Technical Report A Standardized Method for Adjusting Medicare Expenditures for Regional Differences in Prices

Andrea M. Austin, PhD [*]   Daniel Gottlieb, MS [†]
Donald Q. Carmichael, MDiv [*]   Gouri Chakraborti, MA [*]
Jason Sutherland, PhD [†]   Kathryn Gilman Andrews [†]
Stephanie Raymond [*]   Stephanie Tomlin, MPH [*]
Weiping Zhou, MS [†]   Yunjie Song, PhD [†]
Jonathan Skinner, PhD
The Dartmouth Institute for Health Policy and Clinical Practice

July 9, 2018

1   Introduction

This technical report describes in detail the Dartmouth Institute for Health Policy and Clinical Practice's (TDI) methodology for deriving region-specific standardized prices for Medicare expenditures, as discussed in the 2010 Health Affairs article "Prices Don't Drive Regional Medicare Expenditures." The methods are applied to estimating age, sex and race adjusted Medicare beneficiary per-capita expenditures in Hospital Referral Regions (HRR).

The objective is to deconstruct Medicare's per-capita expenditures into 2 components: Variation in expenditures caused by differences in utilization and variation in expenditures due to Medicare's varying rates for the same medical services. Standardized prices represent the adjustment to Medicare's expenditures for these sources of variation.

We acknowledge the pioneering earlier work of MedPAC in developing these methods. While our approach is largely similar to theirs, there are a few points of departure where we simplify the method or take alternative approaches to measuring utilization.

The methodology uses as inputs Medicare claims files for inpatient, outpatient, physician Part B, skilled nursing facilities, hospice, long term care hospitals, swing bed hospitals, critical access hospitals, rehabilitation hospitals, psychiatry hospitals, children's hospitals and durable medical equipment expenditures (as well, the MEDPAR

---

[*]Prepared the report
[†]Developed Standardized price algorithm

file is used to identify some hospital expenditure types, such as swing bed hospitals). We also use the Centers for Medicare and Medicaid Services (CMS) Wage_Index to apply directly to some categories of Medicare reimbursements. We use standardized for the claims where $CMSpayment \geq 0$.

The methods described in this report are applicable to any year of claims data. We begin with the Part A Acute Hospital measures.

2   Standard Utilization and Price Measures for Part A Acute Hospital Spending

The estimate of price-adjusted total acute hospital expenditures for procedure k for individual i who lives in region $j(\text{HE}_{ikj})$ is written [1]:

$$HE_{ikj} = P \times DRG_k + OP_{ik}/WI_j$$

where P is the natonal-level diagnostic-related group (DRG) price, DRG_k is the DRG weight used to determine payment for procedure k (similar for all hospitals), OP_{ik} the outlier payment (if any), and WI_j is the Wage_Index factor (this is described in Section 5 below). Thus, for all claims the standard price P is the same; hence, in the absence of outlier payments, the standardized hospital expenditures for procedure k is the same for any region. The outlier amounts are wage-adjusted to account for the differences in price level costs across regions (Section 5). These are added up across all individuals by hospital referral region (HRR) of residence. These measures are further adjusted for differences in age, sex, and race (see Section 8).

3   Normalizing the Price Index

There is nothing to ensure that aggregate price-adjusted hospital expenditures (as calculated above) will be equal to aggregated actual hospital expenditures. To make sure that the price-adjusted hospital expenditures add up to the same amount, we make a further adjustment (λ) to ensure the adding up constraint – this ensures that we are comparing "apples to apples." That is, λ for hospital expenditures is defined implicitly by

$$Total Hospital Expenditures = \lambda \sum_i \sum_k \sum_j HE_{ikj}$$

That is, λ is used to constrain the sum of total standard prices to equal actual CMS expenditures.

We do this for each of the categories described below, such that the sum of standard prices equals the sum of CMS payments for all age groups (including the under

---

[1] Here region j may refer to a metropolitan statistical area (MSA) or Core-Based Statistical Area (CBSA) or other variation of region, and not necessarily a hospital referral region.

65 population). Thus separate correction factors are calculated for each type of inpatient service too (e.g. acute care, SNF, psychiatric care, long term care, etc.).

