

# **Determinants of Geographic Variation in Medicare Spending**

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## Executive Summary

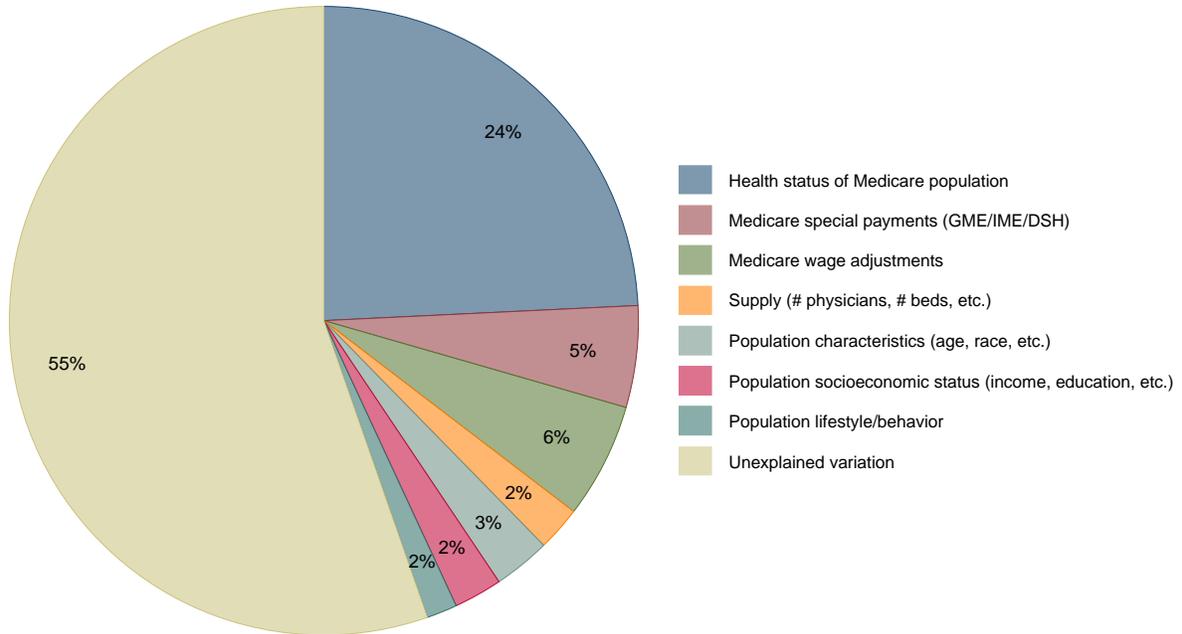
There is a large literature that documents substantial variation in health care spending across geographic areas. A similarly large literature attempts to identify the determinants of the variation in spending across geographic areas. Much of the literature, especially in the context of attempting to explain variation has used geographic market areas as defined and promulgated by the Dartmouth Atlas of Health Care.

In this study we examine the contributions of a large number of potential determinants of geographic variation in healthcare spending using counties as the geographic unit of analysis and per-beneficiary Medicare spending as the measure of spending. We conduct comprehensive regression analyses drawing on data from a variety of sources including CMS county-level data files, Area Resource File (ARF), and the Behavioral Risk Factors Surveillance System (BRFSS) surveys.

Our results depicted in Figure 1 show the following:

1. A relatively small set of county level determinants explains about 45 percent of county-level variation in Parts A and B Medicare spending per beneficiary.
2. Health status of the Medicare population is, by far, the most important determinant of spending, accounting for 24 percent of variation in spending.
3. Medicare special payments (indirect medical education (IME), direct graduate medical education (GME), and disproportionate share (DSH)) and Medicare wage adjustments are about equally important as one another, accounting for 5 and 6 percent of spending respectively.
4. Measures of the supply of healthcare services including per county numbers and types of MDs, hospital beds, SNF beds, nursing facilities, home health agencies, ASCs and hospices, etc. explain only 2 percent of the county-level variation in Medicare spending.
5. Population characteristics such as age and race, measures of socioeconomic status such as income, education, etc. and measures of population lifestyle and behavior including consumption of fruits and vegetables, cigarettes and alcohol, BMI, obesity rates, and rates of sedentary lifestyles, etc. each explain about 2-3 percent of Medicare spending per beneficiary. Note that a number of these population characteristics, included in the regression as separate variables, are also determinants of health status, thereby contributing indirectly to Medicare spending over and above the direct effects.

