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RESEARCH ARTICLE

Following the Money: Factors Associated with the Cost of Treating High-Cost Medicare Beneficiaries

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Objective. To identify factors associated with the cost of treating high-cost Medicare beneficiaries.
Data Sources. A national sample of 1.6 million elderly, Medicare beneficiaries linked to 2004–2005 Community Tracking Study Physician Survey respondents and local market data from secondary sources.
Study Design. Using 12 months of claims data from 2005 to 2006, the sample was divided into predicted high-cost (top quartile) and lower cost beneficiaries using a risk-adjustment model. For each group, total annual standardized costs of care were regressed on beneficiary, usual source of care physician, practice, and market characteristics.
Principal Findings. Among high-cost beneficiaries, health was the predominant predictor of costs, with most physician and practice and many market factors (including provider supply) insignificant or weakly related to cost. Beneficiaries whose usual physician was a medical specialist or reported inadequate office visit time, medical specialist supply, provider for-profit status, care fragmentation, and Medicare fees were associated with higher costs.
Conclusions. Health reform policies currently envisioned to improve care and lower costs may have small effects on high-cost patients who consume most resources. Instead, developing interventions tailored to improve care and lowering cost for specific types of complex and costly patients may hold greater potential for "bending the cost curve."

Key Words. Medicare, health care costs, market factors, heath reform, payment policy

The Patient Protection and Affordable Care Act of 2010 (PPACA) recognizes that solving Medicare's long-term fiscal crisis requires major payment and health care delivery reforms. Consequently, the Act supports demonstrations and initiatives (e.g., accountable care organizations [ACOs], bundled payments, patient-centered medical homes) designed to reduce costs and improve care in Medicare.

In developing these policies, it is important to recognize that Medicare spending is concentrated among a relatively small percentage of its enrollees. The 5 percent of Medicare beneficiaries with the highest spending account for 43 percent of total program spending, while the top 25 percent of spenders, who often have multiple chronic conditions, account for 85 percent of total spending (CBO 2005; Thorpe and Howard 2006). Thus, the ability of proposed reforms to "bend the Medicare cost curve" depends largely on how they affect the costliest beneficiaries.

This research uses patient-level data and a much richer set of explanatory factors than previous studies to examine key patient, physician, practice, and market characteristics associated with costs of high-cost Medicare beneficiaries, defined as the top 25 percent of beneficiaries arrayed by expected Medicare costs. We also analyze the bottom 75 percent as a comparison group.

Background, Theory, and Contribution

We estimate a reduced form expenditure (hereafter "cost") model containing both demand and supply factors. Costs (distinct from Medicare payments) were standardized to represent levels of service utilization. We posit three sets of factors affect medical care utilization in Medicare (Cutler and Sheiner 1999). Two represent aspects of patient demand: patient health status and other beneficiary characteristics that are correlated with health care preferences and the patient's budget constraint (i.e., income). The third set includes supply factors hypothesized to represent providers' proclivity to induce demand for their services or otherwise affect utilization through practice patterns (characteristics of the patient's usual source of care [USOC] physician and practice plus area-level variables describing provider supply and market structure) and an exogenous, geographic-based variable measuring relative physician fees (Hadley et al. 2010). Some supply-side factors might be considered endogenous, a threat we attempt to minimize through inclusion of

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very comprehensive patient health controls. We state our a priori hypotheses for those variables where theory or prior work provide clear expectations.

Most earlier studies addressing factors contributing to Medicare costs (mostly defined as government payments) rely on relationships among geographic area means (e.g., Welch et al. 1993; Center for the Evaluative Clinical Sciences 1999; Fisher et al. 2003). Area-based analyses are particularly prone to bias from unmeasured demand or supply factors likely to confound relationships among area averages (Zuckerman et al. 2010). Moreover, beneficiaries within geographic areas are likely to have heterogeneous characteristics, within-area distributions of variables are likely to vary considerably across areas, and often will not be normally distributed (e.g., health status). As a result, associations among area means and ratios will likely deviate from those that would be estimated at the individual patient level (Hadley and Reschovsky 2006). Consequently, we estimate determinants of Medicare expenditures (costs) at the beneficiary level.

Although no study can avoid specification bias by including all relevant variables, our study investigates a substantial number of both demand and supply-side variables, many of which were not included in previous work. Finally, we compare factors contributing to the costs of treating two sets of Medicare beneficiaries, based on their expected medical costs. It is important to understand how potential effects differ, because the factors that drive the utilization of high-cost beneficiaries are of greatest policy import.

Data and Methods

Data Sources

We use two primary data sources. The 2004–2005 Community Tracking Study (CTS) Physician Survey (response rate = 52 percent) provides physician and physician practice information on a sample of allopathic and osteopathic patient-care physicians practicing in the continental United States who provide at least 20 hours of direct patient care weekly. Physicians were sampled from 60 local health care markets that together are nationally representative.[1] This study uses observations on 5,554 physicians who treated elderly Medicare patients at any time during the 2004–2006 period.

The second data source is Medicare claims from 2004 through 2006 for 2.7 million non-ESRD beneficiaries aged 65 or older enrolled in the traditional fee-for-service program and who received at least one service from a CTS survey respondent between 2004 and 2006. Medicare's Unique Physician

Identifier Numbers were used to link these data sources. We also used several secondary sources to construct area-level variables, described below.

Our analysis sample consists of beneficiaries whose USOC physician was located in one of the 60 CTS sites. The observation period is 12 months (either calendar year 2006 for beneficiaries alive on December 31, 2006 or the 12 months preceding the date of death for 2006 decedents). Beneficiaries who turned 65 or were enrolled in Medicare Advantage during the observation period were excluded. After exclusions, the analysis sample comprised approximately 1.6 million beneficiaries.

