NOTE:

These materials were prepared by subcontractors for consideration by the *Committee on Geographic Variation in Health Care Spending and Promotion of High-value Care*. These analyses were commissioned and overseen by the Committee. However, the findings and views expressed in the subcontractor reports do not necessarily reflect those of the NRC/IOM or the Committee. Neither the methodology nor the subcontractor reports have been subject to formal institutional review for the Interim Report. As the committee continues to review the findings from the analyses contained herein, we invite you to provide feedback on the content of these reports. Please note that any comments will be entered into the project's public access file, and will be available for public review.

Provide Feedback

IOM Study of Geographic Variation: Growth Analysis

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ABSTRACT

Using the universe of Medicare claims data, from 1992 to 2010, this report examines trends in regional variation Medicare spending, utilization, and quality over this time period. Medicare expenditures grew for 16 of the 18 years between 1992 and 2010, with 2010 expenditures 57.3 percent higher than 1992 expenditures after accounting for inflation. High-cost and low-cost regions show similar patterns of spending growth; further, regions that are high-cost or low-cost in 1992 tend to remain so in 2010. In recent year, there has been a slight regression of region-level spending toward the mean as well as a trend of convergence in recent years. These results hold for the Medicare population as a whole as well as for beneficiaries with chronic obstructive pulmonary disease (COPD), depression, diabetes, or stroke. The quality of health care provided to Medicare beneficiaries has shown little change from 1992 to 2010, and regions that provide a high quality of care in 1992 as measured by admissions or readmissions tend to remain high-quality. Regions with high levels of health care utilization, however, do not necessarily achieve better health outcomes than regions with low levels of health care utilization during this time period.

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1 INTRODUCTION

A large body of research indicates there is significant regional variation in health care spending, utilization, and quality across the United States. For instance, the Dartmouth Atlas of Health Care found that per capita Medicare reimbursements in Miami were more than twice as high as in Minneapolis.[1] Other studies also have found significant variation in expenditures for end-of-life care and in the likelihood that individuals are diagnosed with a specific disease.[2] The theme that there exist significant regional variation in the healthcare patient receive has even reached popular media. Atul Gawande's article in *The New Yorker* magazine, for instance, further advanced the notion that variation in physicians' chosen practice patterns drives variation in Medicare costs observed even in cities close to one another.[3] By first identifying the source of this geographic variation, policymakers can potentially develop and implement initiatives to alter practice patterns in high-cost areas. Acumen's previous report showed that while substantial geographic variation in Medicare spending exists across regions and is consistent over time, variation in spending among patients within a region is much greater.[4]

This report broadens the scope of the previous analysis to examine regional variation in the growth of health care spending, utilization, and quality over a longer time frame. Specifically, this report uses the universe of Medicare fee-for-service (FFS) claims data between 1992 and 2010 to answer the following four research questions:

1. How have Medicare expenditures and utilization grown nationally from 1992 to 2010?
2. Have high-cost and low-cost regions converged or diverged over time?
3. Are Medicare growth trends consistent across patient groups?
4. Do regions with high levels of expenditures and utilization also provide high levels of health care quality?

The remainder of this report proceeds as follows. Section 2 describes the methodology used to examine regional variation in Medicare spending, utilization, and quality. Section 2.1 describes the construction of the cohorts of Medicare beneficiaries; Section 2.2 defines the measures of health care service provision; and Section 2.3 specifies the risk adjustment method. Section 3

[1] The Center for the Evaluative Clinical Services and Dartmouth Medical School, *The Dartmouth Atlas of Health* (Chicago: American Hospital Publishing, Inc., 1996).
[2] Y Song et al., "Regional Variations in Diagnostic Practices," *New England Journal of Medicine* 2010, no. 363 (2010).
[3] Atul Gawande, "The Cost Conundrum: What a Texas town can teach us about health care," *New Yorker*(June 2009), http://www.newyorker.com/reporting/2009/06/01/090601fa_fact_gawande.
[4] Thomas MaCurdy et al., "IOM Study of Geographic Variation: Medicare and Medicaid," (August 2012).

addresses each of the above research questions in turn. Finally, Section 4 presents a summary of this report's major findings.

