2%
Osteoarthritis (MTM)	24.7%
Osteoporosis (CCW)	6.9%
Parkinson's Disease (MTM)	1.4%
Plaque Psoriasis (MTM)	1.1%
Rheumatoid Arthritis (MTM)	8.8%
Rheumatoid Arthritis/Osteoarthritis (CCW)	19.1%
Schizophrenia (MTM)	1.9%
Severe Hematologic Disorders (MTM)	0.5%
Stroke/Transient Ischemic Attack (CCW)	3.5%
Transplant (MTM)	0.2%

(CCW: Chronic Condition Warehouse; MTM: Medication Therapy Management)

Source: Avalere Health analysis of 2012 and 2013 Medicare Five Percent Limited Data Set (LDS) Standard Analytical Files (SAFs).

About Us

Avalere is a vibrant community of innovative thinkers dedicated to solving the challenges of the healthcare system. We deliver a comprehensive perspective, compelling substance, and creative solutions to help you make better business decisions. As an Inovalon company, we prize insights and strategies driven by robust data to achieve meaningful results.

Contact Us

For more information, please contact info@**avalere**.com. You can also visit us at **avalere**.com.