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Costs and Clinical Quality Among Medicare Beneficiaries: Associations with Health Center Penetration of Low-Income Residents

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Objective: Determine the association between access to primary care by the underserved and Medicare spending and clinical quality across hospital referral regions (HRRs).

Data Sources: Data on elderly fee-for-service beneficiaries across 306 HRRs came from CMS' Geographic Variation in Medicare Spending and Utilization database (2010). We merged data on number of health center patients (HRSA's Uniform Data System) and number of low-income residents (American Community Survey).

Study Design: We estimated access to primary care in each HRR by "health center penetration" (health center patients as a proportion of low-income residents). We calculated total Medicare spending (adjusted for population size, local input prices, and health risk). We assessed clinical quality by preventable hospital admissions, hospital readmissions, and emergency department visits. We sorted HRRs by health center penetration rate and compared spending and quality measures between the high- and low-penetration deciles. We also employed linear regressions to estimate spending and quality measures as a function of health center penetration.

Principal Findings: The high-penetration decile had 9.7% lower Medicare spending ($926 per capita, p=0.01) than the low-penetration decile, and no different clinical quality outcomes.

Conclusions: Compared with elderly fee-for-service beneficiaries residing in areas with low-penetration of health center patients among low-income residents, those residing in high-penetration areas may accrue Medicare cost savings. Limited evidence suggests that these savings do not compromise clinical quality.

Keywords: Health centers, safety-net, Medicare, costs, clinical quality

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Introduction

Geographic variations in health care costs and clinical quality, particularly within the Medicare program, have long been of interest to health care providers, policy makers, and payers, beginning with foundational research by Wennberg and colleagues (Burney, Schieber, Blaxall, & Gabel, 1978; Cromley & Shannon, 1988; Escarce, 1991; Hirth, Tedeschi, & Wheeler 2001; Keating, Landrum, Lamont, Bozeman, & McNeil, 2012; O'Hare, Rodriguez, Hailpern, Larson, & Kurella Tamura, 2010; Reschovsky, Ghosh, Stewart, & Chollet, 2012; Wennberg, 1996; Wennberg & Cooper 1999; Wennberg & Gittelsohn, 1973; Wennberg & Gittelsohn, 1982; Zhang, Baicker, & Newhouse, 2010a, 2010b). The existence of variations in spending across the United States (U.S.) suggests opportunities for gains in efficiency and cost savings.

Since Wennberg's original work, a rich body of literature has investigated potential sources of these variations (American Hospital Association, 2009; Congressional Budget Office, 2008; Gold & Williams, 2004; Super, 2003). Such variations include: regional differences in costs of physician practice (Mitchell & Davidson, 1989; Pope, Welch, Zuckerman, & Henderson, 1989), payment variations due to policy decisions and market forces (MedPAC, 2009; Centers for Medicare & Medicaid Services, 2009), provider training and supply as well as supply of other health care resources (Baicker & Chandra, 2004; Cooper, Cooper, McGinley, Fan, & Rosenthal, 2012; Ricketts & Belsky, 2012; Welch, Miller, Welch, Fisher, & Wennberg, 1993; Wennberg & Cooper 1999; Zuckerman, Waidmann, Berenson, & Hadley, 2010), population demographics and socioeconomic status (Cooper *et al.*, 2012; Ricketts & Belsky, 2012; Rosenthal, 2012; Zhang,

Steinman, & Kaplan, 2012; Zuckerman *et al.*, 2010), health status and prevalence of particular diseases (Reschovsky, Hadley, Saiontz-Martinez, & Boukus, 2011; Rosenthal, 2012; Sargen, Hoffstad, & Margolis, 2012; Zuckerman *et al.*, 2010), service use arising from patient preferences (Rosenthal, 2012; Wennberg & Cooper, 1999; Zhang *et al.*, 2012), and discretionary decisions by health care providers (Cooper *et al.*, 2012).

Regardless of the geography, access to high-quality primary care yields many benefits for individual patients and for the larger population, including reduced morbidity and mortality (Macinko, Starfield, & Shi 2003, 2007; Shi *et al.*, 2005; Shi, Macinko, Starfield, Xu, & Politzer, 2003; Shi *et al.*, 2004; Starfield, Shi, & Macinko, 2005). Access to primary care is particularly beneficial among underserved or low-income individuals, where it has been linked to fewer preventable hospitalizations and emergency department (ED) visits (Falik, Needleman, Wells, & Korb, 2001; Probst, Laditka, & Laditka, 2009; Rust *et al.*, 2009; Tom *et al.*, 2010). The savings from providing high-quality primary care to low-income individuals can potentially accrue to a large proportion of Medicare beneficiaries, given that an estimated 39% meet the federal definition for low income in 2010 (U.S. Census Bureau, 2010).

