# Medicare Data for the Geographic Variation Public Use File: A Methodological Overview

May 2018 Update

## Introduction

Federal policymakers and health researchers have long recognized that the amount and quality of the health care services that Medicare beneficiaries receive vary substantially across different regions of the United States. Much of that variation does not appear to be caused by differences in beneficiaries' health, and one widely-publicized estimate asserted that as much as 30 percent of Medicare expenditures may be unnecessary.[1]

The Office of Enterprise Data and Analytics within the Centers for Medicare & Medicaid Services (CMS) has developed a public use file, the Geographic Variation Public Use File (GV PUF), to support further analysis of this important issue. This public use file is based primarily on information from CMS's Chronic Conditions Data Warehouse (CCW), which contains 100 percent of Medicare claims for beneficiaries who are enrolled in the fee-for-service (FFS) program as well as enrollment and eligibility data. The GV PUF covers calendar years 2007-2016 and has information on demographics, spending, and service utilization for Medicare beneficiaries in different parts of the country. We also incorporated a variety of quality indicators that can be used to analyze relationships between Medicare utilization and quality of care.

The May 2018 update to the GV PUF includes data for 2007-2016. This update supersedes the data that we provided in March 2017.

This overview is divided into the following seven sections:

1. Key data sources
2. Study population
3. Geographic variables
4. Standardization and risk adjustment of spending
5. Utilization measures
6. Quality measures
7. Changes from the March 2017 dataset to the May 2018 update

## 1. Key data sources

The primary data source for these data is CMS's Chronic Conditions Data Warehouse (CCW). The CCW contains 100 percent of Medicare claims for beneficiaries who are enrolled in the fee-for-service (FFS) program as well as enrollment and eligibility data. The CCW was designed as a database to support research on chronically ill beneficiaries, so it also contains other valuable features, such as a unique identifier for each beneficiary that makes it possible to track spending

[1] John Wennberg et al. *Tracking the Care of Patients with Severe Chronic Illness – The Dartmouth Atlas of Health Care 2008*, The Dartmouth Institute for Health Policy and Clinical Practice.

and utilization for individual beneficiaries over time and flags that indicate if a beneficiary has one or more of 27 specific chronic conditions.

The detailed nature of the CCW claims data makes it possible to analyze differences in cost and/or utilization for specific settings of care or types of services. Some of the settings include inpatient hospital, outpatient hospital, multiple post-acute care settings (long-term care hospital, inpatient rehabilitation facility, skilled nursing facility, and home health agency), hospice, physicians, laboratories, and suppliers of durable medical equipment.

Physician services are defined using the Berenson-Eggers Type of Service (BETOS) classification scheme, which groups services into six major categories: physician evaluation and management, physician procedures, imaging, laboratory tests, durable medical equipment, and other. The total number of distinct BETOS codes is much larger – about 120 – when you count the numerous sub-groupings within those major categories.

We also incorporated several quality measures that were derived from Prevention Quality Indicators (PQIs), which is publicly available software that was developed by the Agency for Healthcare Research and Quality (AHRQ) and uses administrative date to measure hospital admission rates for ambulatory care sensitive conditions. These measures are well-known to health care researchers and have been endorsed by the National Quality Forum.

In addition to the quality measures described above, we also calculated the number of times that Medicare beneficiaries visited hospital emergency departments and all-cause hospital readmission rates.

## 2. Study population

Since the primary goal of the GV PUF is to make it easier to analyze differences in health care utilization and spending for Medicare beneficiaries living in different parts of the United States, we created analytic files that exclude certain categories of Medicare beneficiaries to make those comparisons as meaningful as possible.

Table 1 shows the number and percent of beneficiaries excluded, by year. We applied the same exclusions to each year of the data. Note that whether individual beneficiaries were part of the study population could vary from year to year, depending on whether and when one of the exclusions described below applied to them.

First, we excluded beneficiaries who were enrolled at any point during the year in a Medicare Advantage (MA) plan. (There were 19.4 million beneficiaries in MA plans in 2016, about 33 percent of the overall total.)

Second, we excluded beneficiaries who were enrolled at any point in the year in Part A only or Part B only (roughly 6.3 million in 2016, about 11 percent of the overall total). Since those beneficiaries are enrolled in only one part of Medicare, their per-capita spending cannot be compared directly to spending for beneficiaries that are enrolled in both Part A and Part B.

Although we report data for beneficiaries of all ages, we also report data separately for two age groups: beneficiaries who were under the age of 65 and received Medicare because they were either disabled or had end-stage renal disease (5.6 million in 2016) and beneficiaries age 65 and older (nearly 28.4 million in 2016). We report data separately by age group because beneficiaries under 65 differ in numerous respects from the over-65 population and could have different health service needs that are difficult to adjust for across geographic regions.