We assigned beneficiaries to a USOC physician using an established algorithm based on the plurality of outpatient evaluation and management (E&M) visits over the entire 2004–2006 period (Pham et al. 2007). Every beneficiary was assigned to a physician regardless of the physician's CTS respondent status (respondent, nonrespondent, or unsampled). We explored alternative attribution rules (e.g., changing time periods, including inpatient E&M visits, etc.), but analysis results were robust.

Dependent Variable

The dependent variable is total standardized costs for all Part A and B services received during the observation year. Standardized cost differs from Medicare payment in several important ways. It:

1. incorporates the full reimbursement from payers (Medicare, patient cost sharing, and other insurers);
2. eliminates geographic payment differences that account for local input price variation;
3. eliminates differential payments for identical services across classes of providers (e.g., cost-based reimbursement for critical access hospitals versus DRG-based payment for most hospitals);
4. distributes provider-specific, social-goal payments (e.g., disproportionate share and graduate medical education payments) across all hospitals; and
5. adjusts 2005 payments (for 2006 decedents) to reflect 2006 rates.

Defining the dependent variable as standardized costs allows us to compare beneficiaries' service use, which varies less across local markets than Medicare payments (MedPAC 2009). Details concerning standardization methods are available in Appendix SA3.

Independent Variables

Health Status Risk Adjustment and Beneficiary Characteristics. Models control for beneficiaries' health status, hypothesized to be the key determinant of demand for medical care, using hierarchical coexisting conditions (HCC) risk-adjustment model variables (Pope et al. 2004). The HCC model, developed to set capitation payments for Medicare Advantage Plans, classifies ICD-9-CM codes into over 800 distinct diagnostic groups (DxGroups) on the basis of clinical similarity and resource use. The DxGroups are grouped into 184 condition categories (CCs). The CCs are then ordered into about 100 HCCs. Individuals can be assigned to multiple conditions across the HCCs, but only one condition within an HCC group. The HCC model also includes age and sex interactions, and indicators for dual eligibles and whether originally qualified for Medicare as disabled.

Unlike CMS, which uses prior year's health conditions to risk-adjust current year payment rates, our goal is to control for the effects of current illnesses on current Medicare spending. Therefore, we used concurrent HCC variable values. We enhanced our controls for health status by including interactions between HCC variables and dummies indicating the beneficiary (1) died during 2006 and (2) was long-term institutionalized (H. Yun et al. unpublished data). (CMS estimates separate HCC models for institutionalized beneficiaries).

We also control for other beneficiary characteristics potentially associated with health status. One indicates whether the beneficiary changed his/her residence to another state between 2005 and 2006 and is hypothesized to be associated with greater medical utilization. Among motivations for residential changes in this population is a decline in health prompting a move closer to family or to better suited residential situations. The other indicates whether the beneficiary received Medicare services in multiple census divisions. This variable encompasses residency in two census divisions (snowbirds), travel to obtain specialty care unavailable locally, and border crossing between adjacent census divisions. Consequently, we lack prior expectations as to this variable's association with costs.

A key demand variable hypothesized to be positively associated with utilization is beneficiary income, which was imputed using the parameters of a regression model estimated on elderly respondents to the 2003 CTS Household Survey. Family income was regressed against race, age, gender, and residential zip code characteristics (e.g., median household income, percent nonwhite). We then constructed identical explanatory variables using claims data to impute family income values.[2]

Supply-Side Factors (Physician, Practice, and Market Variables). Physician characteristics for CTS respondents, for which we lack prior expectations as to sign, included race, gender, years in practice, and whether board certified or an international medical graduate (Table 1). Clinical specialty (primary care, medical specialist, surgical specialist) is available for all USOC physicians. Interpretation of the specialty coefficients is complicated by the fact that specialty may reflect patient preferences, unmeasured patient health, or specialty-related proclivity to prescribe tests and procedures. We also included variables for responses to questions asking whether there were major problems with adequacy of time during office visits or timely communication with other providers. Both are related to the quality of care provided and hypothesized to be positively related to the likelihood of complications, duplicative tests, and greater costs. Moreover, inadequate time may increase physicians' proclivity to refer patients to specialists. We included a variable indicating whether the physician considers patients' out-of-pocket costs when making clinical decisions, which we hypothesize to be associated with lower costs.

Practice characteristics of USOC physicians who were CTS respondents included type and size; percentages of revenue from Medicaid, Medicare, and capitated contracts; the percent of hospitalized patients who use a hospitalist; and a three-level categorical variable indicating the strength of compensation incentives to provide more services to patients (based on Landon et al. 2009). We hypothesized that physicians' greater reliance on low-reimbursement Medicaid will be associated with greater supply of services to their Medicare patients (McGuire and Pauly 1991) and that greater exposure to capitation will reduce utilization through spillover effects (Baker 2003). Compensation methods rewarding greater service use are hypothesized to increase costs.

Most market variables are defined at the county level. One exception is the (CTS-respondent) physician's perception of local market competition for their services (very competitive, moderately competitive, or not at all competitive), with greater perceived competition hypothesized to be associated with induced demand and higher costs.