2 MEASURING MEDICAL SPENDING, UTILIZATION, AND QUALITY

To measure how spending, utilization and quality vary across HRRs requires broad methodological steps. First, this study creates a cohort of beneficiaries eligible for inclusion in the study. In the baseline specification, this includes all eligible beneficiaries enrolled in Medicare Part A and Part B in a given month between 1992 and 2010, but this study also examines four cohorts made up of beneficiaries with high-risk conditions. Once the cohorts are defined, the second step defines the three measures of health care service provision (i.e., spending, utilization, and quality). Note that all analyses of geographic variation define a "region" as a Hospital Referral Region (HRR).[5] Finally, the third step accounts for differences in patient case mix. The three sections below describe each step in turn. Note that this report broadly uses the same methodology as Acumen's previous analysis of regional variation in Medicare spending, utilization and quality between 2007 and 2009.[6]

2.1 Construction of Aggregate and Condition-Specific Beneficiary Cohorts

Using data from Medicare claims, this study examines a cohort of all Medicare beneficiaries and four other cohorts restricting to beneficiaries with certain health conditions. The aggregate analysis provides a broad view of regional variation in expenditures, utilization, and quality. Because patterns of geographic variation may differ for beneficiaries with a specific disease, this study also examines beneficiaries with chronic obstructive pulmonary disease (COPD), depression, diabetes, and stroke. COPD, diabetes, and stroke rank in the top ten leading causes of death in the United States.[7] Although depression is not a leading cause of death, the prevalence of major depression is particularly high for individuals that use selected services covered by Medicare including home health (13.5 percent of utilizers are clinically depressed), skilled nursing (4 to 15 percent), or inpatient (11.5 percent) services.[8]

The following two sections describe the methodology applied to construct the aggregate and four condition-specific beneficiary cohorts. Section 2.1.1 defines the data sources used in this study. Section 2.1.2 describes the steps this analysis applies to create the aggregate and condition cohorts.

2.1.1 Data Sources

The growth analysis investigation uses the universe of Medicare fee-for-service claims and enrollment data from 1991 through 2010 to analyze geographic variation in spending,

[5] T.A. Brennan et al., "Incidence of adverse events and negligence in hospitalized patients," *New England Journal of Medicine* 324, no. 6 (1991).
[6] Ibid.
[7] Sherry L. Murphy, Jiaquan Xu, and Kenneth D. Kochanek, "Deaths: Preliminary Data for 2010," National Center for Health Statistics: National Vital Statistics Reports, http://www.cdc.gov/nchs/data/nvsr/nvsr60/nvsr60_04.pdf.
[8] Celia F. Hybels and Dan G. Blazer, "Epidemiology of Late-Life Mental Disorders," *Clinics in Geriatric Medicine* 19, no. 4 (2003).

utilization, and quality over time. Table 2.1 presents the data sources used to create the relevant analytic files. Medicare Part A and B claims include information for each beneficiary encounter with a provider paid by Medicare, describing what services were rendered during the encounter, the costs of those services, who provided the services, and a range of information regarding the beneficiary's health status. Medicare Part D claims provide information about prescription drugs provided to a beneficiary, including the costs paid by the beneficiary and by Medicare. Part D data are available from 2006 onward because the Part D program was implemented in 2006. Medicare enrollment data contain detailed information on all individuals entitled to Medicare, including demographics information, enrollment dates, and third party buy-in information.

Table 2.1: Data Sources

Data Source	Years	Data Files
Medicare Parts A and B Claims	1991 – 2010	Standard Analytic File (SAF) 1991-2005 Common Working Files (CWF) 2006-2010
Medicare Part D Claims	2006 – 2010	Prescription Drug Event (PDE)
Medicare Part A, B, C, and D Enrollment Data	1991 – 2010	Enrollment Database (EDB) Common Medicare Environment (CME) Enterprise Cross Reference (ECR) Files

2.1.2 Defining Beneficiary Cohorts

Not only does this report examine regional variation in cost, utilization, and quality for the aggregate Medicare cohort, but additional analyses answer these same research questions for beneficiaries with four specific condition cohorts. The aggregate cohort includes all Medicare fee-for-service beneficiaries enrolled in Medicare Part A and B. The condition cohorts include Medicare fee-for-service beneficiaries with COPD, depression, diabetes, or stroke, as determined by their claims data. Beneficiaries are included in a cohort if they have any claims with an ICD-9 diagnosis code that corresponds to CMS Hierarchical Condition Categories (HCCs) for COPD, depression, diabetes, or stroke. Table A.1 in Appendix A presents the definitions of the HCCs used to create the four condition cohorts examined in this analysis.