**Figure 1: Proportion of Medicare Spending Explained by Classes of Determinants**  
Explaining Geographic Variation in Spending Per Medicare Beneficiary  
Parts A+B Spending For All Medicare Beneficiaries



## Study in detail

In this study we examine the contributions of a large number of potential determinants of geographic variation in Medicare spending per beneficiary at the county-level.

### Data

The analytical dataset, suitable for regression analysis, contained annual observations at the county level from 2000 – 2007 drawing on data from:

1. CMS county-level files
2. Area Resource File (ARF)
3. Behavioral Risk Factors Surveillance System (BRFSS)

The CMS county-level files are available separately for aged, disabled and end-stage renal disease (ESRD) beneficiaries, and contain total Medicare fee-for-service (FFS) reimbursement, enrollment counts and per capita beneficiary reimbursement, for both Parts A and B. For Part A, reimbursement for direct graduate medical education (GME), indirect medical education (IME) and disproportionate share (DSH) expenditures are also included. These files also contain a health risk score derived from average risk factors for each county based on diagnoses from inpatient claims and other sites of service. These scores are derived from the Hierarchical Clinical Conditions (HCC) software. CMS's Impact Files used for the Final Rules for the inpatient prospective payment system (IPPS) were used to obtain the Medicare Part A wage indices at the MSA/CBSA level. In the earlier years of our sample, wage indices were reported at the MSA level. In more recent years, wage indices are reported at the CBSA level. In both cases, the wage indices were assigned to counties using MSA/CBSA to county crosswalks. These raw wage indices were then weighted by the total number of hospital discharges in the county to arrive at discharge weighted wage indices. The statewide average of each weighted wage index was used as a proxy for the wage index in non MSA/CBSA counties. For Part B, Geographic Practice Cost Indices (GPCIs) are used to adjust payments to physicians for geographic variation in the cost of providing services. There are 89 GPCI payment localities that were initially defined in 1996. These localities have been assigned to counties wherever possible. In addition, the statewide value is used for counties that are not GPCI localities.

The Area Resource File (ARF), available from the Health Resources and Services Administration (HRSA) is a national county-level database and contains information on health providers, health status and socioeconomic characteristics, among others. The Centers for Disease Control and Prevention's (CDC's) Behavioral Risk Factor Surveillance System (BRFSS) is a telephone survey that tracks health conditions as well as risk behaviors.

The outcome variable is Medicare spending (on Parts A and B) per beneficiary by county and year. The definition of beneficiary includes the aged and disabled populations; the ESRD population was excluded. This variable is obtained from the CMS county-level files described above. The potential determinants included Medicare population health status, Medicare wage adjustments, other special Medicare payment adjustments (IME, GME and DSH), measures of healthcare supply, population characteristics, population socioeconomic

status and measures of population lifestyle and behavior. After comprehensive preliminary studies, we arrived at a smaller set of indicators for each of the variable categories. Table 1 below provides details of the variables used in the final analysis and their source. While the CMS files and the ARF provide data at the county-level, the BRFSS contains data at the individual level which were aggregated by year to the county level.

**Table 1: Data Sources for Regression Variables**

<b>Group / Variable</b>	<b>Data Source</b>
<i>Medicare population health status</i>	
CMS Risk Score Derived from HCC software	CMS
Percent Disabled Medicare Enrollees	CMS - derived
<i>Medicare wage adjustments</i>	
Part A Weighted Wage Index	CMS - derived
GPCI	CMS
<i>Other Medicare payment adjustments</i>	
Direct Graduate Medical Education (GME)	CMS
Indirect Medical Education (IME)	CMS
Disproportionate Share Hospital payment (DSH)	CMS
<i>Healthcare supply</i>	
M.D.'s, Patient Care, Office Based Non-Federal Per 100 Enrollees	ARF
M.D.'s, Total Teaching Non-Federal Per 100 Enrollees	ARF
M.D.'s, Total Research Non-Federal Per 100 Enrollees	ARF
Total Hospital Beds Per 100 Enrollees	ARF
Skilled Nursing Facilities Total Beds Per 100 Enrollees	ARF
Nursing Facilities Total Beds Per 100 Enrollees	ARF
Number of Home Health Agencies Per 100 Enrollees	ARF
Number of Ambulatory Surgery Centers Per 100 Enrollees	ARF
Number of Hospices Per 100 Enrollees	ARF
Number of Federally Qualified Health Centers Per 100 Enrollees	ARF
<i>Population characteristics</i>	
Population >=85, 2000 Census, Per 100 Population	ARF - derived
Population Black/African American Non-Hispanic/Latino, Per 100 Population	ARF
Population Asian, Per 100 Population	ARF
Population Total Hispanic/Latino, Per 100 Population	ARF
Veteran Population Estimate, Per 100 Population	ARF
<i>Population socioeconomic status</i>	
Proportion with High School Diploma Among Adults>=25	ARF
Proportion of College Graduates Among Adults>=25	ARF
Median Household Income, Estimates	ARF