Once standard prices are calculated for each claim, we sum payments per individual and restrict to the population of interest (65-99, Medicare Part A and Part B entitled, non-HMO, residing in the US). Because this analysis restricts attention to the 65 and over population only, the averages for the price-adjusted and actual spending per capita are slightly different. (In other words, our adding-up constraint applies to the entire fee-for-service Medicare enrollee population, including those under age 65.) The user may of course adjust the spending measures further (by multiplying the price-adjusted spending measures by an additional factor, which differs in each year, for example it was 1.0061 in 2006) to ensure that the aggregate per capita Medicare spending for the 65+ population in 2006 is \$8217.44 whether price-adjusted or not.

4   Carrier File Standardization Prices Methods

Part B physician billings for non-laboratory services are merged with the physician fee schedule total relative value units (PPRRVU) by the Healthcare Common Procedure Coding System (HCPCS) procedure code and one modifier code (if present).[2] When 2 modifier codes are present on the claim, the modifier codes of primary interest define whether the claim covers only the technical or facility components of the bill. Other modifier codes that alter payments relate to surgical procedures: surgical assistant, bilateral procedure, and only part of the procedure completed. These components, measured in terms of relative value units (RVU), define physician inputs (technical component) as well as the cost for use of the facility where the service is provided (facility component).

In approximately 10% of claims that originate from physicians, there is no corresponding match to the PPPRVU fee schedules. For these procedural terminology (CPT) codes, plus certain modifiers, we impute the national *average* allowed charge per service (that is, over the entire national 20% Part B file) for each calendar year. We thus assign the average allowed charge times the service_count to all missing values. This thereby avoids a potential source of undercounting.

We use a similar approach for laboratory charges, with reimbursements based on the clinical fee schedule standard payment amounts (downloaded from the CMS website) times the number of service units.[3]

In our approach, for claims with a service_count greater than 1, we perform a validity check on a claim by claim basis. If the total standard price determined exceeds the allowed charge by more than 50 percent, the service_count is reduced until that criterion is satisfied (in integer increments); in practice, very few observations are changed, but this simple rule avoids extreme outliers that appear to be coding errors. The service_count is never reduced below 1.

---

[2]There are a few other categories that do not use the PPRVU file. For most billing, we link to the PPRVU file by CPT and modifier code.

[3]In contrast, MedPAC in earlier documents appeared to use a different quantity measure, "Mtus_cnt" for its claims.

Ambulatory surgery center (ASC) standard prices are calculated from the ASC standard payment file (also available from the CMS website) matched by CPT code. For anesthesia, the standard price is based on the sum of the base unit and time units multiplied by an annual national conversion_factor, equal to $17.05 in 2003. When the service is provided by a certified nurse anesthetist, the RVU's are reduced by 50%.

The derivation of standardized prices is sometimes based on the price paid to providers, an amount which may be higher than the price CMS reimburses. Differences between these amounts include copayments and coinsurance amounts paid by insurers or patients. Thus in part, our estimates provide a better measure of the value of services provided and are less affected by individual differences in coinsurance or deductibles.

5 Using the Wage_Index to Adjust Medicare Expenditures

The adjustment for acute hospitals and physician payments are more straightforward because they include implicit "quantity" measures, whether DRG weights or RVUs. For other sources of Medicare expenditures, it is more difficult to discern quantity measures. For these, we use the Wage_Index to adjust dollar reimbursements. For example, we have already described our adjustments for outlier payments (in Section 2). But the adjustment approach is also used for skilled nursing facility (SNF) stays and outpatient services (claims from the outpatient file).

CMS publishes an annual Wage_Index (WI) files by Metropolitan Statistical Areas (MSAs), now known as Core Based Statistical Areas (CBSAs), as well as by provider. We chose to use the MSA/CBSA file because of imperfect merging with the provider specific file and to assure longitudinal consistency. The MSA/CBSAs are based on county boundaries. For counties not in the MSA or CBSA, CMS provides a default value for the state (these are generally rural areas). The county of each billing provider was determined by the claims data itself and/or the point of service (POS) file. While the use of the Wage_Index parallels what CMS does to determine payment rates for certain providers, in some instances CMS allows providers in rural MSAs to be classified with their urban counterparts to benefit from higher reimbursement amounts. Our approach does not capture these effects.