Although restricting the sample to beneficiaries with certain health conditions allows one to answer the research questions of interest more narrowly for individuals with similar health profiles, this approach presents several challenges. First, diagnosis and procedure codes may be reported differently across regions. If physicians in certain regions diagnose patients in systematically different ways than physicians in other regions, the results of a cohort-based analysis of regional variation in health care may be biased. For example, if "upcoding" diabetes diagnoses is common in the Northeast, then beneficiaries included in the diabetes cohort residing in the Northeast will be relatively healthy since some of these individuals may not meet the

criteria for a diabetes diagnosis in other regions. If upcoding occurs, these beneficiaries' costs and utilization will be relatively low compared to other regions not due to treatment choice but due to the cohort to which this study classifies them. Second, regions may differ in the propensity to screen for certain conditions. If some regions are more likely to identify certain conditions at an earlier stage, these conditions may be less expensive to treat and treatment may be more likely to result in a successful outcome in these regions. Although risk adjustment can control for various beneficiary level characteristics including comorbidities, it is not possible to perfectly control for the severity of a beneficiary's condition. Third, using diagnosis codes to define condition cohorts may lead to an endogeneity problem: the lowest cost beneficiaries are less likely to visit a physician, and therefore the methodology will assign fewer low cost beneficiaries to a given condition cohort. If low cost beneficiaries are more common in certain regions, the methodology will overstate costs in these regions for the condition cohorts. Finally, this study does not have access to beneficiary medical records, and thus it is not possible to independently verify diagnostic information. Previous research, however, has compared diagnosis codes on Medicare claims against diagnosis codes included in medical records and found a high positive predictive value (PPV).[9,10,11]

For both the aggregate and condition specific-cohorts, this study applies two exclusion restrictions to ensure that the analysis captures the full range of each beneficiary's health care utilization. First, this analysis excludes a beneficiary for a given month of analysis if the beneficiary's enrollment information indicates that Medicare was the secondary payer. Beneficiaries who have Medicare as the secondary payer are typically the working aged or working disabled. Because Medicare is not paying the full cost of these beneficiaries' health care, regions with larger percentages of these beneficiaries would appear artificially lower-cost if they were included in the analysis. Second, the analysis excludes months in which a beneficiary has a missing or invalid ZIP code which does not map to an HRR because the beneficiary cannot be assigned to a geographic region in that month.[12] Table 2.2 presents the percent of total months of enrollment lost to each restriction for each of the cohorts from 1992 through 2010. Overall, the aggregate analysis loses 1.8 percent of months of enrollment due to these restrictions.

[9]Yuka Kiyota et al., "Accuracy of Medicare Claims-Based Diagnosis of Acute Myocardial Infarction: Estimating Positive Predictive Value on the Basis of Review of Hospital Records," *American Heart Journal* 148(2004).
[10] Wolfgang C Winkelmayer et al., "Identification of Individuals with CKD from Medicare Claims Data: A Validation Study," *American Journal of Kidney Diseases* 46(2005).
[11] Elena Birman-Deych et al., "Accuracy of ICD-9-CM Codes for Identifying Cardiovascular and Stroke Risk Factors," *Medical Care* 43.
[12] The analysis assigns beneficiaries to HRRs based on the HRR in which they resided for the majority of their enrollment in Medicare during the year. In the case of ties, the beneficiary is assigned to the earlier tied HRR in the year, as moving is considered within the set of treatment options available.