The Health Center Program, funded and administered by the Health Resources and Services Administration (HRSA), is a primary care safety-net program specifically targeted to underserved populations (Health Resources and Services Administration, n.d.). In 2010, 1,124 health centers used over 8,000 health care delivery sites to serve 19.5 million patients across the U.S., 62% of whom were racial/ethnic minorities and 93% of whom were low-income (living at or below 200% of the federal poverty level; U.S. Department of Health and Human Services, 2011). Health centers are financed by revenues from patient services as well as other non-patient services sources, including HRSA and other federal grants. Most (38.5%) health center patients are covered by Medicaid, which in 2010 contributed 64% of national health center patient service revenue (U.S. Department of Health and Human Services, 2010). Because of its dominant share of health center patients and patient service revenues, compared with other payers, Medicaid wields considerable influence over health center scope, capacity, and staffing mix. This likely has a bearing on the utilization patterns of patients from other payer categories. The next most frequently served group of health center patients are the uninsured (37.5%), followed by the privately insured (13.9%), and then Medicare beneficiaries (7.5%), which account for 10.0%, 11.6%, and 9.9% of national patient service revenues respectively. Although only 3.1% of 47.7 million Medicare beneficiaries were health center patients in 2010, they represented 1.46 million patients, and the share and number of Medicare beneficiaries seen in health centers has been rising in recent years (Health Resources and Services Administration, n.d.).

Using newly available cross-sectional, aggregated data for hospital referral regions (geographic regions representing health care markets across the U.S.), we hypothesized that greater access to primary care by the underserved may yield benefits to the Medicare program. In particular, we hypothesized that regions with greater penetration of health centers would lower net costs for Medicare beneficiaries due to increased availability of accessible, continuous, and comprehensive primary care to the underserved, which may avert utilization of Medicare covered services, particularly those associated with acute and post-acute care.

We sought to determine the association between Medicare spending and clinical quality,

and access to primary care by the underserved, after accounting for key differences among hospital referral regions regarding local input prices and Medicare payments, population characteristics, and health status (three important non-discretionary sources of variation discussed earlier).

Methods

Data Sources

Cross-sectional data from 2010 came from three data sources: the Geographic Variation in Medicare Spending and Utilization (GV) database from the Centers for Medicare & Medicaid Services (CMS; Centers for Medicare & Medicaid Services, 2012), the Uniform Data System (UDS) from HRSA (U.S. Department of Health and Human Services, 2010), and the American Community Survey (ACS) from the Census Bureau (U.S. Census Bureau, 2008). We linked the data sources by Hospital Referral Region (HRR), geographic regions developed by the Dartmouth Atlas of Health Care to represent regional health care markets in the United States. HRRs are mutually exclusive, are constructed by grouping ZIP Codes together based on referral patterns for tertiary medical care, have an overall population of at least 120,000 residents, and may cross state lines (The Dartmouth Institute for Health Policy and Clinical Practice, 2013; Wennberg, 1996). There were 307 HRRs included in the dataset; we excluded one observation with an unknown HRR.

The Institute of Medicine publically released four datasets in June 2012 that use CMS' new GV database. We used the 2010 HRR-level dataset to obtain a range of demographic, health service cost, utilization, and selected clinical quality indicators aggregated across a sample of Medicare beneficiaries in each HRR. Specifically, the data represent 100% of claims for 26 million Medicare fee-for-service beneficiaries ages 65 or older who were enrolled in Medicare Parts A and B for the entire year (or until date of death if they died during 2010). Spending was assigned to HRRs based on where Medicare beneficiaries lived, rather than where they received care (in 2010, 80% of Medicare costs occurred in the same HRR as the beneficiary's residence; Centers for Medicare & Medicaid Services, 2012). We focused on total spending as well as spending (and utilization) for specific categories of services. For clinical quality indicators, we focused on hospital readmission rate, ED visit rate, and selected measures of preventable hospitalizations for specific conditions, constructs developed by the Agency for Healthcare Research and Quality, which measure potentially avoidable hospitalizations due to particular diagnoses (Agency for Healthcare Research & Quality 2012).

HRSA collects aggregate data from HRSA-funded health centers to produce annual UDS datasets. From the 2010 UDS, we obtained data on the number of health center patients by residential ZIP Code. Because Census 2010 ZIP Code tabulation area (ZCTA) data on demographics/income have not yet been released, we used the Census Bureau's ACS 5-year (2006–2010) microdata and spatial/data aggregation tools to estimate the total population and the number of low-income residents (≤ 200% federal poverty level) for each ZCTA in 2010. We used a mapping between ZIP Code and ZCTA to transfer the ZCTA-level data to ZIP Code level. Next, we used the Dartmouth Atlas of Health Care's mapping between ZIP Code and HRR for 2010 to assign UDS health center patient data and ACS data elements from ZIP Codes to HRRs. We used mappings between ZIP Code and ZCTA and between ZIP Code and HRR for 2010 to assign UDS health center patient data and ACS data elements from ZIP Codes to HRRs. Finally, we merged HRR-level data from the UDS and ACS to the GV dataset.

