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# **Analysis of 2006-2007 Home Health Case-mix Change**

## ***Final Report***

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# 1.0 Overview

The Medicare home health prospective payment system (PPS) was implemented in October 2000. Under the PPS in place between October 2000 and December 2007, Medicare payment for each 60-day episode of care is made based on the location of service and on the episode's classification into one of 80 case-mix groups, also called "home health resource groups" (HHRGs). This classification is based on the patient's characteristics at the start of the episode, as well as the patient's use of rehabilitation therapy services (physical therapy, occupational therapy, or speech language pathology) during the episode. Each HHRG has an associated case-mix weight, which determines how much the payment for the specific episode is adjusted from the standardized base payment established for the current payment year.

Since implementation of the prospective payment system, there has been a steady increase in the average case-mix of home health patients. The overall observed case-mix increased by 15.03% between 2000 and 2007. Given that case-mix assignment is based on patient assessments completed by home health agencies, there are questions about the extent to which this increase reflects nominal case-mix changes attributable to changes in coding practices that lead to case-mix "creep" vs. real case-mix change that is due to true changes in patient characteristics. Measuring the proportion of total case-mix change that is due to nominal vs. real factors has important implications for home health payment rates.

In this paper, we examine how consistently the home health case-mix system was applied in grouping patients into case-mix groups over time. We examine the changes in case-mix that occurred in 2006 and 2007, updating analyses that were originally conducted using data from 2005 (see Chapter 8 of the 2008 report).<sup>1</sup>

Our results since the 2008 report are summarized in the following tabular "Summary of real and nominal case-mix change estimates." The table also presents CMS estimates from its original Notice of Proposed Rulemaking (NPRM) setting forth for public comment a payment adjustment to account for nominal case-mix change (May 4, 2007, 72 FR 25356) .

Table 1 shows that, based on a large beneficiary sample of initial episodes, CMS originally estimated that nominal case-mix growth increased the national average case-mix weight by 8.70% between the year 2000 and 2003. Following updating of the national sample file to 2005, inclusion of initial and subsequent sample episodes, and use of a multivariate model of case-mix (used to estimate "real" case-mix change), we estimated nominal case-mix growth of 11.75% by 2005. This estimate was based on isolating the portion of the total change in the national average case-mix weight that was due to changes in the patient characteristics measured in the multivariate model. For 2005, out of an increase of 0.1401 in the national average case-mix weight, only 0.0104, or 8.03%, of the increase, was predicted by changes in patient characteristics. As a result, CMS reduced by 8.03% a total increase in case-mix of 12.78%, to account for "real" increase in case-mix. These figures implied that

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<sup>1</sup> [http://www.cms.hhs.gov/Reports/downloads/Coleman\\_Final\\_April\\_2008.pdf](http://www.cms.hhs.gov/Reports/downloads/Coleman_Final_April_2008.pdf)

nominal change in case-mix was 11.75% (12.78% minus 8.03% times 12.78% leaves 11.75%). This was the nominal case-mix change that was the basis for rate reductions implemented in CMS rulemaking (August 29, 2007, 72 FR 49762). We subsequently revised the multivariate-model-based estimates, finding that nominal case-mix growth was slightly lower by 2005. (Reasons for the revisions are discussed later in this report.) Our estimate of nominal case-mix growth by 2005 was revised to 10.71%. Applying the same methodology to 2006 data, our estimate of nominal case-mix growth by 2006 was 12.46%. The latest estimate, continuing with the same methodology but based on 2007 data, indicates that nominal case-mix growth by 2007 was 13.56%.

<b>-Table 1 Summary of Real and Nominal Case-mix Change Estimates</b>					
	<b>2008</b>	<b>2008</b>	<b>Revised</b>	<b>2010</b>	<b>2010</b>
	<b>NPRM</b>	<b>Final Rule</b>		<b>NPRM</b>	<b>NPRM</b>
Follow-up year	2003	2005 *	2005	2006	2007
IPS Baseline average case-mix weight	1.134	1.0960	1.0959	1.0959	1.0952
Follow-up year average case-mix weight	1.233	1.2361	1.2326	1.2501	1.2606
Total change in average case-mix weight (follow-up minus baseline)	0.099	0.1401	0.1367	0.1542	0.1647
Total percentage increase	8.70%	12.78%	12.47%	14.07%	15.03%
Estimated real portion of total change in average case-mix weight	n/a	0.0104	0.0193	0.0177	0.0161
Percent of total change estimated as real	n/a	8.03%	14.15%	11.48%	9.77%
Percentage points (of total percentage increase) estimated as nominal	8.70%	11.75%	10.71%	12.46%	13.56%