Consistent with prior research, provider supply is hypothesized to be positively related to the proclivity to induce demand, and hence costs (Center for the Evaluative Clinical Sciences 2007). Most supply and market structure variables were constructed from the 2005 CMS Provider of Services File and the Area Resource File. Physician capacity was measured as physicians per 1,000 county residents, and the percentages of physicians who are medical or surgical specialists. A greater share of specialists in the county is hypothesized

Table 1: Description of Key Independent Variables*

Variable	*Description*	*Source*
Beneficiary characteristics		
Enhanced HCC variables	240 variables. See Appendix SA2 for more details	Claims data
Imputed income	Predicted values from a regression estimated using 2003 CTS Household Survey data. Based on beneficiary age, race, and gender, as well as zip code level Census characteristics	2003 CTS HH survey, Census zip code data, claims data
USOC physician variables	Medical home physician is physician who provides plurality of office-based E&M visits over 3-year period, 2004–2006	Claims data
Specialty	Dummies indicating medical or surgical specialist (reference group are PCPs)	Claims data
Board certified	Dummy variable	CTS survey
Sensitive to patient out-of-pocket costs	Dummy variable indicating that the physician mostly or always considers patient out-of-pocket costs when prescribing generic versus brand name drugs, in ordering on diagnostic tests, and in deciding whether procedures be conducted in outpatient or inpatient settings	CTS survey
Foreign medical graduate	Dummy indicating medical training outside United States or Canada	CTS survey
Number of years in practice	Continuous	CTS survey
Market competition	Categorical variable indicating whether CTS respondent characterized their market situation as very competitive, moderately competitive, or not at all competitive in terms of attracting and retaining patients	CTS survey
Inadequate time	Dummy indicating physician reported inadequate time during office visits was a major problem affecting ability to provide quality care	CTS survey
Communication problems	Dummy indicating physician reported lack of timely reports from labs and other providers was a major problem affecting ability to provide quality care	CTS survey
Concern for patient out-of-pocket costs	Dummy variable indicating whether the physician considers patient out-of-pocket costs most or all of the time when deciding between prescribing brand-name and generic drugs, in deciding on the types of diagnostic tests to prescribe, or whether to	CTS survey

continued

Table 1. *Continued*

Variable	*Description*	*Source*
	seek treatment in inpatient or outpatient settings	
Practice characteristics		
Practice type/size	Set of dummies indicating whether practice is solo/2 physician (ref.), group with <10 physicians, group with 10–39 physicians, group with 40+ physicians, group/staff model HMO, hospital, medical school/ university, other	CTS survey
Practice financial incentives	Dummies variables indicating weak (ref.), moderate, or strong financial pressures to increase services to patients. Based on practice ownership, compensation method, receipt of bonuses, and specific factors important in determining compensation (see Hadley et al. 2010 for details)	CTS survey
Percent Medicaid	Percent revenue from Medicaid	CTS survey
Percent Medicare	Percent revenue from Medicare	CTS survey
Percent capitated	Percent revenue from capitated contracts	CTS survey
Hospitalist use	Percent of hospitalized patient for whom a hospitalist is used	CTS survey
Market characteristics		
Physician supply	Number of physicians per 1,000 pop. in city	ARF
Percent medical specialists	Percent medical specialists in county	ARF
Percent surgical specialists	Percent surgical specialists in county	ARF
Medical school affiliated hospital supply	Number of hospital beds in county per 1,000 pop. in facilities affiliated with medical school	CMS-POS file, ARF
Nonmedical school affiliated hospital supply	Number of hospital beds in county per 1,000 pop. in facilities not affiliated with medical school	CMS-POS file, ARF
SNF supply	Number of skilled nursing facility beds per 1,000 elderly in county	CMS-POS file, ARF
HHA supply	Number of home health agency employees per 1,000 elderly in county	CMS-POS file, ARF
Hospice supply	Number of hospice employees per 1,000 elderly in county	CMS-POS file, ARF
HHA for-profit rate	Percent of HHA employees in county used in for-profit entities	CMS-POS file
Hospital for-profit rate	Percent of HHA employees in county used in for-profit entities	CMS-POS file
SNF for-profit rate	Percent of SNF beds in county in for-profit entities	CMS-POS file

continued

Table 1. *Continued*

Variable	*Description*	*Source*
Hospital concentration	Herfindahl index (on 0–1 scale) based on MSA or collection of nonmetropolitan counties making up CTS rural sites	AHA survey data
MA penetration rate	County Medicare Advantage penetration rate	CMS
Fragmentation scale	This measure uses a beneficiary-level Herfindahl index (scaled 0–1) to measure the concentration of physicians across beneficiary Part B claims. To deal with the potential endogeneity of this measure, we then calculate risk-adjusted county level means to reflect area level variations in practice patterns. Lower values indicate greater fragmentation	Claims data
Medicare fee difference	Measure of how the Medicare fee schedule deviates from an ideal RBRVS (input price based) fee for a hypothetical service consisting of one physician work and one practice expense RVU. See Hadley et al. (2010) for details. Varies mostly by county. The variable is based on 2005 data and is linked to physician by the county in which they practice	Various sources

*Other variables not listed here include interaction terms with the supply of various types of providers (hospitals, SNFs, HHAs) and a variable that indicates the county population is $<30{,}000$. This controls for rural areas where a facility is likely to draw patients from multiple counties. Moreover, we include several dummy variables to indicate that the county lacks a type of provider. This was required to deal obtain unbiased coefficients for the variables that measure the percent of providers that are for-profit. Dummy variables indicating whether the USOC respondent is a CTS physician and whether the beneficiary lives in the CTS sites are also included. All these variables are suppressed from model results as well.

to be associated with greater beneficiary costs. Hospital supply was measured as the number of hospital beds per 1,000 residents, distinguishing between beds in teaching and nonteaching hospitals. Other provider supply variables were defined as the number of skilled nursing facility (SNF) beds, home health agency (HHA) employment, and hospice employment per 1,000 elderly residents. We also controlled for Medicare Advantage penetration and the percentages of hospital, SNF, and HHA capacity in for-profit entities (hypothesized to be positively related to the proclivity to induce demand and hence costs). Because rural markets extend beyond the county, we included interaction terms with a dummy variable indicating a county with $<30{,}000$ people. Similarly, we control for counties with no hospitals, SNFs, or HHAs.