Measures

Our primary measure of interest was access to primary care by the underserved in each HRR. We quantified this measure using "health center penetration," defined as the number of health center patients (i.e., individuals who used a health center at least once in 2010)[1] in each HRR as a share of total number of low-income residents (≤200% federal poverty level) in that HRR (National Association of Community Health Centers, 2012; Robert Graham Center, n.d.; Shin, Kones, & Rosenbaum, 2003). HRSA data indicate that among health center patients with known income, at least 90% are low income. Thus, the health center penetration rate is intended as a proxy for the extent of primary care safety-net coverage available to the low-income population in HRRs (Shin *et al.*, 2003).

Outcomes of interest included various measures of health care costs, utilization, and clinical quality. For each HRR and service category, we calculated total Medicare spending after making three adjustments to account for geographic differences in input costs, population size, and health status: 1) standardized per-user costs; 2) per capita standardized spending; and 3) risk-adjusted spending. The GV dataset included standardized per-user costs, that is, unit-cost figures adjusted for local variations in input prices and Medicare payments. *Total standardized* spending was the product of cost per user of a given service (e.g., unit cost per hospital inpatient stay) and the number of users of that service (e.g., number of inpatient users). *Per capita* standardized spending in an HRR was the ratio of total standardized spending for a given service over the number of Medicare beneficiaries. *Risk-adjusted* spending for each HRR was the ratio of the preceding figure and the average Hierarchical Condition Category (HCC) score for the HRR relative to the national HCC score. The HCC health risk score is a validated and well-accepted risk adjustment method (Pope *et al.*, 2004). Note that this relative HCC risk-adjustment occurs at the HRR level rather than the individual beneficiary level. Hence, we arrived at the cost measures of interest: standardized, per capita, risk-adjusted Medicare spending for each service category and HRR.

To obtain the total standardized, per capita, risk-adjusted spending for each HRR, we summed the cost measures across all service subcomponents, which included: hospital inpatient, post-acute care (including intermediate care facility, skilled nursing facility, home health, and others), hospice, hospital outpatient, outpatient dialysis facility, federally qualified health center or rural health clinic (FQHC/RHC), ambulatory surgery center, provider evaluation and management services, procedures performed by provider, and other costs (i.e., imaging, durable medical equipment, lab tests, other tests, Part B drugs, all other costs).

We obtained utilization rates for service subcomponents (i.e., percentage of beneficiaries in each HRR who used a particular service) directly from the GV database.[2]

We assessed clinical quality within each HRR using five measures of preventable hospitalizations developed by the Agency for Healthcare Research and Quality (Agency for Healthcare Research and Quality, 2012). These measures represent hospital admissions per 100,000 beneficiaries for specific ambulatory care sensitive conditions common among the Medicare elderly population: (a) chronic obstructive pulmonary disease (COPD) or asthma, (b) congestive heart failure, (c) dehydration,

[1] For each health center, the Uniform Data System (UDS) only collects the number of unique patients by residential ZIP Code; it does not collect any further information, such as the extent of health center utilization by each patient, by residential ZIP Code.

[2] Unlike cost, there were no adjustments to utilization measures.

(d) bacterial pneumonia, and (e) urinary tract infection.[3] Preventable hospitalizations were examined for two age groups, 65 to 74 years and 75 years and above; these pre-defined age groups were provided in the GV data. Aside from preventable hospitalizations, we assessed clinical quality using two additional measures (for all persons 65 years and over): rate of all-cause hospital readmissions within 30 days of discharge and emergency department (ED) visit rate (per 1,000 beneficiaries).

Analysis

Using bivariate methods, we tested the association between health center penetration at the HRR level and Medicare spending, as well as between health center penetration and clinical quality. We sorted all HRRs by level of health center penetration and created HRR deciles based on penetration rate.[4] For each decile, we constructed decile-specific weights for each HRR according to its share of the total Medicare beneficiary population in the decile. We then compared weighted average risk-adjusted Medicare spending and clinical quality measures between the high and low health center penetration deciles (i.e., 10th vs. 1st deciles).

As a sensitivity analysis, we also tested for associations using an alternative method. We employed a linear regression model to estimate Medicare spending (per capita, standardized, risk-adjusted) as a function of health center penetration. Using the same technique, we also examined each of the five measures of preventable hospitalizations (separately for each age group), hospital readmissions, and ED visits as a function of health center penetration. To assess the impact of a substantive change in penetration rate, we estimated the impact of a 20 percentage point increase in mean health center penetration on outcomes.[5]

All analyses were conducted using Stata version 12.0 and SAS version 9.3. Cost and clinical quality estimates from the GV dataset were weighted using HRR share of the Medicare population, since areas with more Medicare beneficiaries tend to be more resource intensive for Medicare relative to areas with few beneficiaries. Two-tailed tests of differences in means were conducted and p-values less than or equal to 0.05 were considered statistically significant.