Percent Persons in Poverty, Estimates	ARF
Unemployment Rate, 16+	ARF
Proportion of Under 65 Uninsured	BRFSS - derived
<i>Population lifestyle, behavior</i>	
Proportion of adults with Health Checkup in Past 2 Years	BRFSS - derived
Healthy eating index based on consumption of fruits, vegetables and salad	BRFSS - derived
Proportion of adults who do Not Participate in Any Physical Activity	BRFSS - derived
Proportion of heavy drinkers defined as: Man>2, Woman>1 Drinks per day	BRFSS - derived
Proportion of Current and Daily Smoker	BRFSS - derived
BMI	BRFSS - derived
Proportion of adults who are Obese	BRFSS - derived

## Methods

We used linear regression methods to analyze the data in which the unit of observation is a county in a given year. Weighted least squares was used to estimate the parameters of the regression models in Stata v.10.1 with county and time specific Medicare enrollee population size used as analytical weights. Inference is based on robust standard errors. We used a variety of statistical model selection criteria to evaluate the strengths of categories of determinants, e.g. health status, and a variety of measures within each category, before arriving at the final model.

The key results of the regression analyses are shown in Figure 1 and reported in the executive summary preceding this description. Nevertheless, it is useful to see which measures within each group of variables are statistically significant. These are shown in Table 2 below. The regression results show that both measures of health status are significant and so are both measures of county-level health sector wages. A number of healthcare supply variables are significant as well, but the number of hospital beds, as well as the number of teaching and research M.D's are notably insignificant. Among population characteristics, only the veteran population is not a statistically significant determinant of Medicare costs. Income and unemployment rates are significant, but not poverty rates or uninsurance rates among the non-Medicare population. Finally, a number of health-related lifestyle and behavior characteristics including participation in physical activity and drinking and smoking rates are significant. Note that these behavioral variables are known to be significant determinants of the measures of health status also included in the regressions. Therefore, the coefficients on these behavioral variables are likely smaller than they would be if the other measures of health status were not included.

**Table 2: Regression Variables by Group**

<b>Group / Variable</b>	<b>Significance</b>
<i>Medicare population health status</i>	
CMS Risk Score Derived from HCC	**
Percent Disabled Medicare Enrollees	**
<i>Medicare wage adjustments</i>	

Part A Weighted Wage Index	**
GPCI	**
<i>Healthcare supply</i>	
M.D.'s, Patient Care, Office Based Non-Federal Per 100 Enrollees	*
M.D.'s, Total Teaching Non-Federal Per 100 Enrollees	
M.D.'s, Total Research Non-Federal Per 100 Enrollees	
Total Hospital Beds Per 100 Enrollees	
Skilled Nursing Facilities Total Beds Per 100 Enrollees	**
Nursing Facilities Total Beds Per 100 Enrollees	*
Number of Home Health Agencies Per 100 Enrollees	**
Number of Ambulatory Surgery Centers Per 100 Enrollees	**
Number of Hospices Per 100 Enrollees	**
Number of Federally Qualified Health Centers Per 100 Enrollees	*
<i>Population characteristics</i>	
Population >=85, 2000 Census, Per 100 Population	*
Population Black/African American Non-Hispanic/Latino, Per 100 Population	**
Population Asian, Per 100 Population	**
Population Total Hispanic/Latino, Per 100 Population	**
Veteran Population Estimate, Per 100 Population	
<i>Population socioeconomic status</i>	
Proportion with High School Diploma Among Adults>=25	
Proportion of College Graduates Among Adults>=25	
Median Household Income, Estimates	**
Percent Persons in Poverty, Estimates	
Unemployment Rate, 16+	**
Proportion of Under 65 Uninsured	
<i>Population lifestyle, behavior</i>	
Proportion of adults with Health Checkup in Past 2 Years	**
Healthy Eating Index based on consumption of fruits, vegetables and salad	
Proportion of who do Not Participate in Any Physical Activity	**
Proportion of Heavy Drinkers defined as: Man>2, Woman>1 Drinks Per Day	**
Proportion of Current and Daily Smoker	**
BMI	
Proportion of adults who are Obese	

\* denotes significance at the 5% level.

\*\* denotes significance at the 1% level.

Note: the dependent variable in this regression is total Medicare spending net of GME, IME and DSH, per capita.