The final market structure area variables in the analysis control for care fragmentation and hospital concentration. We measure the extent of fragmentation in the area using a 0–1 Herfindahl-like index, with 1 indicating no care dispersal among physicians (Jee and Cabana 2006). To ensure that this variable was exogenous, we regressed Herfindahl values for each beneficiary on HCC variables and county fixed effects. From this equation, we calculated risk-adjusted county means and assigned them to beneficiaries, based on location of their USOC physician. Because it is a county-level variable, it is exogenous to the beneficiary's specific care pattern but reflects geographic variations in care patterns.[3] We measure hospital concentration for each of the 60 CTS metropolitan and nonmetropolitan sites using a Herfindahl index based on total hospital bed shares calculated using American Hospital Association Annual Survey data. Though not directly related to Medicare payment rates, hospital concentration could affect hospitals' willingness to treat Medicare patients and efficiency.

Finally, we included a relative Medicare fee variable that varies by county. This variable (adapted from Hadley et al. 2010) captures the difference between actual Medicare payment in 2005 and a more accurate measure of the input costs that underpin the resource-based relative value system (RBRVS) on which the fee schedule is based. The increased accuracy is achieved by defining geographic price indices using smaller geographic areas, using better or more recent data, and eliminating fee formula components designed to achieve other social goals (e.g., support for rural physicians).[4] The variable is exogenous because it is based on policy decisions external to individual physicians and is hypothesized to be positively associated with beneficiary costs. Table 1 provides greater detail and data sources for independent variables.

Defining High- and Low-Cost Beneficiary Samples

To avoid sample selection bias, we define high-cost beneficiaries as the top quartile of sample beneficiaries ranked by their total predicted annual standardized cost of care, based on a linear regression estimated on the full analysis sample using only enhanced HCC model variables as predictors. If the ranking were based on actual observed costs, then the sample may be affected by selection bias, because treatment efficiency will influence whether a patient's actual cost falls in the top quartile. Sensitivity analyses assessing the effect of various percentile cut-offs to define high-cost beneficiaries (e.g., top decile) indicated results were robust.

Estimation

Total beneficiary annual standardized costs models were estimated on predicted low- and high-cost beneficiary samples using OLS. Since not all USOC physicians were CTS respondents and beneficiaries attributed to CTS physicians ($N \approx 276{,}000$) differed somewhat from beneficiaries with non-CTS USOC physicians we included a dummy variable indicating beneficiaries with CTS USOC physicians and interacted it with all survey-based variables. Results were robust when the models were estimated only on beneficiaries with CTS USOC physicians. Use of the full sample did not appreciably reduce standard errors; key results and conclusions were not sensitive to choice of sample. We also explored alternative functional forms as a robustness check.

Because sample inclusion was determined by being treated by a CTS physician, we weighted beneficiary observations with the CTS physician's survey weight, regardless of whether the beneficiary had a CTS USOC physician. SUDAAN was used to account for the CTS sample's complex design.

RESULTS

Descriptive Results

Sample Characteristics. Table 2 provides independent variable means for predicted high- and low-cost Medicare beneficiaries.[5] Predicted high-cost patients are older, have more conditions, are far more likely to be institutionalized (27 versus 0.1 percent), and experience much greater mortality than predicted low-cost patients. They are about 3 years older on average and slightly more likely to be male and Black. The average imputed income of high-cost beneficiaries is only about U.S.$3,500 lower, but they are nearly twice as likely to be dual Medicare-Medicaid eligibles, likely reflecting their much higher institutionalization rates.[6] Other than high-cost beneficiaries being more likely to have a medical specialist as their USOC, high-cost and low-cost beneficiaries are very similar in terms of their USOC physicians' personal, practice, and market characteristics.

Medical Costs and Medicare Payments. The 2006 average standardized medical cost for predicted high-cost beneficiaries was nearly U.S.$48,000, compared with about U.S.$7,000 for predicted low-cost patients (Table 3). (Median values were U.S.$37,704 and U.S.$3,406, respectively.) Overall, 69 percent of total costs were spent on the 25 percent classified as predicted high-cost

Table 2: Individual, Physician, Practice, and Market Characteristics of Predicted High- and Low-Cost Medicare Beneficiaries*