Results

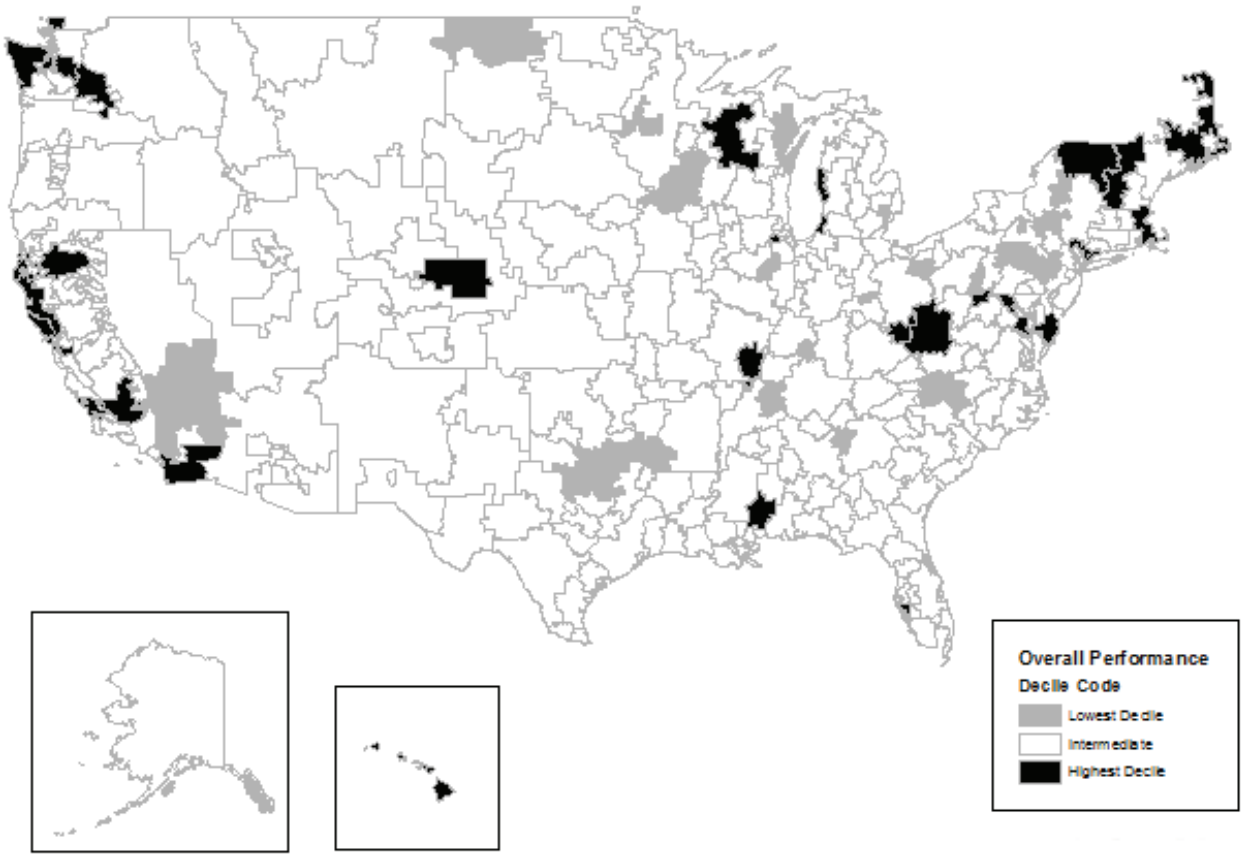
Exhibit 1 presents a map of the U.S., depicting HRRs in the lowest and highest deciles of health center penetration. Exhibit 2 presents a description of the sociodemographic characteristics and burden of disease among Medicare beneficiaries in 2010, across all HRRs overall and among the HRR deciles with lowest and highest health center penetration. The average HRR had 153,102 elderly Medicare fee-for-service beneficiaries, and a 21% health center penetration rate among low-income residents. The low-penetration decile had 3% health center

[3] These five measures were selected from 8 measures reported in the CMS dataset. Three measures included in the dataset (for diabetes long-term complications, hypertension, and lower extremity amputation) were omitted because of data suppression by individual HRRs or disparities in reporting across age-groups. By omitting these, we do not intend to imply they do not pertain to older adults.

[4] We selected deciles among alternative discrete dataset divisions to minimize intra-group variation in penetration rate, thus reducing heterogeneity within resulting groups of HRRs, while still allowing statistical estimates of inter-group differences in terms of observed characteristics of interest.