We would like to note that our analytic files do include beneficiaries who died during the calendar year (about 4 percent of the study population) as long as they were not excluded for one of the reasons outlined above.

In sum, the study population for the GV PUF is comprised of individuals who have both Part A and Part B coverage and are enrolled in Medicare's fee-for-service (FFS) program. Individuals who have both Part A and Part B coverage can enroll in either the FFS program or an MA plan, and the share enrolled in MA plans has risen steadily in recent years. The GV PUF therefore includes three sets of enrollment figures – the total number of beneficiaries with Part A and Part B, the total number of MA beneficiaries, and the total number of FFS beneficiaries (i.e., the study population) – to help users understand what share of the overall Medicare population for a given geographic area is described in the file.

Table 2 provides some basic demographic information about the beneficiaries.

## 3. Geographic variables

We used hospital referral regions (HRRs), as well as states and counties, as the geographic units of analysis. HRRs were developed by the Dartmouth Atlas of Health Care to delineate regional health care markets in the United States. See Appendix 1 for a complete list of HRRs.

The Dartmouth Atlas constructed HRRs by grouping zip codes together based on the referral patterns for tertiary care for Medicare beneficiaries. HRRs also had to have a minimum overall population of 120,000, and the residents of each HRR had to receive at least 65 percent of their hospitalizations within the HRR. There are 306 HRRs in the United States, and their boundaries often cross state lines. For example, the HRR for Memphis, Tennessee, includes parts of southeastern Missouri, eastern Arkansas, and northern Mississippi.

We assigned Medicare spending to HRRs and states based on where beneficiaries live, rather than where they received care. Although HRRs are smaller than states, they are large enough to encompass most of the care received by beneficiaries, even if they obtain care in multiple localities or counties. Our data show that roughly 78 percent of Medicare expenditures in 2016 occurred in the same HRR where the beneficiary lived. Furthermore, HRRs generally have populations that are large enough to generate stable averages for comparisons of cost and utilization, even for narrowly defined combinations of conditions and services.

**Table 1: Study Population in the GV PUF**

| | *2007* | | *2009* | | *2011* | | *2013* | | *2016* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Count** | **Percent** | **Count** | **Percent** | **Count** | **Percent** | **Count** | **Percent** | **Count** | **Percent** |
| *Total Medicare beneficiaries* | 46,735,669 | 100.0% | 48,916,748 | 100.0% | 51,667,138 | 100.0% | 55,206,238 | 100.0% | 59,748,964 | 100.0% |
| *Beneficiaries excluded: Any enrollment in MA* | 9,413,557 | 20.1% | 11,786,418 | 24.1% | 13,113,962 | 25.4% | 15,700,076 | 28.4% | 19,421,665 | 32.5% |
| *Part A only or Part B only* | 4,449,418 | 9.5% | 4,877,672 | 10.0% | 5,309,546 | 10.3% | 5,864,361 | 10.6% | 6,345,655 | 10.6% |
| *Total excluded beneficiaries* | 13,862,975 | 29.7% | 16,664,090 | 34.1% | 18,423,508 | 35.7% | 21,564,437 | 39.1% | 25,767,320 | 43.1% |
| *Study Population* | 32,872,694 | 70.3% | 32,252,658 | 65.9% | 33,243,630 | 64.3% | 33,641,801 | 60.9% | 33,981,644 | 56.9% |
| *Beneficiaries in study population that died during the year* | 1,515,588 | 3.2% | 1,450,580 | 3.0% | 1,488,744 | 2.9% | 1,483,291 | 2.7% | 1,442,768 | 2.4% |