Characteristic	*Predicted High-Cost*	*Predicted Low-Cost*
Individual		
Mean age	79.1	76.3
% Age 85+	24.8	14.9
% Female	58.3	61.7
% White	87.8	90.0
% Black	9.1	6.9
% Other race/ethnicity	3.1	3.1
Mean no. of HCCs	6.7	1.6
% Died in 2006	27.4	1.5
% Dual eligible	19.6	10.3
% Institutionalized	26.6	0.1
Predicted family inc. (U.S.$)	36,409	39,860
% Received care in multiple census divisions	25.5	20.5
Attributed to CTS phys.	19.1	17.1
Med. home physician		
% Primary care physician	65.7	73.1
% Medical specialist	27.8	19.8
% Surgical specialist	6.5	7.1
Years in practice	18.1	18.6
% Board certified	87.0	87.4
% Int'l. Med. Grad.	21.6	18.1
Patient OOP cost index	0.91	0.91
Under strong fin. Incent.	53.9	54.6
% In very competitive mkt.	16.1	14.3
Use of hospitalist (% pts)	27.8	30.8
Inadeq. Time major prob.	20.2	20.4
Lack of reports major prob.	14.4	13.5
Practice		
Solo/2 phys.	43.3	43.7
Group practice	34.9	34.8
Hospital	11.0	11.2
Medicare school	4.2	3.2
Other	6.6	7.1
% Revenue from Medicare	43.2	40.9
% Revenue from Medicaid	10.4	9.8
% Capitated revenue	10.6	11.0
Market		
Hospital concentration	9.8	11.9
Medicare MC penetration	14.5	13.2
Provider supply		
Physicians/1,000 pop.	2.3	2.2
% Medical specialists	31.7	31.6
% Surgical specialists	14.7	15.0

continued

Table 2. *Continued*

Characteristic	*Predicted High-Cost*	*Predicted Low-Cost*
MS hosp. beds/1,000 pop	1.4	1.2
Non-MS hosp. Beds/1,000	3.4	3.4
SNF beds/1,000 elderly	37.5	37.1
HHA employees/1,000 eld.	6.3	5.9
Hospice empl./1,000 eld.	81.9	82.8
% HHA supply for-profit	50.5	50.3
% Hosp. supply for-profit	18.4	18.4
% SNF supply for-profit	69.6	70.5
County fragmentation index	41.8	42.2
Relative Medicare fees (U.S.$)[†]	76.0	75.3

*Because of the very large sample sizes, significance tests are suppressed because even small, policy insignificant differences were found to be significantly significant.

[†]Based on a hypothetical two RVU service consisting on one physician work and one practice expense RVU. Malpractice RVUs do not enter into the construction of the variable.

beneficiaries. This is lower than the 85 percent typically reported for the 25 percent most costly beneficiaries because of our inability to perfectly predict high and low-cost users, the fact that we are using standardized costs, which truncates some outlier cases, and the exclusion of beneficiaries who received no Medicare services. Medicare payments were a higher percentage of total standardized costs among high-cost beneficiaries (88 versus 82 percent), reflecting greater use of Part A services. For instance, 79 and 84 percent of expenditures on hospitals and postacute care were incurred by predicted high-cost beneficiaries, respectively, compared with about 50 percent of physician service and outpatient costs. Inpatient and postacute care accounted for 63 percent of total costs of predicted high-cost beneficiaries, as compared with 34 percent for predicted low-cost beneficiaries.

Multivariate Results. Table 4 presents multivariable results for predicted high-and low-cost beneficiaries. Along with model coefficients, we assess variables' relative importance by reporting elasticities for continuous variables and the coefficient as a percent of mean standardized costs for categorical variables.[7]

In results not shown, most patient demographic and most HCC variables were highly significant and explained a large majority of medical costs. The coefficient on patient income was not significant, but beneficiaries who received care in multiple Census Divisions had significantly higher costs

Table 3: Annual Standardized Costs and Medicare Payments among Predicted High- and Low-Cost Medicare Beneficiaries

	Predicted High-Cost Beneficiaries				*Predicted Low-Cost Beneficiaries*				*% of Costs Incurred by Predicted High-Cost Beneficiaries*
	Mean Costs	*% Using Service*	*Mean Costs, Given Any Use*	*% of Total Costs in Category*	*Mean Costs*	*% Using Service*	*Mean Costs, Given Any Use*	*% of Total Costs in Category*	
Total standardized costs	47,674	100.0	47,674	100.0	7,115	100.0	7,116	100.0	69.1
Total Medicare payments	41,921	100.0	41,921	87.9	5,806	99.5	5,833	81.6	70.6
Standardized costs by type									
Physician services	7,755	99.1	7,822	16.3	2,470	98.5	2,506	34.7	51.1
Hospital	20,902	84.7	24,669	43.8	1,866	18.6	10,040	26.2	78.9
Outpatient services	3,351	92.9	3,608	7.0	1,186	79.5	1,491	16.7	48.5
Post acute care	9,274	60.3	15,393	19.5	586	9.1	6,450	8.2	84.1
Other*	6,393	98.4	6,497	13.4	1,008	92.0	1,096	14.2	67.9

*"Other" includes clinical lab services, durable medical equipment, Part B drugs, hospice care, psychiatric facility care, and long-term care hospital care.

Table 4: Multivariate Results: Standardized Annual Costs of Care among Aged Medicare Beneficiaries