Calculating the wage adjustment is a multi-step process. First, we determine the Wage_Index (WI) for each relevant claim based on the location of the billing provider. Next we apply the following formula which allocates only a portion of total expenditures to be affected by the WI (The ratio is 0.6 for the outpatient file and 0.75 for others). The simple Wage_Index (WI) for the general case of a 0.75 ratio is:

$$WI_m = [0.25 + 0.75 \times (\text{Wage\_Index for this provider})]$$

for each provider m based on their MSA.

For the component of Medicare payments subject to this adjustment, the unadjusted standardized payment (SPi) for individual i seeking care at provider m be-

comes:

$$SP_i = \text{Medicare reimbursement}/WI_m$$

As noted above, all of these measures are also normalized (with the appropriate λ) to ensure the adding-up constraint.

6 Outpatient Standardized Prices Methods

The outpatient claims file represents the most complex set of services because of the disparate types of claims it contains and the very different approaches to reimbursements it involves. The majority of outpatient claims are facility claims for procedures, paid under the outpatient prospective payment system (OPPS). There are, however, federally qualified health centers (FQHC) and rural health clinic (RHC) visits too that represent clinical work.

The analyses of outpatient claims are confounded by the complex relationship between identifying the volume of services provided and the amount actually paid by Medicare. We propose to use the 60%/40% Wage_Index to price-adjust actual dollar payments to providers since CMS uses a 60%/40% weighting. Payments to providers, the sum of CMS payments, primary insurer payments and coinsurance/deductibles best represents the value of the service. We again apply an adjustment factor so that the sum of standard payments equals the sum of CMS payments.

7 Standardized Prices for Other Types of Hospitals

7.1 Skilled Nursing Facilities (SNF) and Hospice Standardized Prices

Medicare uses a complex approach to compensating providers for nursing home stays, using length_of_stay and resource utilization groups (RUG) to determine the standard payment amount. There are different prices per day for the first 14 days, days 15-30, 31-60, 61-90 and then for any stay beyond 90 days. The overall length_of_stay is capped at 100 days for our calculations, although very few claims reach this upper limit. Rather than using this complex approach (which requires information from data sources outside of the Medicare administrative data) we instead adjust the expenditure using the Wage_Index described above, with a 0.75 weighting factor.

Hospice payments are based on two primary factors: the type of service rendered and the number of hospice days. Nearly all claims are based on service types (routine home care, general inpatient care and continuous home care) and each contains a specific code for physician services. We use a method that parallels what was done for CPT codes that did not merge with the PPRVU file: we calculate the average per diem payment for each of the service types, both with and without MD involvement.

This national mean, calculated each calendar year, is then applied to each service type and MD involvement combination.

Prices per service days are then adjusted to ensure that price-adjusted hospice spending equals actual unadjusted spending (with the hospice-specific λ factor). While we recognize that it is possible to more accurately account for other physician services included, the number of claims for physician services in the hospice file is very small; hence, we did not make this adjustment.

7.2   Long-term Care Hospitals and Swing Bed Hospitals

For Long-term Care Hospitals (LTCH) and Swing Bed Hospitals (SWNGB), we use the 0.75 wage-index ratio based on the provider's location to adjust the Medicare payment, inclusive of outlier payments. Long term hospital stays represent only about 0.5% of total hospital claims, but due to the duration of these stays, they account for approximately 1.7% of total hospital expenditures.

7.3   Other Hospital Types

There are several other hospital types that account for small proportions of overall expenditures: (a) Critical Access Hospitals (CAH), (b) Rehabilitation hospitals (RE-HAB), (c) Psychiatry Hospitals (PSYCH), and (d) Children Hospitals (CHL). Akin to DRG weighting systems, Medicare uses a different set of methods to pay for stays in each of these types of hospitals. To determine standard payment rates to these hospital types, we calculate the mean payment per day (by DRG analogue) separately in CAH, REHAB, PSYCH and CHL hospitals. The mean per diem payment is then applied to each claim in these hospitals so that the standard price for a claim is the mean national DRG specific mean*length_of_stay for this claim. We again apply a hospital-type specific λ to enforce that the sum of standard payments equals the sum of CMS payments.