\*Note: The 2008 NPRM analysis used initial episodes of the beneficiary sample to compute the national averages. Beginning with the analysis presented in the 2008 Final Rule, both initial and all subsequent episodes of the sample were included.

## 2.0 Data

### 2.1 Baseline Period Data

The baseline period data are from Federal Fiscal Year (FY) 2000 (October 1, 1999 to September 30, 2000), a period when the Home Health Interim Payment System (IPS) was in effect. Since home health services were not yet paid on the per-episode basis used under PPS, we used Medicare home health claims to construct an analysis file of simulated 60-day episodes, applying rules based on the anticipated design of the impending prospective payment system.

To assign case-mix weights to the simulated episodes, we needed the appropriate patient characteristics variables. While the collection of the Outcomes and Assessment Information Set (OASIS) variables on all Medicare and Medicaid home health patients began in July 1999, the data

collection time points for each patient did not always match the starting points of our simulated payment episodes. This is because, at that time, OASIS assessments were conducted solely for outcomes monitoring purposes. When matching OASIS assessments to simulated payment episodes, we accepted any assessment within 14 days of the episode start date. If there were multiple qualifying assessments, we chose the closest start/resumption of care assessment for initial episodes, and the closest start/resumption or followup/recertification assessments for subsequent episodes. In approximately 18% of cases, no suitable OASIS assessment (close enough to a simulated payment episode start date) was available, and those episodes had to be excluded from the analysis.

Episodes with fewer than five visits were also excluded from the analysis because they would be considered low utilization payment adjustment (LUPA) episodes under PPS, and would not be paid using home health resource groups (HHRGs) in any case. The analysis file for the base period included episodes for a 10% sample of beneficiaries and included 313,447 episodes. For episodes with OASIS assessments, an HHRG was assigned using the OASIS information, even though the actual claims for the services in the episodes were not paid (in 1999) using HHRGs.

## **2.2 PPS Period Data**

The PPS period data consisted of analogous files from Calendar Years 2006 and 2007. These data were drawn from the Home Health Datalink file, which was created for CMS by Fu Associates, Ltd., of Arlington, Virginia. This database includes 100% of home health episode claims from the start of PPS linked to matched OASIS assessments, data on other Medicare service use by the beneficiary, and additional data on provider and beneficiary characteristics. We used data for a 20% sample of Medicare home health users, selected based on beneficiary Medicare (HIC) number digits. This analysis file contained 917,415 episodes for 2006 and 974,974 episodes for 2007. Since these were records from the PPS period, the actual paid HHRGs were available. However, in preparing the file, we corrected the HHRG and its associated case-mix relative weight in situations where claims-based information on therapy visits during the episode was inconsistent with the HHRG on the claim.

## **3.0 Methodology**

The basic method is the same used in Chapter 8 of the Final Report. We used data from the IPS period to estimate a regression-based, predictive model of individual case-mix scores (relative weights) based on measures of patients' demographic characteristics, clinical status, inpatient history, and Medicare costs in the time period leading up to their home health episodes.

The regression coefficients from the IPS period model were applied to episodes from 2006 and 2007, allowing one to estimate how much of the change in observed case-mix is attributable to variations in patient characteristics over time. We classify the sources of case-mix change into two major types: predicted and unpredicted.

- ***Real (predicted) change:*** This is change that is based on the relationship between patient characteristics and case-mix (i.e., coefficients from the regression model) and

changes in the characteristics of patients over time (i.e., the change in mean values of the model covariates).

- **Nominal (unpredicted) change:** This is the portion of case-mix change that cannot be explained by changes in patient characteristics. Nominal case-mix change is assumed to reflect differences over time in agency coding practices.