[5] We considered controlling for additional factors beyond input costs, population size, and population health status, but ultimately decided against that approach for the following reasons. Since our cost measure already adjusts for average health risk, and health risk is highly correlated with presence of chronic diseases and activity limitations, only non-health status covariates that describe the patient and/or provider population were of interest (e.g., poverty, uninsured, Medicaid coverage, racial/ethnic minority, primary care physicians per 100k, age, gender, urbanicity). Yet the majority of these potential covariates are highly correlated with health center penetration, by virtue of the Health Center Program mandate that all service locations be in medically underserved areas characterized by high rates of poverty, large proportions of uninsured and/or Medicaid enrollees, sizeable minority population, low primary care physician to population ratio, and/or poor access due to geographic barriers.

Exhibit 1. Health Center Penetration by HRR (2010)



SOURCE: 2010 Uniform Data System, 2006–2010 American Community Survey.

Exhibit 2. Sociodemographic Characteristics and Burden of Disease among Medicare Beneficiaries in HRRs, by Health Center Penetration (2010)

	Overall (All HRRs) N=306	Decile 1 (Low Penetration) N=30	Decile 10 (High Penetration) N=30	P-Value (10 vs. 1)
Number of Medicare beneficiaries (mean)[a]	153,102	118,176	175,617	0.400
Number of health center patients (mean)	106,707	15,394	259,438	<0.001*
Number of low-income population (mean)	526,671	440,359	515,603	0.629
% health center patient penetration among low-income population	21.35	2.94	54.22	<0.001*
Sociodemographic Characteristics[a]				
Age, years (mean)	76.42	76.34	76.55	0.404
% Female	57.53	57.62	57.30	0.644
% Non-Hispanic White	84.09	87.23	80.36	0.110
% African American	7.42	5.93	6.36	0.848
% Hispanic	4.89	4.14	5.70	0.440
% Asian American/Pacific Islander	2.32	1.67	5.74	0.066

(Continued)

Exhibit 2 Continued. Sociodemographic Characteristics and Burden of Disease among Medicare Beneficiaries in HRRs, by Health Center Penetration (2010)

	Overall (All HRRs) N=306	Decile 1 (Low Penetration) N=30	Decile 10 (High Penetration) N=30	P-Value (10 vs. 1)
% American Indian/Alaskan Native	0.40	0.25	0.27	0.834
% Other/ Unknown race	0.88	0.77	1.59	0.036*
% Eligible for Medicaid	14.87	13.75	17.81	0.021*
Health Conditions [a]				
Standardized HCC Score (mean) [b]	1.002	1.020	0.986	0.082
% Heart failure	17.39	18.34	16.12	0.003*
% Ischemic heart disease	33.75	34.91	30.66	0.003*
% Atrial fibrillation	9.37	9.43	9.46	0.950
% Heart attack	1.02	1.11	0.98	0.077
% Hypertension	61.16	62.57	58.93	0.034*
% Diabetes	27.83	28.43	26.61	0.073
% Chronic kidney disease	15.24	15.94	14.78	0.013*
% Depression	11.65	12.58	11.37	0.150
% COPD	11.79	12.60	10.65	0.002*
% Asthma	4.18	4.36	4.21	0.530
% Prostate cancer	3.75	3.76	3.68	0.643
% Breast cancer	3.13	3.06	3.21	0.368
% Colorectal cancer	1.44	1.44	1.42	0.832
% Lung cancer	1.17	1.16	1.17	0.952

NOTES: HRR: Hospital referral region. HCC: Hierarchical Condition Code. COPD: Chronic obstructive pulmonary disease.

[a] Statistics are weighted.

[b] HCC score expressed as a ratio to the national average.

*P-value at or below 0.05.

SOURCE: 2010 Uniform Data System (health center patients), 2006–2010 American Community Survey (low-income population, minority population), 2010 Geographic Variation in Medicare Spending and Utilization database (Medicare beneficiaries, sociodemographic characteristics, health conditions).

penetration while the high-penetration decile had 54% penetration. Average age of Medicare beneficiaries across all HRRs was 76 years, 58% of beneficiaries were female, 84% were non-Hispanic White, and 15% were eligible for Medicaid ("dual eligibles"). There were more dual eligibles in the high-penetration decile than the low-penetration decile (18% vs. 14%), but no other notable sociodemographic differences between the high- and low-penetration deciles.

Several chronic conditions were prevalent among Medicare beneficiaries overall: across all HRRs, 61% of beneficiaries had hypertension, 34% had ischemic heart disease, 28% had diabetes, 17% had heart failure, 15% had chronic kidney disease, 12% had depression, 12% had COPD, and 9% had atrial fibrillation. The high-penetration decile had lower average rates of hypertension, ischemic heart disease, heart failure, chronic kidney disease, and COPD than the low-penetration decile.