7.4   Durable Medical Equipment Standardized Prices

Durable medical equipment (DME) includes devices, such as wheelchairs, covered under the Medicare program. The DME claims arrive in a format similar to several other Part B files: a claim component and one or more line components. The claim component contains summary information (for example, total payment, physician and diagnostic codes) while the line component contains the actual items billed using current procedural terminology (CPT) codes. The line component also includes a measure of "service_counts." This field is often coded inconsistently (for example, service_count might represent a dosage, or it might represent actual counts of service).

In our methodology, we propose that if the claim indicates that the service_count is measuring a dosage, we set the service_count to one; otherwise, when the service_count is meant to indicate units of service, the count is "capped" at 5. The rationale for this approach is to minimize the opportunity for poorly coded data to introduce large errors into average expenditure amounts (for example, when dosage is entered in the

field instead of service_counts). We derive standardized values for each CPT code by averaging payments to providers per CPT code for an entire calendar year. The standardized values are then applied by CPT code of the claims, multiplying by the adjusted service_count. A DME-specific adjustment factor λ is applied to normalize price adjusted_payments sum to actual payments.

8 Other Adjustments to Regional Spending

Medicare expenditures are then adjusted to reflect differences in age, sex and race between HRRs. This is done by creating "cells" of individuals by 5-year age groups (65-69, etc., through 85+), sex (male or female) and race (black or non-black) to provide estimates of what price-adjusted expenditures should be in all HRRs given their demographic compositions; this is, expected Medicare expenditures. We then take the ratio of actual expenditures and expected expenditures (the "O/E" ratio) and multiply by the national per capita average of Medicare expenditures (as described in Fisher and van Belle, 1993).

References
Fisher L, van Belle G. (1993). Biostatistics: a methodology for the health sciences (1993). New York: John Wiley, 769-72.

Summary of Medicare Components Std Payment Methods

We used the MSA (2006 and prior)/CBSA (Core-Based Statistical Areas 2007 onward)/State Wage_Index to create the std payment for hospital component, outpatient component, HHA Component, and we calculate diem as per payment per day by service type, then multiplied by length_of_stay as the std payment for Hospice Component, physician fee schedule RVU for Physician Component, median allowed charge/line payment of each CPT for DME Component.The details are as follows:

A   Hospital Component (Part A)

A.1   ACH (Acute Care Hospital):

$$Std\_price = r \times (drg\_weight\_dollar + adjusted\_outlier\_amount)$$
$$adjusted\_outlier\_amount = [\text{outlier\_amount}/WI]$$
$$WI = [0.25 + 0.75 \times (\text{Wage\_Index})]$$
$$drg\_weight\_dollar = [conversion\_factor \times drg\_cd]$$
$$r : adjusted\_factor = [(sum\_of\_pmt\_amt)/(total\_standarized\_price)]$$
$$pmt\_amt = pmt\_amt + passthru$$

A.2   CAH (Critical Access Hospital), REHABILITATION, PSYCHIATRIC, CHILDREN, and OTHER Hospital:

$$Std\_price = r \times diem \times length\_of\_stay$$
$$Diem = payment\_per\_day\_per\_DRG$$
$$std\_payment = Diem \times loscnt$$
$$total\_standarized\_price = sum(std\_payment)$$
$$r : adjusted\_factor = [(sum\_of\_pmt\_amt)/(total\_standarized\_price)]$$

(if length_of_stay = 0, then length_of_stay = 1)
NOTE:length_of_stay for CAH is restricted to the number of days 365 or less

A.3 LONGTERMCARE, SWNGBED:

$$Std\_price = r \times (adjusted\_payment + adjusted\_outlier\_amount)$$
$$adjusted\_payment = reimbursement/WI$$
$$Adjusted\_outlier\_amount = outlier\_amount/WI$$
$$WI = [0.25 + 0.75 \times (\text{Wage\_Index})]$$
$$r : adjusted\_factor = [(sum\_of\_payment\_amount)/(total\_standarized\_price)]$$

A.4 SKILLED NURSING FACILITY:

$$Std\_price = r \times adjusted\_payment$$
$$adjusted\_payment = reimbursement/WI$$
$$WI = [0.25 + 0.75 \times (\text{Wage\_Index})]$$
$$total\_standarized\_price = sum(adjusted\_payment)$$
$$r : adjusted\_factor = [(sum\_of\_payment\_amount)/(total\_standarized\_price)]$$

B Physician Component (Part B)