*Note: Percentages may not sum to totals because of rounding.*

**Table 2: Demographics of Beneficiaries in the GV PUF**

| | *2007* | | *2009* | | *2011* | | *2013* | | *2016* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Count** | **Percent** | **Count** | **Percent** | **Count** | **Percent** | **Count** | **Percent** | **Count** | **Percent** |
| *Total FFS Medicare beneficiaries* | 32,872,694 | 70.3% | 32,252,658 | 65.9% | 33,243,630 | 64.3% | 33,641,801 | 60.9% | 33,981,644 | 56.9% |
| *By age:* | | | | | | | | | | |
| < 40 | 893,073 | 2.7% | 910,087 | 2.8% | 980,089 | 2.9% | 990,371 | 2.9% | 907,621 | 2.7% |
| 41 to 64 | 4,616,269 | 14.0% | 4,692,492 | 14.5% | 5,025,522 | 15.1% | 5,017,361 | 14.9% | 4,691,318 | 13.8% |
| 65 to 74 | 13,129,489 | 39.9% | 12,985,217 | 40.3% | 13,539,267 | 40.7% | 14,166,072 | 42.1% | 15,216,392 | 44.8% |
| 75 to 84 | 9,787,184 | 29.8% | 9,169,809 | 28.4% | 9,053,183 | 27.2% | 8,828,218 | 26.2% | 8,688,628 | 25.6% |
| 85 to 95 | 4,037,913 | 12.3% | 4,071,836 | 12.6% | 4,196,031 | 12.6% | 4,170,731 | 12.4% | 3,973,847 | 11.7% |
| 95+ | 408,766 | 1.2% | 423,217 | 1.3% | 449,538 | 1.4% | 469,048 | 1.4% | 503,838 | 1.5% |
| *By gender:* | | | | | | | | | | |
| Female | 18,458,053 | 56.2% | 18,035,304 | 55.9% | 18,464,420 | 55.5% | 18,577,930 | 55.2% | 18,650,721 | 54.9% |
| Male | 14,414,641 | 43.8% | 14,217,354 | 44.1% | 14,779,210 | 44.5% | 15,063,871 | 44.8% | 15,330,923 | 45.1% |
| *By race/ ethnicity:* | | | | | | | | | | |
| White, non-Hispanic | 26,952,446 | 82.0% | 26,208,974 | 81.3% | 26,747,885 | 80.5% | 26,901,204 | 80.0% | 27,037,631 | 79.6% |
| African American | 3,084,854 | 9.4% | 3,086,068 | 9.6% | 3,278,721 | 9.9% | 3,309,581 | 9.8% | 3,218,260 | 9.5% |
| Hispanic | 1,806,462 | 5.5% | 1,850,901 | 5.7% | 1,970,137 | 5.9% | 1,993,608 | 5.9% | 1,994,862 | 5.9% |
| Asian/ Pacific Islander | 632,186 | 1.9% | 676,125 | 2.1% | 734,626 | 2.2% | 781,309 | 2.3% | 838,204 | 2.5% |
| Other | 396,746 | 1.2% | 430,590 | 1.3% | 512,261 | 1.5% | 656,099 | 2.0% | 892,687 | 2.6% |

*Note: Percentages may not sum to totals because of rounding.*

## 4. Standardization and risk adjustment

These data will help users analyze underlying differences in resource use among Medicare beneficiaries in different parts of the country. These differences reflect variation in such factors as physicians' practice patterns and beneficiaries' ability and willingness to obtain care. However, Medicare spending and utilization can vary for reasons that are not attributable to practice patterns or willingness to seek care, and two of those reasons are particularly important. First, Medicare often pays different amounts for the same service in different areas (for example, to reflect variation in local wages or input prices). Second, the health of Medicare beneficiaries also varies geographically, and those differences will clearly affect spending and utilization.

To account for those factors, we modified the data from the CCW in two ways:

- We standardized Medicare's payment amounts to remove geographic differences in payment rates for individual services as a source of variation, and

- We adjusted for differences in beneficiaries' health using the risk-adjustment model that CMS uses to pay MA plans.

### Standardization

We standardized payment rates using the same methodology that CMS uses to calculate its Medicare spending per beneficiary (MSPB) metric for the hospital value-based purchasing program. (The only exception is that we standardize the Medicare payment amount, while the methodology used for the MSPB standardizes the allowed amount.) This methodology examines Medicare's various FFS payment systems and identifies the factors that lead to different payment rates for the same service. In general, those factors are adjustments that Medicare makes to account for local wages or input prices, and extra payments that Medicare makes to advance other program goals, such as compensating certain hospitals for the cost of training doctors. We generally then either built up a payment amount using just the base rate for the service and the weight applied under the particular payment system for that service, or worked backward from the actual payment amount to determine what Medicare would have paid without those adjustments.

The process that we used to calculate standardized payments for each claim under the major FFS payment systems is summarized below. For additional detail, please refer to the Technical Supplement.

*Inpatient acute care hospitals paid under the prospective payment system (PPS).* We took the operating and capital base rates and multiplied them by the relative weight for each claim's diagnosis-related group. We then added an adjusted outlier payment as well as any new technology payment if they were included on the claim.

Medicare uses the hospital wage index to adjust base rates to reflect local differences in wage levels. For example, the base payment rate in FY 2010 for chronic obstructive pulmonary disease (without any complications or comorbidities) was $4,056 but the amount that Medicare paid after

the wage index was applied ranged from a low of $3,391 in rural Alabama to a high of $5,768 in Santa Cruz, California. Effectively, under standardization we calculated all payment amounts with the wage index set at 1.0 to eliminate those differentials.

Our methodology excluded a number of other payments that hospitals can receive under the PPS: payments for medical education (both direct and indirect), payments to hospitals that serve a disproportionate share of low-income patients, payments for bad debt (deductibles and cost sharing that beneficiaries do not pay), and extra payments to certain rural hospitals such as sole community hospitals and Medicare-dependent hospitals.