Exhibit 3 summarizes the average per beneficiary, standardized, risk-adjusted Medicare (collectively referred to as "adjusted") costs and utilization rates by Medicare beneficiaries, across

Exhibit 3. Average Medicare Costs and Utilization Rates, by Health Center Penetration (2010)

	Overall (All HRRs) N=306	Decile 1 (Low Penetration) N=30	Decile 10 (High Penetration) N=30	P-Value (10 vs. 1)
Standardized Risk-Adjusted Cost per Beneficiary[a]				
Total Medicare Cost per Beneficiary	$9,222.25	$9,541.92	$8,616.27	0.010*
Inpatient hospital	2,751.02	2,721.88	2,672.44	0.508
Post-acute care	1,908.11	2,245.40	1,642.13	0.029*
Hospice	345.75	378.73	255.35	0.001*
Hospital outpatient	1,031.38	998.15	1,078.46	0.312
Outpatient dialysis facility	130.54	122.31	130.42	0.441
FQHC/RHC	30.80	16.50	45.42	0.015*
Ambulatory surgery center	90.23	91.96	83.58	0.472
Provider evaluation and management	915.02	924.39	890.31	0.385
Procedures	604.74	589.96	563.36	0.366
Other costs	1,414.65	1,452.65	1,254.81	0.011*
Imaging	284.06	294.00	265.36	0.293
Durable medical equipment	215.25	227.04	182.03	0.002*
Lab tests	211.09	213.80	187.13	0.216
Other tests	62.27	64.08	56.49	0.136
Part B drugs	297.00	307.83	237.75	0.016*
All other costs	344.98	345.89	326.04	0.296
Percentage of Medicare Beneficiaries Using Services[a]				
Inpatient hospital	20.33%	20.73%	19.35%	0.077
Post-acute care	14.55	15.99	13.22	0.060
Hospice	3.09	3.34	2.55	<0.001*
Hospital outpatient	64.64	64.69	65.23	0.901
Outpatient dialysis facility	0.64	0.62	0.62	0.938
FQHC/RHC	7.38	4.12	9.46	0.021*
Ambulatory surgery center	10.87	11.16	10.02	0.364
Provider evaluation and management	91.53	92.30	89.87	0.019*
Procedures	65.80	66.68	63.19	0.021*
Other costs	—	—	—	—
Imaging	72.67	73.71	70.79	0.018*
Durable medical equipment	30.14	31.11	26.92	<0.001*
Lab tests	73.56	74.52	68.98	0.038*
Other tests	51.43	52.03	50.61	0.604
Part B drugs	57.54	58.92	52.92	0.001*
All other costs	47.65	48.08	45.98	0.462

NOTES: HRR: Hospital referral region. FQHC: Federally qualified health center. RHC: Rural health clinic.

[a] Statistics are weighted.

*P-value at or below 0.05.

SOURCE: 2010 Geographic Variation in Medicare Spending and Utilization database.

all HRRs overall and among the HRR deciles with lowest and highest health center penetration. Across all HRRs, the average adjusted total Medicare cost per beneficiary was $9,222. Relative to the low-penetration decile, the high-penetration decile had 9.7% lower adjusted Medicare spending ($926 per beneficiary, p=0.01). Much of the estimated net savings in the high-penetration decile accrued from lower costs per capita for post-acute care (cost differential between the low and high deciles was $603 per beneficiary, p=0.029), hospice services ($123 cost differential, p=0.001), and other costs such as durable medical equipment and Part B drugs ($198 cost differential for other costs combined, p=0.011). Unit costs (i.e., per user) for these service categories were also statistically significantly lower in the high-penetration decile compared with the low-penetration decile (detailed results available upon request). Not surprisingly, FQHC/RHC costs (and utilization rates) were higher in the high-penetration decile than the low-penetration decile ($29 cost differential per beneficiary, p=0.015), since health centers are included in the category of FQHC/RHC services and deciles were, by design, stratified based on health center penetration.

Utilization rates (i.e., the percentage of Medicare beneficiaries using a given service type) were lower for the high-penetration decile for several service types, including hospice, health care provider evaluation and management services, health care provider procedures, and certain other costs (i.e., imaging, durable medical equipment, lab tests, Part B drugs). The lower costs for the high-penetration decile for hospice, durable medical equipment, and Part B drugs are in part driven by corresponding lower utilization for these categories of goods/services.