The analyses described in this paper incorporate refinements to the data files, sample creation, and variable construction relative to the results included in the 2008 report. We re-estimated the IPS period models using a file that included only episodes ending from October 1999 through September 2000 (Federal fiscal year 2000). In addition, we applied a consistent four-year look-back period for hospitalizations that preceded the home health episode for both the IPS and 2006 and 2007 periods. As a result of these refinements, the average case-mix for the baseline (IPS) was estimated to be 1.0959 (versus the 1.0998 that was reported in Exhibit 8.4 of the 2008 report). The regression coefficients for the IPS period model also differ slightly from those in the report.<sup>2</sup> We also made a change in the methods used to determine the mean values for the living arrangement variables that are derived from OASIS item M0340. After 2002, this item was not required on recertification or follow-up assessments. It is thus missing for a substantial portion of our 2006 and 2007 data. In the IPS sample, this item is available for almost all assessments.

In our previous analyses, we set all of the living arrangement variables equal to zero for observations in which M0340 was missing. This resulted in a substantial decrease in the estimated mean of the M0340 items between the IPS period and later periods. For the analyses described in this report, we impute the living arrangement variables for observations missing item M0340. The basic method was to calculate the percentage difference in mean values of the living arrangement variables for the subset of IPS records that have both a SOC/ROC and recertification/follow-up assessment and use this as the basis for imputing the mean value of recertification/follow-up assessments in 2006 and 2007. The overall estimated mean for the living arrangement variables is based on the observed mean for SOC/ROC assessments, weighted by the proportion of SOC/ROC assessments, plus the imputed mean for recertification/follow-up assessments, weighted by the proportion of recertification/follow-up assessments. The imputed living arrangement variables for 2006 are shown in Table 2.

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<sup>2</sup> In the development of the 2006/2007 sample file, we made some additional, but minor, refinements to the sample selection procedures that were used to create the original, 2005 sample file described in the Final Report and used for the CY 2008 Final Rule. These refinements were also implemented in a revised version of the 2005 sample file. The original 2005 sample file inadvertently included 7,212 RAP records, as well as some records with apparent date inconsistencies that were not included in the 2006/2007 sample file used to calculate the latest official estimates of case-mix increase. This would have had some lowering effect on the average case-mix weight for the sample, since the average case-mix weight for these cases was lower than that of other cases. In addition, in the original 2005 file SCICs were assigned the case-mix weight at episode start, while in the 2006/2007 sample file and the revised 2005 sample file they were assigned an average of all case-mix weights that were submitted on the claim (weighted by the proportion of paid days for each one.) This would also have had a slight lowering effect on the overall average case-mix weight in the original 2005 sample file. However, we believe these differences are unlikely to have had any systematic impact on the findings of the nominal case-mix prediction analysis, which were based on the regression using the IPS data and the claims history and demographic variables of patients in the 2005 data.

<b>Table 2 Imputed Means for Patient Living Arrangement Variables (M0340): 2006</b>						
<b>Patient living arrangement</b>	<b>Baseline Period</b>			<b>2006</b>		
	<b>SOC/ROC mean</b>	<b>Recert/FU Mean</b>	<b>% difference: SOC/ROC and Recert/FU</b>	<b>SOC Mean</b>	<b>Imputed mean for Recert/FU</b>	<b>Estimated Overall Mean</b>
Patient Lives Alone	0.30426	0.29626	-0.02629	0.29349	0.28578	0.29083
Patient Lives with Other (Not Family, Friends, Paid Help or Spouse)	0.01595	0.01439	-0.09781	0.00980	0.00884	0.00947
Patient Lives with Other Family	0.28761	0.29089	0.01140	0.28271	0.28593	0.28382
Patient Lives with Paid Help	0.06828	0.07778	0.13913	0.08639	0.09841	0.09054
Patient Lives with Spouse	0.35279	0.35279	-0.00001	0.36468	0.36468	0.36468

Notes:  
1) 2006 estimated overall mean for Recert/Fu equals SOC mean \* (1+ % difference in SOC/ROC and Recert/FU mean in the baseline period).  
2) Estimated overall mean equals 2006 SOC mean multiplied by the percent of SOC/ROC assessments in 2006 (0.6553) plus the 2006 imputed mean for recert/FU multiplied by the percent of Recert/FU assessments for 2006 (0.3447).  
3) The instructions for M0340 say to check all that apply, so the sum of the living arrangement variables is greater than 100%.