Under the inpatient PPS, Medicare uses a per-diem methodology to make reduced payments for certain short-stay transfers and for discharges in certain MS-DRGs where the beneficiary goes on to receive post-acute care. In those instances, we used the reduced payment amount as the starting point for standardization rather than the higher, DRG-based amount.

Payment rates for hospitals in Maryland are set by the state's all-payer rate-setting commission. For claims from those facilities for 2007-2010, we worked backward from actual paid amounts to remove the impact of wages, using the wage index, and of payments for medical education and uncompensated care, using hospital-specific factors that we developed based on data supplied by the state's rate-setting commission. Starting with 2011, we used a different approach and determined the standardized payment using the method for inpatient PPS hospitals.

*Critical Access Hospitals (CAHs).* For 2007-2010, since CAHs are paid on a cost-plus basis, we determined the standardized payment by adjusting for the lower wages paid in rural areas, which we calculated by dividing the actual amount paid by the local wage index. Starting with 2011, we used a different approach and determined the standardized payment using the method for inpatient PPS hospitals.

*Long-term care hospitals (LTCHs).* We took the base payment rate for LTCHs and multiplied it by the relative weight for each claim's diagnosis-related group. We then added an adjusted outlier payment if it was included on the claim. As with inpatient PPS hospitals, payments are reduced for certain short stays, and in those cases we used the reduced payment amount as the starting point for standardizing instead of the DRG-based amount.

Medicare uses the hospital wage index to adjust base rates for LTCHs. Effectively, under standardization we calculated all payment amounts with the wage index set at 1.0 to eliminate those differentials.

*Inpatient rehabilitation facilities (IRFs).* We took the base payment rate for IRFs and multiplied it by the weight for each claim's case-mix-group. We then added an adjusted outlier payment that the hospital received if the claim was for an unusually high-cost case. As with inpatient PPS hospitals, payments are reduced for certain short stays, and in those cases we used the reduced payment amount as the starting point for standardizing instead of the amount based on the case-mix-group.

Medicare uses the hospital wage index to adjust base rates for IRFs. Effectively, under standardization we calculated all payment amounts with the wage index set at 1.0 to eliminate those differentials.

Our methodology excluded the additional payments that Medicare makes to certain rural facilities, facilities that treat large numbers of low-income patients, and facilities that are part of teaching hospitals.

*Inpatient psychiatric facilities (IPFs).* We took the base payment rate for IPFs and followed Medicare's rules for adjusting that rate to account for the patient's age, the weight for their diagnosis-related group, length of stay, and comorbidities (if any). We then added an adjusted outlier payment and a payment for electroconvulsive therapy if the claim included such add-ons.

Medicare uses the hospital wage index to adjust base rates for IPFs. Effectively, under standardization we calculated all payment amounts with the wage index set at 1.0 to eliminate those differentials.

Our methodology also excludes the additional payments that Medicare makes to certain rural facilities, facilities that are part of teaching hospitals, and facilities in Alaska and Hawaii.

*Skilled nursing facilities (SNFs).* We took the base daily payment rates for SNFs (there are separate ones for urban and rural facilities; we used the average of the two) and multiplied the nursing and rehabilitation components by the appropriate weight for that claim's resource utilization group. By using the base payment rates, we eliminated the impact of the hospital wage index, which Medicare uses to adjust SNF payment rates. We then multiplied the overall daily rate by the number of days on the claim and the AIDS adjustment, if applicable. We calculated standardized payments for swing beds in CAHs in a manner similar to inpatient services in CAHs (i.e., we adjusted for the effects of local wages).

*Home health services.* We took the base rate for home health services and multiplied it by the weight for each claim's home health resource group. We then added an adjusted outlier payment that the home health agency received if the claim was for an unusually high-cost case. For short stay claims, we work backward from the actual payment, removing the impact of the wage index.

Medicare uses a version of the hospital wage index to adjust base rates and outlier payments for home health services. Effectively, under standardization we calculated all payment amounts with the wage index set at 1.0 to eliminate those differentials.

*Hospice care.* We generally used the base daily and hourly payment rates for hospice care as the standardized rates. By using the base payment rates, we eliminated the impact of the hospice wage index, which Medicare uses to adjust hospice payment rates. For services of physicians or nurse practitioners billed on a hospice claim, we used the actual payment as the standardized amount.

*Outpatient hospital services PPS.* We calculated standardized payments amounts at the revenue center line level, except for outlier payments, which we determined at the claim level. For revenue center lines that were included in an ambulatory payment classification (APC), we generally used

the conversion factor for outpatient services and multiplied it by the weight for the relevant APC and by the number of units. For revenue center lines that were paid using another Part B payment system (such as clinical lab), we used the methodology described below for that payment system. To the extent feasible, we followed payment rules that reduce payment amounts for multiple or interrupted services by 50 percent. For revenue center lines that reflect pass-through services, we did not make any adjustments to the actual paid amounts. Finally, we added an adjusted outlier payment that the hospital received if the claim was for an unusually high-cost case.