Exhibit 4 provides the clinical quality measures among Medicare beneficiaries, again across all HRRs and for the low- and high-penetration deciles. Preventable hospital admission rates overall were generally lower for the younger old (65 to 74 years) than the older old (75 years and over). Among the younger old, the high-penetration decile had lower admission rates than the low-penetration decile for both congestive heart failure (714 vs. 870 admissions per 100,000 beneficiaries, p=0.01) and for bacterial pneumonia (590 vs. 727 admissions per 100,000 beneficiaries, p=0.01). There were no differences in preventable hospitalizations between the two deciles for the older age group. The overall hospital readmission rate was 18% and the average ED visit rate was 562 visits per 1,000 beneficiaries; there were no differences across the low- and high-penetration deciles for these measures.

To ascertain the robustness of our findings, we conducted a sensitivity analysis by estimating regression models for our outcome variables as a function of health center penetration (see Appendix Exhibit A1). The results confirmed our earlier findings: a 20 percentage point increase in mean health center penetration (from 21% to 41%) was associated with a 4.1% reduction in adjusted spending per beneficiary (i.e., $378 per beneficiary). For ages 65 to 74, this increased penetration was also associated with reductions in preventable hospitalizations for four of five conditions; for ages 75 and above, increased penetration was associated with a reduction in only one condition.

Discussion

Hospital referral regions with high health center penetration had 10% lower Medicare spending by fee-for-service elderly beneficiaries ($926 per capita) while preserving health care quality compared with regions with low health center penetration. Our findings suggest that substantively greater health center penetration is associated with net Medicare fee-for-service program savings arising from lower costs per user and utilization rates by elderly beneficiaries

Exhibit 4. Clinical Quality Outcomes among Medicare Beneficiaries, by Health Center Penetration (2010)[a]

	Overall (All HRRs) N=306	Decile 1 (Low Penetration) N=30	Decile 10 (High Penetration) N=30	P-Value (10 vs. 1)
Preventable Hospitalizations for 65–74 years[b]				
COPD or asthma	960	1,019	877	0.193
Congestive heart failure[c]	806	870	714	0.010*
Dehydration[d]	263	269	233	0.097
Bacterial pneumonia	674	727	590	0.010*
Urinary tract infection[e]	352	377	318	0.086
Preventable Hospitalizations for 75+ years[b]				
COPD or asthma	1,185	1,245	1,147	0.352
Congestive heart failure	2,210	2,307	2,109	0.276
Dehydration	643	649	591	0.370
Bacterial pneumonia	1,668	1,714	1,584	0.184
Urinary tract infection	1,287	1,350	1,202	0.290
All-cause hospital readmission rate[f]	18.12%	18.03%	18.16%	0.811
ED visits per 1,000 beneficiaries[f]	562	580	572	0.704

NOTES: HRR: Hospital referral region. COPD: Chronic obstructive pulmonary disorder. ED: Emergency department.

[a] All statistics are weighted.

[b] Hospital admission rates per 100,000 beneficiaries.

[c] Data only available for 29 out of 30 HRRs in Decile 1.

[d] Data only available for 24 out of 30 HRRs in Deciles 1 and 10.

[e] Data only available for 25 out of 30 HRRs in Deciles 1 and 10.

[f] Across all ages (65 years and over).

*P-value at or below 0.05.

SOURCE: 2010 Geographic Variation in Medicare Spending and Utilization database.

for particular types of health care services, after accounting for different locality prices or Medicare payments, population size, and average health risk profiles. In addition to cost savings, we also found some evidence of comparable performance on clinical quality measures among HRRs with higher health center penetration, particularly among the younger old (65–74 years).

Several possibilities may explain the source of the evident savings: Savings may accrue from health centers located in higher penetration HRRs serving a larger number and/or proportion of Medicare beneficiaries relative to health centers in lower penetration HRRs. Although the national average proportion of health center patients who were Medicare beneficiaries was 7.5% in 2010, there is likely considerable variation across HRRs. In low-penetration HRRs, health center capacity may be very limited and therefore unable to accommodate additional patients, including Medicare beneficiaries. In addition, high-penetration HRRs have a larger proportion of dual eligibles than low-penetration HRRs. This finding suggests that health center penetration is high where it is most needed; that is, it is most needed in areas with a relatively higher concentration of dual eligibles—a resource-intensive group of patients for both Medicare and Medicaid. Most acute and post-acute care costs

for these beneficiaries are covered by Medicare, although some costs, such as premiums, copayments, and long-term care, may be covered by Medicaid; therefore, the latter are not included in the Medicare cost estimates presented here. Finally, greater health center presence may allow access to needed primary care to greater numbers of the underserved without any apparent compromise of quality of care. Further research is needed to elucidate the potential pathways between health center penetration and Medicare cost savings.

There are several limitations with this study to bear in mind. First, this is an ecological analysis using the HRR as the unit of geography; therefore, we cannot make causal claims regarding the association between health center penetration and Medicare costs or clinical quality at the individual beneficiary level. The data do not allow us to conclude that high health center penetration leads to cost savings, but simply that regions with high penetration also experience lower costs. Without more detailed data, we can only hypothesize that comprehensive and coordinated primary care for Medicare beneficiaries who visit health centers may be associated with lower rates of preventable hospitalizations and other downstream costs; however, we cannot elucidate the pathways between improved access to health centers and reductions in cost.