Table 2.2: Effect of Exclusion Restrictions on Cohort Size

Cohort	Beneficiary Months Enrolled (billions)	Medicare Not Primary Payer	Missing/ Invalid ZIP Code	Percent of Months Excluded
Aggregate	6.8	0.3%	1.5%	1.8%
COPD	0.8	0.3%	1.4%	1.7%
Depression	0.2	0.6%	1.7%	2.3%
Diabetes	1.2	0.3%	1.9%	2.2%
Stroke	0.2	0.2%	1.5%	1.7%

2.2 Measures of Health Care Service Provision

To quantify the growth in the provision of health care services across geographic regions, this analysis examines three outcome variables of interest: health care expenditures, utilization, and quality of care. Health care expenditures measure the actual costs of care incurred by Medicare beneficiaries. Total health care expenditures are affected by the prices of health care services as well as the quantity of health care services that are utilized. To identify growth in expenditures due specifically to increasing resource use intensity, this analysis also creates a measure of utilization that controls for regional differences in prices. Higher levels of service utilization or expenditures growth, however, do not necessarily indicate that a region is inefficient if this region uses the additional medical care to achieve better health care outcomes. To determine if health care expenditures and utilization are correlated with quality levels over time, this analysis also utilizes a variety of quality measures. The following three sections describe how this study defines health care spending, utilization, and quality outcomes in more detail.

2.2.1 Measurement of Health Care Expenditures

To quantify the growth in health care expenditures across geographic regions, this analysis measures per-member, per-month health care expenditures using two steps. The first step aggregates all Medicare payments for each beneficiary in each month of analysis. The methodology draws payment information from Medicare claims; total raw cost is the sum of the claim payment, coinsurance, and deductible from the inpatient, outpatient, hospice, home health, skilled nursing, carrier, and durable medical equipment (DME) claim types, as well as the Part D claim type from 2006 through 2010.[13] The analysis excludes claims with total negative payment, as these are likely due to coding errors or are claims that have been rescinded.

[13] The results of the analysis including costs from Part D are presented in Appendix C. Expenditure calculations from the Inpatient claim type remove the add-on Indirect Medical Education (IME) and Disproportionate Share (DSH) payments.

The second step adjusts expenditures for inflation in input prices. The analysis adjusts costs for inflation in input prices each quarter by dividing by the CMS market basket adjustment for each payment system or setting.[14] CMS applies the market basket adjustment to update payments for the input price inflation facing each type of provider.[15]

Unlike the previous analysis of Medicare and Medicaid expenditures from 2007 through 2009, this analysis examines actual beneficiary spending each month rather than average monthly spending per year. Calculating average per-month spending would remove the effect of increased expenditures at different points of time in the beneficiary's enrollment, such as at the beginning of an illness. Instead, calculating actual per-month spending allows the outcome to reflect all of the variation in the changing spending levels for a beneficiary.

2.2.2 Measurement of Health Care Utilization

Standardized prices reflect only variation in expenditures due to differences in utilization of health care services. Output price standardization assigns each service its average national price to observe variation in the utilization of services across regions. In essence, price standardization removes Medicare payment policies that reimburse providers differently by region. The analysis calculates output price adjusted expenditures in three steps:

1. Define a service type for each setting;
2. Measure utilization as the average cost nationally for each service in each setting; and
3. Account for inflation.

The first step defines a unit of service for each setting. CMS pays providers based on different services depending on the provider's setting. For example, providers in an inpatient setting are paid based on the Diagnosis-Related Group (DRG) recorded on the claim; thus, in the second step of calculating output price-adjusted expenditures, this analysis calculates average costs for each DRG. Table A.2 in Appendix A defines each unit of service by setting and explains the limitations, if any, to each method.

The second step measures utilization as the average national cost for each service in each setting. Because the unit of analysis is defined separately in each care setting, the analysis sums beneficiary costs in each setting and for each unit of service. The second step also renormalizes

[14] "Market Basket Data," Centers for Medicare & Medicaid Services, http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/MedicareProgramRatesStats/MarketBasketData.html.