As with inpatient services, payment rates for hospitals in Maryland are set by the state's all-payer rate-setting commission; in those cases, for 2007-2010, we worked backward from actual paid amounts to remove the impact of wages, using the wage index, and of payments for medical education and uncompensated care, using hospital-specific factors that we developed based on data supplied by the state's rate-setting commission. For outpatient services that were provided by CAHs in 2007-2010, we used a methodology similar to the one used for CAH inpatient services during those years. Starting with 2011, for both Maryland hospitals and CAHs, we used a different approach and determined the standardized payment using the method for outpatient PPS hospitals.

Medicare uses the hospital wage index to adjust base rates and outlier payments for outpatient hospital services. Effectively, under standardization we calculated all payment amounts with the wage index set at 1.0 to eliminate those differentials.

*Outpatient dialysis facilities.* For outpatient dialysis facilities, we determined standardized amounts by working backward from paid amounts to remove the impact of the wage index.

*Ambulatory surgical centers (ASCs).* We took the conversion factor for ASC services and multiplied it by the relative weight for the ASC service provided and by the number of units provided. By using just the conversion factor and the relative weights, we eliminated the impact of the hospital wage index, which Medicare uses to adjust ASC payment rates. We followed Medicare rules by reducing payment amounts on claims for multiple or interrupted services by 50 percent.

*Physician services.* Medicare uses three geographic practice cost indices to adjust payment rates for physician services. We eliminated those differentials by simply taking the appropriate facility or non-facility payment amount from the fee schedule. We followed Medicare payment rules such as the reduction for multiple procedures and the reduction when services are provided by non-physician providers (such as physician assistants and nurse practitioners). Standardized payments do not include bonuses received in health professional shortage areas or the discount on payments to non-participating physicians.

*Anesthesia services.* For anesthesia claims, we used the base time unit, added any additional 15-minute time units, and multiplied the sum by the conversion factor. We followed payment rules with regard to discounting multiple procedures or when services are furnished by a certified registered nurse anesthetist.

*Durable medical equipment (DME), prosthetics, and orthotics.* Medicare pays for DME, prosthetics, and orthotics using a combination of state-specific fee schedules and a national fee

schedule that has minimum and maximum payment amounts. (Since 2011, Medicare has used competitive bidding to pay for certain DME items in some areas.) For DME claims, we used the ceiling amount on the national fee schedule as the payment amount for each claim. For prosthetics and orthotics, we used five-sixths of the ceiling as the payment amount.

*Laboratory services.* Medicare pays for laboratory services using state-specific fee schedules, but they are subject to a national limitation that applies to most claims. Generally, we used that national limit times the number of units to determine the standardized amount.

*Ambulance services.* Medicare pays for ambulance services using a fee schedule that pays separately for mileage and for the level of support provided during the trip. We did not make any adjustments to payments for mileage-related codes. For all other codes, we used the average payment amount for each code as the standardized amount.

*Other services.* We did not adjust payment amounts for drugs covered under Part B (which are paid using national rates) or for parenteral and enteral nutrition claims. For federally-qualified health centers and rural health centers, we worked back from the actual payment amount to determine the standardized amount by removing the impact of wage variation. The determination of standardized payments for Comprehensive Outpatient Rehabilitation Facilities (CORFs) and Outpatient Rehabilitation Facilities (ORFs) follows the methodology for physician services. Determination of standardized payments for Community Mental Health Centers (CMHCs) follows the methodology for hospital outpatient services.

Finally, we reduced all payment amounts to reflect any cost sharing that Medicare beneficiaries paid through a deductible, copayment, or coinsurance. For example, Part A had a deductible in 2015 of $1,260 for inpatient care and charged copayments on beneficiaries who received more than 60 days of inpatient care, while Part B had a deductible of $147 and required beneficiaries to pay coinsurance of 20 percent for most services.

**Risk adjustment**

CMS developed a risk-adjustment model that uses HCCs (hierarchical condition categories) to assign risk scores. Those scores estimate how beneficiaries' FFS spending will compare to the overall average for the entire Medicare population. The average risk score is set at 1.0; beneficiaries with scores greater than that are expected to have above-average spending, and vice versa. Risk scores are based on a beneficiary's age and sex; whether the beneficiary is eligible for Medicaid, first qualified for Medicare on the basis of disability, or lives in an institution (usually a nursing home); and the beneficiary's diagnoses from the previous year.[2] The HCC model was designed for risk adjustment on larger populations, such as the enrollees in an MA plan, and

[2] Other methods of risk adjustment exist. For example, the Dartmouth Atlas has adjusted for risk in some of its research by comparing beneficiaries with the same chronic condition during the last two years of life and by comparing beneficiaries who are admitted to the hospital for the same reason. We decided to use the HCC model because it is generally regarded as the best risk-adjustment model available and is used by CMS for both MA and (in a modified form) Part D payment. However, the HCC model relies in part on diagnoses, so scores may reflect variation in physicians' practice patterns rather than beneficiaries' health status. For example, some areas with high utilization patterns may look riskier because more diagnoses will show up on claims.

generates more accurate results when used to compare groups of beneficiaries rather than individuals.