	Predicted High-Cost Beneficiaries			*Predicted Low-Cost Beneficiaries*		
Independent Variable	*OLS Coefficient*	*p-Value*	*Elasticity/% of Mean Costs*	*OLS Coefficient*	*p-Value*	*Elasticity/% of Mean Costs*
Intercept	−28	.993	–	5,080***	.000	–
Beneficiary characteristics						
Predicted beneficiary family income (U.S.$1,000)	−8	.370	−0.006	−0.4	.852	−0.002
Received care in multiple census divisions	1,990***	.000	4.1%	825***	.000	12.0%
Physician characteristics						
Specialty of USOC physician (PCP = ref)						
Medical specialist	1,839***	.000	3.9%	142*	.019	2.0%
Surgical specialist	−2,679***	.000	−5.6%	462***	.000	6.5%
Board certified	1,185	.211	2.5%	265+	.077	3.7%
Sensitivity to OOP costs index	−602	.520	−1.3%	−305*	.042	−4.3%
Years in practice	44+	.071	0.02	−11**	.006	−0.041
International medical graduate	−405	.529	−0.8%	−257	.137	−3.6%
Percent of hospitalized patients treated by hospitalist	−18**	.003	−0.012	−1	.349	-0.005
Inadequate time with patients during visits a major problem	1,672**	.002	3.5%	225+	.053	3.2%
Not getting timely reports from other providers a major problem	−1,288*	.035	−2.7%	−359*	.031	−5.0%
Practice characteristics						
Practice size/type (Solo/2 physician = ref)						
Group, <10 physicians	137	.843	0.3%	−20	.917	−0.3%
Group, 10–39 physicians	191	.891	0.4%	−15	.965	−0.2%
Group, 40+ physicians	1,865+	.053	3.9%	−7	.975	−0.1%
Group/staff model HMO	−226	.855	−0.5%	184	.453	2.6%
Medical school	−3,275	.109	−6.9%	−26	.928	−0.4%
Hospital	1,793	.110	3.8%	352	.152	4.9%
Other	581	.625	1.2%	−110	.634	−1.5%
% Practice revenue from Medicaid	51+	0.073	0.01	1	.895	0.03

continued

Table 4. *Continued*

	Predicted High-Cost Beneficiaries			*Predicted Low-Cost Beneficiaries*		
Independent Variable	*OLS Coefficient*	*p-Value*	*Elasticity/% of Mean Costs*	*OLS Coefficient*	*p-Value*	*Elasticity/% of Mean Costs*
% Practice revenue from Medicare	−15	.157	−0.04	2	.380	0.10
% Practice revenue that is capitated	−10	.382	−0.01	−5*	.035	−0.07
Practice financial incentives (weak = ref)						
Moderate	−404	.738	−0.8%	−141	.507	−2.0%
Strong	994	.359	2.1%	−15	.917	−0.2%
Market characteristics						
Physician perception of local market competitiveness ("not at all = ref)						
Somewhat	−99	.822	−0.2%	−65	.449	−0.9%
Very	−7,96	.330	−1.7%	−272*	.039	−3.8%
Hospital concentration (0–1 Herfindahl)	−3,113**	.003	−0.006	−713	0.011	−0.012
Medicare Advantage penetration rate, 2005	−24	.426	−0.007	2	.821	0.004
Number of physicians/1,000 pop. in county	18	.920	0.001	−95^{+}	.063	−0.031
Proportion medical specialists in county	4,711^{+}	.066	0.031	1,808*	.011	0.083
Proportion surgical specialists in county	−1,791	0.587	−0.005	292	0.778	0.006
Number of beds in hospitals with Medical school/1,000 pop.	312**	.002	0.009	31	0.294	0.006
Number of beds/1,000 pop. in hospitals without Medical school affiliation	223**	0.005	0.016	25	.246	0.012
Number of SNF beds/1,000 elderly pop.	−39*	.036	−0.030	−12^{+}	.052	−0.067
Number of FTE home health agency (HHA) workers/1,000 elderly in county	7	.725	0.001	−9	.112	−0.008
Number of FTE hospice workers/1,000 elderly in county	−294	.156	−0.005	101^{+}	.092	0.012
Proportion HHA capacity in for profit entities	2,251***	.000	0.024	353*	.012	0.026
Proportion hospital beds in for-profit entities	2,098**	.005	0.008	201	.326	0.005
Proportion SNF beds in for-profit entities	3,518***	.000	0.051	389	.114	0.040
Average fragmentation in county	−4,748	.332	−0.041	−6,198***	.001	−0.380
Medicare fee difference	145***	.001	0.227	37*	.010	0.413
R^2	0.52			0.23		
Number of observations	390,388			1,179,638		

$^{+}p \leq 0.10$; $*p \leq 0.05$; $**p \leq 0.01$; $***p \leq 0.001$.

than those who did not, by 4 percent of mean costs for high-cost beneficiaries and 12 percent for low-cost beneficiaries.

Few physician or practice characteristics had statistically significant coefficients that warrant discussion. Among high-cost beneficiaries, the 27.8 percent attributed to a medical specialist as their USOC physician had U.S.$1,839 greater costs than those attributed to primary care physicians, representing roughly 4 percent of the mean cost of care. Although this may reflect unmeasured patient preferences and health status differences, research provides mixed results whether management by specialists leads to better outcomes or lower costs (Donohoe 1998; Hartz and James 2006; Smetana et al. 2007). Moreover, medical specialists functioning as USOC physicians may provide inadequate primary care outside the scope of their specialty.

The 6.5 percent of high-cost beneficiaries attributed to a surgical specialist as their USOC physician had lower costs than beneficiaries with a primary care USOC, possibly representing the influence of unmeasured health status, as having a surgical specialist USOC suggests these beneficiaries have few conditions that would normally be treated by other types of physicians, or have relatively minor conditions that may be treated nonsurgically by physicians classified as surgical specialists (e.g., urologists treating benign prostrate hyperplasia with drugs).[8] Consistent with this interpretation, low-cost beneficiaries assigned surgeons had higher costs than other beneficiaries. Since low-cost beneficiaries have fewer conditions, treatment for a surgical condition represents a higher proportion of all care received.