### ***3.1 Models to Examine Relationship Between Patient Characteristics and Case-Mix***

Using data from the baseline (IPS) period, we estimated a regression model of the following basic functional form:

$$\text{Relative Payment Weight}_i = \alpha + \beta * \text{Personal Characteristics}_i + \varepsilon_i$$

where:

Relative Payment Weight for individual i is the relative payment weight for that individual's 60-day home health episode (based on the then-current 80 HHRGs);

$\alpha$  is a constant term (to be estimated);

$\beta$  is a vector of coefficients (to be estimated);

Personal Characteristics is the vector of demographic and clinical variables for each individual; and

$\varepsilon$  is an error term.

Our goal in estimating the model was to predict the case-mix weights, using variables that could be created using the available administrative data. As a result, we were not particularly concerned about redundancy among variables, as long as groups of variables make sense broadly as correlates of case-mix. Our interest was in achieving as much predictive power as possible from the variables taken together.

The model used in this paper has the same specifications as Model 6 in the 2008 report. It included these types of independent variables:

- **Demographic variables:** The demographic variables were included to control for any differences in case-mix determination associated with age, gender, and race/ethnicity. The following demographic variables were included:
  - Age (age groups 65 to 74, 75 to 84, 85 to 84, and 95 and above; age under 65 is the reference category);
  - Gender (male);
  - Race (White and African American; other, including Asian, Hawaiian/Pacific Islander, and Native American/Alaskan Native, is the reference category).

In addition, the age variables were interacted with the gender and race dummy variables to fully exploit the potential differences in effect on case-mix from the various demographic subgroups. There were a total of 19 demographic variables in the model.

- **Measures of prior utilization:** Prior hospital, inpatient rehabilitation, and SNF stays and days of care are likely to be associated with home health case-mix for a variety of reasons. For example, individuals with a recent rehabilitation facility stay may be recovering from an injury or fall and may require substantial amounts of care and further rehabilitation services as they continue to recover during their home health episodes. The model included measures of utilization of acute care hospital, long-term care hospital, inpatient rehabilitation facility, and Medicare skilled nursing facility in the period preceding the home health episode:
  - Acute Care Hospital Days in Period 14 Days Preceding Home Health Episode
  - Acute Care Hospital Days in Period 15 to 120 Days Preceding Home Health Episode
  - Long Term Care Hospital Days in Period 14 Days Preceding Home Health Episode
  - Long Term Care Hospital Days in Period 15 to 120 Days Preceding Home Health Episode
  - Rehabilitation Facility Days in Period 14 Days Preceding Home Health Episode
  - Rehabilitation Facility Days in Period 15 to 120 Days Preceding Home Health Episode
  - Medicare Skilled Nursing Facility (SNF) Days in Period 14 Days Preceding Home Health Episode
  - Medicare Skilled Nursing Facility (SNF) Days in Period 15 to 120 Days Preceding Home Health Episode
- **Measures of patient living arrangements:** Individuals who live with other people, especially spouses and close family members, may have lower home health care needs from third parties (home health agencies), resulting in lower home health resource use and lower case-mix, all else equal. The model included dummy variables indicating the patient's living status at home:
  - Patient Lives Alone
  - Patient Lives with Other (Not Family, Friends, Paid Help or Spouse)
  - Patient Lives with Other Family
  - Patient Lives with Paid Help
  - Patient Lives with Spouse

These living status variables were the only variables in the model that came from agency-reported OASIS data.