CMS uses HCCs to determine the diagnosis-related portion of the risk score. For example, the HCC system for 2010 included a total of 189 conditions, with related conditions grouped into 70 disease hierarchies. One hierarchy had three different diseases that affect the liver: end-stage liver disease, cirrhosis, and chronic hepatitis. Each condition had a weight that reflects its marginal contribution to a beneficiary's total expected Medicare costs.

Under the HCC system, CMS calculates the diagnosis-related portion of a beneficiary's risk score by adding up the weights for the most severe diagnosis that the beneficiary has in each disease hierarchy. Continuing the example above, a beneficiary with both cirrhosis (weight = 0.406) and chronic hepatitis (weight = 0.406) would receive credit only for the cirrhosis diagnosis.[3] The researchers who developed the HCC system adopted this approach after finding that having multiple conditions within a hierarchy did not increase overall patient spending substantially.

We used the risk scores to adjust spending data at the beneficiary level rather than in aggregate. As a result, the aggregate standardized, risk-adjusted spending in a region does not equal the aggregate standardized costs divided by the average HCC risk score. In addition, the HCC model was not designed to risk-adjust spending for individual services and therefore is not applied to service-level spending. The Medicare Payment Advisory Commission has used a similar approach in some of its work.[4]

By standardizing payment amounts and adjusting for differences in beneficiaries' health status, these data provide a more accurate picture of how resource use varies for Medicare beneficiaries across the country.

**5. Utilization measures**

In addition to standardizing and risk-adjusting spending amounts, we also calculated a series of figures that measure actual utilization for certain major types of Medicare-covered services. We used the claims-level data from the CCW to generate three different types of utilization measures for each geographic region:

- The *number of times* that the beneficiaries in our study population used a particular service, expressed in terms of usage per 1,000 beneficiaries. We calculated these figures across all beneficiaries in our study population, not just the beneficiaries who used that particular service. The metrics that we used to measure utilization varied by the type of service and are described in more detail below.

- The *number of beneficiaries* in our study population who used a particular service

[3] The HCC model has two sets of weights: one for beneficiaries living in the community and another for beneficiaries living in an institution. This example uses the weights for a beneficiary living in the community (which happen to be identical for these two conditions).

[4] For example, see Medicare Payment Advisory Commission, *Measuring Regional Variation in Service Use*, December 2009.

- The *percentage of beneficiaries* in our study population who used a particular service

We generated these utilization measures for 16 major service categories. Those categories are listed below, grouped by the units of measurement that we used for each service:

- Number of stays, number of days of care[5]
  - Inpatient hospital care (including inpatient acute care hospitals paid under the PPS, CAHs, and other inpatient hospital care[6])
  - LTCHs
  - IRFs
  - SNFs
  - Hospice

- Number of episodes, number of visits
  - Home health

- Number of visits
  - Hospital outpatient services
  - Outpatient dialysis facilities
  - Clinics (federally-qualified health centers and rural health centers)

- Number of events
  - ASCs
  - Physician evaluation and management services
  - Physician procedures
  - Imaging
  - DME
  - Tests (laboratory and non-laboratory)
  - Ambulance

We also generated figures for the number and percentage of beneficiaries using prescription drugs that are covered under Part B. We did not calculate the number of times that beneficiaries used those drugs because of the difficulty in devising a standard way to measure their utilization.

Finally, we also calculated four metrics on all-cause hospital readmissions[7] and emergency room (ER) use:

- Total number of all-cause hospital readmissions

- All-cause hospital readmission rate (i.e., the number of readmissions divided by the total number of admissions where the beneficiary was discharged alive)

[5] Our calculations for all hospital-related and SNF services were based only on Medicare-covered days.
[6] This category includes hospitals such as IPFs and cancer hospitals.
[7] We used all readmissions that took place within 30 days of the initial discharge.

- Total number of ER visits

- Total number of ER visits per 1,000 beneficiaries

## 6. Quality measures

The relationships between the quality, use, and cost of health care are important elements to consider when analyzing the geographic variation in Medicare spending. For example, do areas with above-average spending provide high-quality care, or is there little correlation between the two?

The statistics on hospital readmissions and ER visits discussed above are useful in examining some issues related to the quality of care, such as continuity of care and access to primary care. We have supplemented those metrics by adding dozens of other quality-related measures to support additional analyses. We first selected individual quality measures from the Prevention Quality Indicators' measure set, which is publicly available software developed by AHRQ that uses administrative data to measure hospital admission rates for ambulatory care sensitive conditions. Due to small cell sizes for many of the measures, we do not present the PQIs in the county-level data.