[15] Since four-quarter moving percent average changes in the market basket from 1992-1995 only exist for the Medicare Economic Index (MEI) and the Inpatient Prospective Payment System (IPPS), this analysis applies the MEI percent changes to home health expenses and applies the IPPS percent changes to the other inpatient expenses and skilled nursing facility expenses. In addition, this analysis uses the medical equipment component of the MEI (which is the Producer Price Index (PPI) for medical equipment and instruments) to adjust durable medical equipment (DME) payments for inflation. Finally, because CMS does not apply a market-basket adjustment to hospice costs, this analysis uses the home health market basket to adjust hospice costs for input price inflation.

total price-adjusted costs (before inflation adjustment) to be equal to total unadjusted costs in each year so that price-adjusted costs reflect the actual prices paid by CMS. Renormalization occurs at the setting (i.e., inpatient, outpatient, DME) and year level.[16] The third step adjusts price-standardized utilization for inflation in input prices using the CMS market baskets, as described above for the expenditures calculation.

While calculating a national average price for a given year and setting removes considerable variation in output prices, this methodology is limited. This study's prior methodology completely removed for all variation in Medicare payment rules for all settings each year by directly accounting for each payment rule. Applying this methodology for all years of this analysis, however, is not feasible due to the complexity and frequent adjustments in Medicare payment policy. Averaging costs by service type for each year provides a reasonable—although imperfect—estimate of changes in payment rules over time.[17]

2.2.3 Measurement of Health Care Quality

This study utilizes three measures of health care quality to analyze trends in quality across geographic regions. The first two quality measures are Agency for Healthcare Research and Quality (AHRQ) composite measures, and the third measure calculates readmissions to the hospital. The three quality measures are as follows:

1. The AHRQ Inpatient Quality Indicator Composite (IQI #91)[18]
2. The AHRQ Prevention Quality Indicators Composite (PSI #90)[19]
3. All-cause unplanned readmission within 30 days of discharge.[20]

Researchers have used the IQI and PQI quality indicators to study variation in quality across a variety of payer settings (e.g., Medicaid, Medicare, and commercial) and patient cohorts,[21] and

[16] Price-adjusted expenditures are not renormalized for each condition cohort.
[17] Despite this difference in price-standardization methodology between the previous study and this study, the resulting utilization measures are comparable. The Pearson and Spearman rank correlations between utilization levels in the previous study and in this study are above 0.84 for each year.
[18] D. Lakdawalla, T.J. Philipson, and D. Goldman, "Addressing Geographic Variation and Health Care Efficiency: Lessons for Medicare from Private Health Insurers."
[19] S.C. Williams et al., "Quality of care in US hospitals as reflected by standardized measures, 2002–2004," *New England Journal of Medicine* 353, no. 3 (2005).
[20] This analysis uses a variant of the Hospital-wide All-Cause Unplanned Readmission Measure (HWR) with a single logistic regression for simplicity.
Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation (YNHHSC/CORE), "Hospital-wide All-Cause Unplanned Readmission (HWR) Measure: Final Technical Report," Centers for Medicare & Medicaid Services.
[21] For a list of publications that use the AHRQ quality indicators, see: http://www.qualityindicators.ahrq.gov/Resources/Publications.aspx

the measures have been extensively tested.[22] The readmission measure used as the basis for this study was developed by researchers at Yale University and has been approved by the National Quality Forum.[23] Table A.3 in Appendix A presents the definitions of each of these quality measures. The methodology evaluates each quality measure for the aggregate cohort and for each condition cohort.

2.3 Accounting for Differences in Patient Case Mix

To account for regional differences in the utilization of health care services due to patient case mix, this analysis risk-adjusts the measures of utilization and quality. Risk adjustment controls for factors that are outside of the provider's control but may affect health care outcomes. The general risk adjustment approach uses an ordinary least squares (OLS) regression at the beneficiary level to calculate the coefficients that estimate the relationship between utilization and the independent variables.[24] At the beneficiary level, risk-adjusted utilization is measured as the average price-standardized spending nationwide plus the difference between the beneficiary's observed utilization level and predicted utilization level based on the OLS risk adjustment model. In essence, this approach represents a two-stage methodology where the HRR level estimates are the coefficients from a regression of individual residuals on HRR-level indicator variables.[25]

To risk adjust the quality measures, this study follows the approach outlined in the AHRQ and NQF measure specifications for the IQI and readmission measures. Because both quality measures are binary outcomes, this analysis applies a single logistic regression at the beneficiary level using the same set of beneficiary characteristics as independent variables for these two measures. The PQI measure is adjusted using an OLS regression because it is a count of events during the observation window.