- **Measures of patient's acute care hospital inpatient history:** We examined the patient's acute care hospital inpatient history for the four years preceding the home health episode, considering the All Patient Refined Diagnosis Related Group (APR DRG) for the patient for his or her most recent inpatient stay<sup>3</sup>. Approximately 90% of beneficiaries with home health care episodes in the sample had a hospital stay during the look-back period. APR DRGs are designed to predict patient acuity and care needs in acute care hospital settings. To the extent that such acute care acuity and needs reflect the patient's need for more-intensive care in other settings (in this case, in home health settings), APR DRGs are reasonable proxy variables for home health resources need (i.e., home health case-mix). The model included dummy variables for the following:

- The All Patient Refined Diagnosis Related Group (APR DRG) for the patient for his or her most recent inpatient stay.
- Whether that APR DRG was procedure-based or medically-based.
- The patient's expected risk of mortality at the time of the hospitalization (four levels – the reference group is patients with no APR DRGs– their relative mortality risk cannot be coded).
- Interactions between the APR DRG and APR DRG severity level. Based on a patient's personal characteristics and comorbidities at the time of the hospital stay, each patient within each APR DRG is assigned to one of four severity levels in the APR DRG algorithm. The severity levels are specified in the model as interactions, because the APR DRG severity levels are developed individually for each APR DRG classification. Interactions for the first three severity levels are included (the fourth and highest severity level is the reference category). This specification is equivalent to having a separate group indicator variable for each combination of APR DRG and severity level.

APR DRG variables and interactions with severity levels were included only if at least 25 episodes had that combination of APR DRG and severity in the baseline (IPS) period file. The model included a total of 291 APR DRG variables and interactions. Stays from APR DRG groups that did not meet the sample size requirements are included in the model and they have values for the basic procedure- or medically- based classification and mortality risk variables.

To adjust for changes in ICD-9-CM code sets and the derivation of the DRGs, the APR DRG software incorporates an ICD-9-CM code “mapper” to map hospital diagnosis codes back to their predecessor codes in case of changes to the code set across the study years. The code mapper, which we used in defining our analysis variables, is intended to permit valid comparisons of acute stay APR DRG assignments across years, even though the ICD-9-CM code set may incorporate a few changes from year to year.

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<sup>3</sup> The APR-DRG system was developed in 1990 to address both the severity of illness and risk of mortality over all patient populations. The APR- DRG system includes four severity of illness classes (minor, moderate, major or extreme loss of function) and risk of mortality subclass for each base diagnostic group (minor, moderate, major, and extreme).

We consulted with clinical experts to review the findings for APR DRGs that had large changes in prevalence over time, soliciting input on whether there were “external” explanations for such changes ((e.g. changes in coding guidelines) or whether the changes likely reflected actual changes in patient conditions. Changes in APR DRG incidence that were identified for further review were those that had a prevalence of at least 0.2% in the prior year and which had a change in incidence of 11% or more. For the 2007 analyses, this included the following DRGs:

- 130: Respiratory system diagnosis w ventilator support 96+ hours
- 165: Coronary bypass w/o malfunctioning coronary bypass w cardiac cath
- 169: Major abdominal vascular procedures
- 460: Renal failure
- 468: Other kidney & urinary tract diagnoses

Also, CMS requested that we examine APR DRG 227 (Hernia procedures except inguinal & femoral). For each of these DRGs, analyses were performed to identify the most frequent principal diagnoses and other diagnoses, and the most frequent procedures performed (all from the inpatient claim record). These data were circulated to clinical coding experts asking whether coding guidelines for any of these diagnoses or procedures could conceivably account for the observed changes in incidence of the APR-DRGs. There was no feedback received that indicated that any particular adjustment to the data was required to account for changes in coding guidance, and no such changes were made for this year's analysis.

- ***Measures of home health agency ownership type:*** The model included dummy variables based on the agency's ownership type/type of control:
  - Free-standing, voluntary or non-profit
  - Free-standing, proprietary
  - Free-standing, government-owned
  - Facility-Based, voluntary or non-profit
  - Facility-Based, proprietary
  - Facility-Based, government-owned
  - Other, voluntary or non-profit
  - Other, proprietary
  - Other, government-owned

The reference category is unknown facility ownership/control.

- ***Measures of Medicare Part A payments.*** Measures of Medicare Part A payments may serve as measures of the intensity of services in the period preceding the home health episode. The model included measures of Medicare Part A payments in the 120 days preceding the home health episode, by service type:
  - Acute care hospital payments in 120 days preceding home health episode
  - Long-term care Hospital payments in 120 days preceding home health episode
  - Rehabilitation facility payments in 120 days preceding home health episode
  - Medicare SNF payments in 120 days preceding home health episode



















































