These measures have been endorsed by the National Quality Forum and are well-known to health care researchers and quality improvement organizations. See Appendix 2 for a complete list of the measures that we included in the data set.

*Calculation of HRR-level and state-level scores for individual measures.* The current PQI software contains a total of 17 different measures. We decided not to use eight of those measures, either because they address issues that are not significant for the Medicare population (such as obstetric care) or because the sample size is too small. We then took the remaining 9 measures, which are usually reported for an individual zip code or provider, and aggregated them at the HRR and state level.

We did this by downloading the PQI software from the AHRQ website and applying it to inpatient claims. The software generates results by metropolitan statistical area; we then followed procedures developed by AHRQ to convert those results to the zip code level. We then added the results for all zip codes in each HRR or state. We used AHRQ's software to calculate each PQI measure separately for beneficiaries under age 65, those between the ages of 65 and 74, and those who were 75 or older (with some exceptions if the measure specifications dictated otherwise; see Appendix 2).

## 7. Changes from the March 2017 dataset to the May 2018 update

In March 2017, CMS posted a GV PUF with data for calendar years 2007-2015. This May 2018 update has data for calendar years 2007-2016. One notable change from the 2017 PUF to the 2018 PUF is the underlying source data used to determine beneficiary enrollment, which had an impact on the geographic distribution of data within the 2018 PUF.

Historically, the Enrollment Database (EDB) has been the source for Medicare enrollment and demographic information for the Master Beneficiary Summary File (MBSF), which forms the basis for the GV PUF enrollment data. However, since the EDB was first developed, the Medicare program has become increasingly complex and Medicare enrollment and other data systems have evolved. CMS has now designated the Common Medicare Environment (CME) database as the single, enterprise-wide authoritative source for Medicare beneficiary enrollment and demographic data. Since the last version of the GV PUF, we have transitioned the source for enrollment and demographic information in the MBSF from the EDB to the CME database.

In some cases, this change affected what county a beneficiary is assigned to in the GV PUF. The EDB relied on point-in-time SSA codes to identify a beneficiary's county of residence, while the CME uses a last-best monthly FIPS code to identify the county the beneficiary resided in. For example, beneficiaries in zip code 50266 can live in Dallas or Polk counties in Iowa. The EDB designates all beneficiaries in 50266 as living in Polk County, while in the CME, beneficiaries are split between Polk and Dallas counties.

This CME as the source for beneficiary enrollment has been applied to all years of data in the May 2018 GV PUF. The change will result in differences in total beneficiary enrollment counts, as well as utilization and spending data, in the 2018 GV PUF compared to previous versions of the PUF.

**Appendix 1 - Hospital Referral Regions**

We list HRRs by state and the name of the primary city or county within each HRR. For maps that show the specific boundaries for each HRR, please go to: http://www.dartmouthatlas.org/downloads/methods/geogappdx.pdf.

| | |
|---|---|
| Alabama (6) | Birmingham, Dothan, Huntsville, Mobile, Montgomery, Tuscaloosa |
| Alaska (1) | Anchorage |
| Arizona (4) | Mesa, Phoenix, Sun City, Tucson |
| Arkansas (5) | Fort Smith, Jonesboro, Little Rock, Springdale, Texarkana |
| California (24) | Alameda County, Bakersfield, Chico, Contra Costa County, Fresno, Los Angeles, Modesto, Napa, Orange County, Palm Springs, Redding, Sacramento, Salinas, San Bernadino, San Diego, San Francisco, San Jose, San Luis Obispo, San Mateo County, Santa Barbara, Santa Cruz, Santa Rosa, Stockton, Ventura |
| Colorado (7) | Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Pueblo |
| Connecticut (3) | Bridgeport, Hartford, New Haven |
| Delaware (1) | Wilmington |
| District of Columbia (1) | Washington |
| Florida (18) | Bradenton, Clearwater, Fort Lauderdale, Fort Myers, Gainesville, Hudson, Jacksonville, Lakeland, Miami, Ocala, Orlando, Ormond Beach, Panama City, Pensacola, Sarasota, St. Petersburg, Tallahassee, Tampa |
| Georgia (7) | Albany, Atlanta, Augusta, Columbus, Macon, Rome, Savannah |
| Hawaii (1) | Honolulu |
| Idaho (2) | Boise, Idaho Falls |
| Illinois (13) | Aurora, Bloomington, Blue Island, Chicago, Elgin, Evanston, Hinsdale, Joliet, Melrose Park, Peoria, Rockford, Springfield, Urbana |
| Indiana (9) | Evansville, Fort Wayne, Gary, Indianapolis, Lafayette, Muncie, Munster, South Bend, Terre Haute |
| Iowa (8) | Cedar Rapids, Davenport, Des Moines, Dubuque, Iowa City, Mason City, Sioux City, Waterloo |
| Kansas (2) | Topeka, Wichita |
| Kentucky (5) | Covington, Lexington, Louisville, Owensboro, Paducah |
| Louisiana (10) | Alexandria, Baton Rouge, Houma, Lafayette, Lake Charles, Metairie, Monroe, New Orleans, Shreveport, Slidell |
| Maine (2) | Bangor, Portland |
| Maryland (3) | Baltimore, Salisbury, Takoma Park |
| Massachusetts (3) | Boston, Springfield, Worcester |
| Michigan (15) | Ann Arbor, Dearborn, Detroit, Flint, Grand Rapids, Kalamazoo, Lansing, Marquette, Muskegon, Petoskey, Pontiac, Royal Oak, Saginaw, St. Joseph, Traverse City |