Our measure of health center penetration applied to the overall low-income population in each HRR because we did not have the data to determine health center penetration specifically among low-income Medicare beneficiaries. In addition, our definition of a health center patient was based on having at least one visit to a health center in 2010, which does not necessarily indicate regular or frequent use of the health center. Hence, our estimates may be overstated if we had considered only regular, relatively frequent-use health center patients, to the extent they display systematically different health services usage and cost patterns compared to those with occasional or infrequent health center use. We did not have the available data to ascertain the number of annual visits by beneficiaries in order to identify those individuals who received most of their primary care in health centers.

We also cannot detect variations at more granular levels within HRRs, although the literature suggests that the choice of geography affects the extent of measured variation (Rosenthal, 2012). In addition, because we did not have data on HRR healthcare supply measures (e.g., primary care physicians per 100k of population, number of short-term general hospitals per 100k of population, etc.), we could not directly account for the possibility that non-health center healthcare supply factors may influence our findings. Furthermore, the mapping we used to transfer the ACS population/income data from ZCTA to ZIP Code was an approximation because some ZCTAs include multiple ZIP Codes; in these instances, we determined the centroid of each ZCTA and assigned the data to the ZIP Code in which the centroid was located. Finally, we accounted for key differences among regions regarding input costs, population size, and health status, and assessed the role of primary care access in explaining the remaining variation in Medicare spending and clinical quality. However, other sources of variation may account for additional unexplained variation.

Despite these limitations, our findings show that increased access to primary care among vulnerable populations is associated with reduced cost and comparable quality outcomes among Medicare fee-for-service elderly beneficiaries. Although Medicare beneficiaries currently comprise a modest proportion (7.5%) of all health center patients, this represents 1.46 million patients served. Our results suggest that greater health center penetration in an HRR may be associated with Medicare cost savings without compromising clinical quality. Expansion of the Health Center

Program appears to represent an effective policy lever that may be associated with reduced Medicare spending variation across geographies, potentially yielding attendant gains in efficiency.

Disclaimer

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Appendix 1: Correlation of Health Center Penetration in HRRs and Medicare Costs and Clinical Quality Outcomes [a]

We estimated Medicare spending (per capita, standardized, risk-adjusted) as a function of health center penetration (continuous variable) using a generalized linear model with a log link function. We selected this technique because of the skewed nature of spending data (requiring log transformation) and to obtain reliable standard error estimates. Since spending was already adjusted for variations in input prices, population size, and health risk, these factors were not considered as potential covariates. We excluded other covariates from the regression because many, including race/ethnicity and percent of population in poverty, were highly correlated with health center penetration. Using the same regression technique, we also examined each of the five measures of preventable hospitalizations (separately for each age group), hospital readmissions, and ED visits as a function of health center penetration. To assess the impact on outcome variables of a substantive change in penetration rate—one that is a significant departure from the overall average—we examined the impact of a 20 percentage point increase in mean penetration rate (21%). Additional regression model details are available upon request.

Exhibit A1. Regression Models: Medicare Costs and Clinical Quality Outcomes as a Function of Health Center Penetration

	Impact of a 20-percentage point increase in health center penetration (95% CI)	
Total Medicare Cost per Beneficiary [b]	–$377.75	(–$518.32, –$219.17)***
Preventable Hospitalizations for 65–74 years [c]		
COPD or asthma	–58	(–103, 9)
Congestive heart failure	–55	(–85, –16)**
Dehydration	–13	(–22, –1)*
Bacterial pneumonia	–51	(–74, –19)**
Urinary tract infection	–29	(–41, –11)**
Preventable Hospitalizations for 75+ years [c]		
COPD or asthma	–36	(–84, 29)
Congestive heart failure	–57	(–135, 40)
Dehydration	–24	(–50, 12)
Bacterial pneumonia	–52	(–105, 15)
Urinary tract infection	–78	(–128, –9)*
All-cause hospital readmission rate	–0.10%	(–0.24%, 0.49%)
ED visits per 1,000 beneficiaries	–1	(–12, 16)

NOTES: HRR: Hospital referral region. CI: Confidence interval. COPD: Chronic obstructive pulmonary disorder. ED: Emergency department. Coefficients for health center penetration were statistically significant at:

*p< 0.05, ** p < 0.01, *** p < 0.001.

[a] Statistics are weighted.

[b] Standardized and risk-adjusted.

[c] Hospital admission rates per 100,000 beneficiaries.

SOURCE: 2010 Geographic Variation in Medicare Spending and Utilization database.