This analysis accounts for differences in patient case mix using a set of beneficiary-level independent variables that may influence utilization (or quality) but are outside providers' control. The variables included broadly represent the "baseline cluster" specification for the

[22] Haytham M. A. Kaafarani et al., "Validity of Selected Patient Safety Indicators: Opportunities and Concerns," *Journal of the American College of Surgeons* 212, no. 6 (2011).
[23] National Quality Forum, "NQF's All-Cause Readmissions Project," http://www.qualityforum.org/Projects/NQF_All-Cause_Readmissions_Project.aspx.
[24] Because the analysis includes independent variables for health status, this equation must be calculated separately for each year to account for changes in health care coding over time. The equation is also calculated separately for each condition cohort because the independent variables may affect the dependent variable differently for beneficiaries with different health conditions.
[25] This average residuals approach mirrors the approach used in the earlier Acumen analysis. MaCurdy et al., "IOM Study of Geographic Variation: Medicare and Medicaid". According to the Frisch-Waugh-Lovell Theorem, this methodology is equivalent to first stage fixed effects regression, if the risk adjusters are linearly unrelated to the HRR indicator variables.

previous analysis of Medicare and Medicaid data.[26] The methodology uses enrollment information and claims data to account for beneficiary demographics, health status, and enrollment differences.[27] The risk adjustment model includes the following beneficiary-level characteristics, which are defined in Table A.4 in Appendix A:

- Age and Sex
- Health status
- New enrollee indicator
- Partial year enrollment

The risk adjustment methodology defines health status by categorizing diagnoses on beneficiary claims in the prior year into clinically-related categories using CMS's Hierarchical Condition Categories (HCCs).[28] This approach for assigning HCCs may lead to a positive correlation between area utilization levels and the number of assigned HCCs, as beneficiaries in high-use areas are more likely to have their conditions noted in their claims. Thus, the estimated coefficients may be upwards-biased for beneficiaries in high-use areas since these beneficiaries may have more comorbidities than they would otherwise have in low-use areas. This drawback, however, occurs whenever a study uses administrative claims data.[29]

[26] Ibid.
[27] The quality measure scores are only risk-adjusted using demographic and health status information. The partial year enrollment variable is only included in the analyses including Part D.
[28] Gregory C. Pope et al., "Evaluation of the CMS-HCC Risk Adjustment Model," *RTI International and the Centers for Medicare & Medicaid Services*(March 2011), https://www.cms.gov/MedicareAdvtgSpecRateStats/downloads/Evaluation_Risk_Adj_Model_2011.pdf.
[29] Medicare Payment Advisory Commission, "Regional Variation in Medicare Service Use: Report to Congress," (January 2011), http://www.medpac.gov/documents/Jan11_RegionalVariation_report.pdf.

3 REGIONAL VARIATION IN SPENDING, UTILIZATION AND QUALITY

Using the methodology described above, this section characterizes the growth in expenditures and utilization for the Medicare program. Specifically, the following discussion answers these four research questions:

1. How have Medicare expenditures and utilization grown nationally from 1992 to 2010?
2. Have high-cost and low-cost regions converged or diverged over time?
3. Are Medicare growth trends consistent across patient groups?
4. Do regions with high levels of expenditures and utilization also provide high levels of health care quality?

Each section below presents the answers to these questions. All cost and utilization results exclude Part D prescription drugs costs. Appendix B presents the same results from 2006 to 2010 including costs from Part D, which are largely similar to the results presented below.

3.1 National Growth in Medicare Expenditures and Utilization

Between 1992 and 2010, the Medicare program has grown steadily in terms of average expenditures and utilization rates per beneficiary. Medicare expenditures grew for 16 of the 18 years between 1992 and 2010, with 2010 expenditures 57.3 percent higher than 1992 expenditures after accounting for inflation. Utilization, computed as price-standardized and risk-adjusted expenditures, grew by 62.7 percent over the same period. Table 3.1 presents the growth rate from the previous year for Medicare expenditures and utilization, and Figure 3.1 graphically represents these results using red bars for expenditures and blue bars for utilization.