- Merge with physician fee schedule RVU file by CPT and Modifier

- Merge with Clinical Lab Data by CPT and Modifier

- Merge with Anesthesia data by CPT

- $total\_RVU\_claims = median(alowchrg/(conversion\_factor \times service\_count))$
  for each CPT using previous two year and current year Part B data

C Outpatient Component

$$Std\_price\_for\_Medicare\_payment = r \times adjusted\_payment$$
$$adjusted\_payment = pmt\_amt/WI$$
$$WI = [0.40 + 0.60 \times (\text{Wage\_Index})]$$
$$total\_pmtstandardized\_price = sum(adjusted\_payment)$$
$$r : adjusted\_factor = [(sum\_of\_pmt\_amt)/(total\_pmtstandardized\_price)]$$

$$Std\_price\_for\_total\_payment = r \times adjusted\_totalpayment$$
$$adjusted\_total\_payment = total\_payment/WI$$
$$WI = [0.40 + 0.60 \times (\text{Wage\_Index})]$$
$$r: adjusted\_factor = [(sum\_of\_total\_pmt)/(total\_totStd\_price)]$$
$$total_pmt = sum(of\,ptb\_coinsurance, ptbdeductible, pmt\_amt, primarypayeramo$$
$$total_totStd\_price = sum(adjusted\_totpmt)$$

D   Hospice Component

$$Stdprice = r \times diem \times length\_of\_stay$$
$$r: adjusted\_factor = [(sum\_of\_pmt\_amt)/(total\_standardized\_price)]$$
$$total\_standardized\_price = sum(adjusted\_payment)$$
$$adjusted\_payment = diem \times length\_of\_stay$$
$$Diem = total\_payment/total\_days$$
$$total\_days = sum(length\_of\_stay)$$
$$total\_payment = sum(totpmt)$$
$$totpmt = sum(pmt\_amt, prpayamt)$$

E   HHA (Home Health) (only claim file)

$$Stdprice = r \times adjusted\_payment$$
$$adjusted\_payment = totpmt/WI$$
$$WI = [0.40 + 0.60 \times (\text{Wage\_Index})]$$
$$r: adjusted\_factor = [(sum\_of\_pmt\_amt)/(total\_adjusted\_pay)]$$
$$totpmt = sum(pmt\_amt, prpayamt)$$
$$total\_adjusted\_pay = sum(adjusted\_payment)$$

F   DME (both RICM and RICO)

$$TotalRVU\_allowed = median\_allowed \times service\_count \times conversion\_factor$$
$$Median\_allowed = median(allowed\_charge/(service\_count \times conversion\_factor))$$
$$TotalRVU\_linepmt = median\_linepmt \times service\_count \times conversion\_factor$$
$$Median\_linepmt = median(line\_payment/(service\_count \times conversion\_factor))$$
$$workRVU\_allowed = 0.54 \times TotalRVU\_allowed$$
$$workRVU\_linepmt = 0.54 \times TotalRVU\_linepmt$$

<div align="center">Definitions:</div>

- Conversion_factor: It is a value used in Medicare's payment formula that turns RVUs into dollar values (i.e. actual fees). These factors are issued by Medicare in every annual physician fee schedule. It includes the overall state of the economy of the United States, the number of Medicare beneficiaries, the amount of money spent in prior years, and changes in the regulations governing covered services.

- Outlier_amt: Medpar drg outlier payment amount, which is an additional payment amount approved to an outlier situation for a beneficiary's stay for a specific DRG.

- Pmt_amt: Medicare payment amount for the services covered by claim record [details on the payment amount can be found on www.resdac.org]

- RVU : Relative value unit, which measures Physician Work, Practice expenses and Professional Liability Insurance

- prpayamt: Payment made by a primary payer other than Medicare

- Wage_index: An adjustment factor, which is used to get the relative hospital wage level among different geographic areas compared to national average

- RICM: DME claims only processed through regional DME carrier

- RICO:DME claims from a carrier who also processes Physician claims

- Allowed_charge: the total allowed charges on the claim,the sum of line item allowed charges

- Linepmt: Amount of payment made, after deductible and coinsurance amounts have been paid, for the line item service.

References

D.J. Seidenwurm and J.H. Burleson, The Medicare Conversion Factor, AJNR Am J Neuroradiol 35:242– 43 Feb 2014