Physicians' self-reported perceptions and behavior provided mixed results. As hypothesized, high-cost beneficiaries assigned to physicians reporting inadequate time during office visits as a major problem affecting quality of care had U.S.$1,627 (3.5 percent) higher costs than beneficiaries with physicians reporting inadequate time as a minor or no problem at all. However, inconsistent with expectations, having a USOC physician who reported not getting timely reports from other providers was a major problem affecting quality and was negatively associated with costs (− U.S.$1,288 and − U.S.$359 for high- and low-cost beneficiaries, respectively). Lastly, costs were significantly lower for only low-cost patients whose USOC physician reported being sensitive to patients' out-of-pocket costs.

Several market characteristics were significantly associated with medical costs, although many have quantitatively small effects, as indicated by elasticities or percentages of mean costs. Note that coefficients for continuous 0–1 variables (hospital concentration, proportion for-profit, fragmentation)

may be large while marginal effects or elasticities are small. The supplies of physicians, hospital beds (regardless of medical school affiliation), SNFs, HHAs, and hospices—bore only very weak, often insignificant, associations with costs. Medical costs were positively associated with the proportions of hospitals, SNFs, and HHAs organized as for-profits, but with very small elasticities. For example, the elasticities associated with the proportion of for-profit SNFs are only 0.04–0.05, which imply that a 10 percent increase in the proportion of SNF beds in for-profit facilities would increase the overall cost of treating Medicare patients by about half of one percent. Consistent with higher costs for beneficiaries with a medical specialist as their USOC, the proportion of physicians in the county who are medical specialists is associated with greater costs for both predicted high- and low-cost beneficiaries, but with elasticities of only 0.03 and 0.08, respectively.

Results suggest that care fragmentation does result in higher costs, though the relationship was only statistically significant among predicted low-cost beneficiaries. Since higher values of the Herfindahl index indicate less fragmentation, the elasticity is -0.38 for low-cost beneficiaries suggest that increasing continuity from the current average value of 0.42 by one standard deviation to 0.46 would reduce costs among predicted low-cost beneficiaries by U.S.$248 (3.6 percent of mean costs). However, reduced fragmentation among predicted high-cost beneficiaries would reduce their costs by only U.S.$190 (0.4 percent).

The Medicare fee difference variable generated the largest elasticities. Consistent with our hypothesis and previous research, higher relative fees are associated with greater service provision (Hadley and Reschovsky 2006; Hadley et al. 2010). The estimated elasticity is larger (0.41) among low-cost beneficiaries than among high-cost beneficiaries (0.23), suggesting physicians may exercise greater discretion in the treatment of healthier beneficiaries.

Discussion and Policy Implications

Although models estimated over the entire sample of low- and high-cost patients explain two-thirds of the variation in beneficiaries' medical costs, several limitations should be noted. First, causal inferences should be made cautiously because the data are cross-sectional. Second, unobserved heterogeneity in the beneficiary population could be correlated with model variables and bias

coefficients. Third, available data limit our ability to characterize all key features of local health care markets (e.g., level of care coordination). Fourth, there is no definitive way to define local healthcare markets and our use of counties for most market variables is driven by available data. Finally, the sample is only approximately representative of the elderly, non-ESRD Medicare beneficiaries because it excludes Medicare Advantage enrollees, new enrollees, and beneficiaries because use no physician services over an extended time period, and it uses an indirect sampling method.

A final limitation is that our study focused only on costs, without considering effects on outcomes (for which claims data are not particularly suited). Though not reported here, we constructed mortality and ambulatory sensitive hospitalization rates (which are analyzed in another study). We did attempt to identify factors that were efficiency enhancing or diminishing by estimating parallel reduced-form models, but the results were ambiguous.

Nonetheless, a key finding from this work is that key conclusions from prior small area analyses (e.g., Fisher et al. 2003; Center for the Evaluative Clinical Services 2007) that much of the variation in cost of treating Medicare beneficiaries is driven by supply-induced demand (e.g., "supply-sensitive care") cannot be supported when one comprehensively controls for health status and conducts analysis at the beneficiary level. Zuckerman et al. (2010) reaches a similar conclusion. Medical specialists serving as USOCs and the proportion of medical specialists in the county were the only two supply-side variables with positive effects on costs consistent with other research (Fisher et al. 2003; Baicker and Chandra 2004). However, the strength of the medical specialist results, though not trivial, would explain little of the geographic variation documented in the Dartmouth Atlas. The supplies of hospital beds had significant positive effects among high-cost beneficiaries, but elasticities suggest that the magnitude of the effect is extremely small: doubling hospital bed supply would increase costs by <2 percent.

These geographic cost variation studies have been influential in policy formulation, although policy implications from the research are unclear. In the run-up to the passage of PPACA, the Congressional Budget Office, Senate Finance Committee as well as others put forth or considered options that would reduce Medicare updates to providers in high-cost areas (Congressional Budget Office 2008; Commission on a High Performance Health System 2009; U.S. Senate Finance Committee 2009). Subsequent to the passage of PPACA, the Secretary of HHS commissioned a study by the Institute of Medicine to consider geographic variations in health spending and develop policy proposals. Setting rates applicable to all providers based on average

area costs (especially if outcomes are not considered) is likely to punish efficient providers in high-cost areas and reward inefficient providers in low-cost areas. At the same time, evidence from physicians' responses to sustainable growth rate fee cuts suggests that across-the-board changes in payment updates are an inefficient way to lower costs (Hadley et al. 2010). This is likely to apply to uniform fee changes at the local level, not only at the national level.

One geographic-based policy enacted into the health reform law also highlights potential problems. Section 1109 of the Health Care and Education Reconciliation Act of 2010, which amended PPACA, allocates 400 million dollars over 2 years to hospitals in the lowest cost quartile of counties (based on Part A and B spending adjusted for age, sex, and race). Apart from equity concerns about rewarding hospitals for costs largely attributable to other area providers, our results suggest that local health care costs are largely driven by disease burdens that go well beyond that which can be accounted for by demographic characteristics. The payments also fail to account for differences in outcomes across areas or hospitals.