| | |
|---|---|
| Minnesota (5) | Duluth, Minneapolis, Rochester, St. Cloud, St. Paul |
| Mississippi (6) | Gulfport, Hattiesburg, Jackson, Meridian, Oxford, Tupelo |
| Missouri (6) | Cape Girardeau, Columbia, Joplin, Kansas City, Springfield, St. Louis |
| Montana (3) | Billings, Great Falls, Missoula |
| Nebraska (2) | Lincoln, Omaha |
| Nevada (2) | Las Vegas, Reno |
| New Hampshire (2) | Lebanon, Manchester |
| New Jersey (7) | Camden, Hackensack, Morristown, New Brunswick, Newark, Paterson, Ridgewood |
| New York (10) | Albany, Binghamton, Bronx, Buffalo, East Long Island, Elmira, Manhattan, Rochester, Syracuse, White Plains |
| New Mexico (1) | Albuquerque |
| North Carolina (9) | Asheville, Charlotte, Durham, Greensboro, Greenville, Hickory, Raleigh, Wilmington, Winston-Salem |
| North Dakota (4) | Bismarck, Fargo, Grand Forks, Minot |
| Ohio (10) | Akron, Canton, Cincinnati, Cleveland, Columbus, Dayton, Elyria, Kettering, Toledo, Youngstown |
| Oklahoma (3) | Lawton, Oklahoma City, Tulsa |
| Oregon (5) | Bend, Eugene, Medford, Portland, Salem |
| Pennsylvania (14) | Allentown, Altoona, Danville, Erie, Harrisburg, Johnstown, Lancaster, Philadelphia, Pittsburgh, Reading, Sayre, Scranton, Wilkes-Barre, York |
| Rhode Island (1) | Providence |
| South Carolina (5) | Charleston, Columbia, Florence, Greenville, Spartanburg |
| South Dakota (2) | Rapid City, Sioux Falls |
| Tennessee (7) | Chattanooga, Jackson, Johnson City, Kingsport, Knoxville, Memphis, Nashville |
| Texas (22) | Abilene, Amarillo, Austin, Beaumont, Bryan, Corpus Christi, Dallas, El Paso, Fort Worth, Harlingen, Houston, Longview, Lubbock, McAllen, Odessa, San Angelo, San Antonio, Temple, Tyler, Victoria, Waco, Wichita Falls |
| Utah (3) | Ogden, Provo, Salt Lake City |
| Vermont (1) | Burlington |
| Virginia (8) | Arlington, Charlottesville, Lynchburg, Newport News, Norfolk, Richmond, Roanoke, Winchester |
| West Virginia (3) | Charleston, Huntington, Morgantown |
| Wisconsin (8) | Appleton, Green Bay, La Crosse, Madison, Marshfield, Milwaukee, Neenah, Wausau |
| Washington (6) | Everett, Olympia, Seattle, Spokane, Tacoma, Yakima |
| Wyoming (1) | Casper |

## Appendix 2 – Quality Measures Included in the GV PUF

**Prevention Quality Indicators (9 measures, calculated per 100,000 beneficiaries in the specified age groups)**

| |
|---|
| Diabetes long-term complications admission rate (<65, 65-74, 75+) |
| Chronic obstructive pulmonary disease or asthma in older adults admission rate (40-64, 65-74, 75+) |
| Hypertension admission rate (<65, 65-74, 75+) |
| Congestive heart failure admission rate (<65, 65-74, 75+) |
| Dehydration admission rate (<65, 65-74, 75+) |
| Bacterial pneumonia admission rate (<65, 65-74, 75+) |
| Urinary tract infection admission rate |
| Asthma in younger adults (<40) |
| Rate of lower extremity amputations among patients with diabetes (<65, 65-74, 75+) |

**Readmissions and Emergency Room Use (4 measures)**

| |
|---|
| Total number of hospital readmissions |
| Hospital readmission rate |
| Total number of emergency room visits |
| Total number of emergency room visits per 1000 beneficiaries |