We also found that over one in five Medicare beneficiaries receives care in different census divisions during the year, and that these patients have significantly higher costs. Although the precise reasons for interdivisional care receipt are ambiguous, this result suggests that any geographic-based policy needs to be mindful that there are no natural boundaries to local health care markets and that a very substantial portion of beneficiaries will use providers in multiple "markets," however defined. The results also have implications for ACOs, as envisioned in the PPACA. Beneficiaries are to be attributed, ex post, to ACOs rather than prospectively assigned to ACOs. If care is not consistently concentrated within a narrow number of providers, especially among high-cost beneficiaries, ACO success in improving care and lowering cost may be limited.

Our Medicare fee-difference and care fragmentation results suggest that payment reforms may contribute to controlling costs. Correcting the considerable variation in the profitability of different types of services under the current RBRVS system, adoption of more "value-based" pricing of services, or constructing provider payment incentives tied to the cost and quality of care provided are all likely to be more effective strategies than current uniform payment updates.

Although there was only modest geographic variation in average care fragmentation across counties, we found that less fragmentation is associated with lower costs. This suggests that payment reforms designed to encourage greater provider accountability and care coordination (e.g., patient-centered

medical homes and ACOs) could lower costs. However, reducing care fragmentation appears more effective in reducing costs for relatively healthy, lower-cost beneficiaries than for more complex, higher cost patients, suggesting the potential for substantial cost savings may be limited.

The findings that physicians reporting more severe time pressures have patients who are more costly on average are consistent with the fragmentation results. Time pressure may be associated with poorer quality, which subsequently results in poorer outcomes and higher costs; or physicians who report time pressure may be more likely to refer to specialists or use technology rather than cognitive skills for diagnosis. This suggests that elevation of the role and reimbursement of primary care physicians that is central to patient-centered medical home proposals could succeed in lowering costs.

Finally, our results that greater for-profit presence in a market is modestly associated with higher costs is consistent with prior research (Cutler and Sheiner 1999; Silverman, Skinner, and Fisher 1999; Silverman and Skinner 2001). This suggests that CMS should assess the role of for-profit organization on coding behavior, service volume, and health benefits. If quality of care is no better in for-profit settings, as suggested by various studies, then changes in payment or level of oversight might be warranted.

Meaningful efforts to reduce Medicare costs will require policies that specifically address the needs of high-cost beneficiaries. Several of our findings suggest that certain policies currently being considered may be more successful in lowering the costs of low-cost rather than high-cost beneficiaries. Consequently, the task of reducing Medicare costs in the aggregate may prove difficult unless reforms can improve health care quality or eliminate unnecessary services for very sick, complex patients.

The literature on care management programs targeted to expensive patients with complex health needs was recently reviewed by Bodenheimer and Berry-Millett (2009). Although a number of care management programs have shown improvements in the quality of care, the evidence concerning the ability of these programs to reduce costs is less encouraging. While some have been shown to reduce costs, many evaluations have produced inconclusive or negative findings along this dimension. Programs aimed at enhancing care coordination during hospital-to-home transitions have shown the most consistent beneficial effects on costs and quality. For instance, Mary Naylor and Eric Coleman have developed highly effective, proven programs that address short-term hospital readmissions by using advance practice nurses. This is a major source of potential savings for Medicare, since 20 percent of all Medicare beneficiaries discharged from a hospital are readmitted within 30 days,

often for problems that could have been prevented with adequate postdischarge care, coaching, and monitoring of the patient (Brown 2009). Naylor's protocol-driven, nurse-directed approach is targeted to congestive heart failure patients and extends 3 months past discharge (Naylor et al. 2004). Coleman's approach, mostly applied in managed care settings, coaches patients and their families in self-management during the month following discharge (Coleman et al. 2006; Jencks, Williams, and Coleman 2009).

It is imperative that we continue research to identify, develop, and test interventions aimed at improving care and reducing costs for various types of high-cost beneficiaries. After all, this is where the money is.

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NOTES

1. The sample population excludes physicians in Alaska and Hawaii, federal employees, and physicians with little or no direct patient contact (e.g., radiologists). Sites were defined as either Metropolitan Statistical Areas, Primary Metropolitan Statistical Areas, and nonmetropolitan portions of economic areas defined by the Bureau of Economic Analysis. The AMA and AOA masterfiles served as sampling frames.
2. A similarly constructed variable measuring the likelihood of supplemental insurance coverage was dropped from the final specification because it was highly correlated with imputed income.
3. The measure could be endogenous if care fragmentation was positively correlated with physician diagnosis coding patterns (Song et al. 2010). If so, the resulting bias would be conservative in direction, toward zero.

4. Details are available at http://www.hschange.org/CONTENT/1115/1115appendices.pdf (accessed March 19, 2010).
5. Significance tests of differences between predicted high- and low-cost beneficiaries' characteristics are not given because, with our very large samples, even very small differences of no particular policy import achieve statistical significance.
6. The imputed income variable is based on a sample of noninstitutionalized elderly persons, so it may overstate the incomes of institutionalized beneficiaries.
7. Elasticities were calculated based on sample means.
8. Consistent with this explanation, multiple chronic conditions are often contra-indicators for surgery.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Appendix SA2: Health Related Beneficiary Characteristics (Enhanced HCC Model).

Appendix SA3: Construction of Standardized Costs.

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