As a result of national legislation, Medicare expenditures contracted for one short period in 1998 and 1999 but rebounded again in 2000. During 1998 and 1999, per-beneficiary monthly expenditures fell by about 4.2 and 2.3 percent from the previous year, respectively. However, prior to 1997, expenditures grew by between 3.9 and 8.8 percent each year.[30] This decrease in expenditures in 1998 and 1999 is likely due to the implementation of the Balanced Budget Act (BBA) in 1997, which reduced Medicare payments for many services and restrained the update factors for payment.[31] Two additional factors decreased total Medicare spending past the BBA's projected savings: increased compliance with payment rules caused by increased efforts to

[30] This trend mirrors the trend found in National Health Expenditures data. "National Health Expenditure Data," Centers for Medicare & Medicaid Services, http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/tables.pdf.

[31] Dan L. Crippen, "CBO Testimony on the Impact of the Balanced Budget Act on the Medicare Fee-for-Service Program," (Committee on Commerce, U.S. House of Representatives: Congressional Budget Office, 1999).

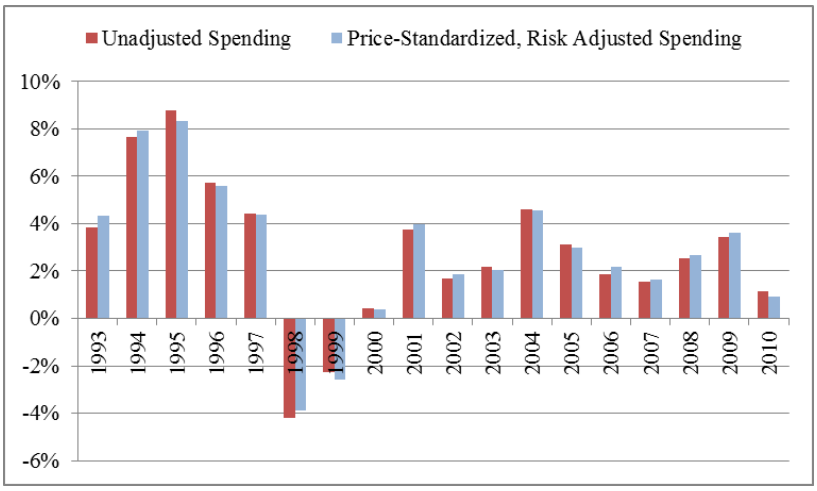
penalize fraud and changes in billing patterns.[32] The Medicare Balanced Budget Refinement Act (BBRA) of 1999 was created to offset the larger-than-expected gains in Medicare savings and resulted in positive expenditure growth in 2000.[33] Expenditures continued to rise from 2000 through 2010 and grew from between 0.4 and 4.6 percent each year. Growth in expenditures after accounting for variation in Medicare payment policies and in patient case mix mirrors growth in unadjusted expenditures. Utilization growth rates are generally within a percentage point of expenditure growth rates, and the correlation between the rates is 0.99.

Table 3.1: Medicare Expenditures and Utilization, Annual Growth Rates

Year	Expenditures	Utilization
1993	3.9%	4.3%
1994	7.6%	7.9%
1995	8.8%	8.3%
1996	5.7%	5.6%
1997	4.4%	4.4%
1998	-4.2%	-3.9%
1999	-2.3%	-2.6%
2000	0.4%	0.4%
2001	3.7%	4.0%
2002	1.7%	1.9%
2003	2.2%	2.0%
2004	4.6%	4.6%
2005	3.1%	3.0%
2006	1.9%	2.2%
2007	1.6%	1.6%
2008	2.5%	2.7%
2009	3.4%	3.6%
2010	1.1%	0.9%

[32] Ibid.
[33] The Lewin Group and the American Hospital Association, "Trend Watch: The Impact of the BBA and the BBRA," 2, no. 1 (March 2000), http://www.aha.org/research/reports/tw/twmarch2000.pdf.

Figure 3.1: Differences between Medicare Expenditures and Utilization Growth Rates



3.2 Regional Variation in Growth of Medicare Expenditures and Utilization

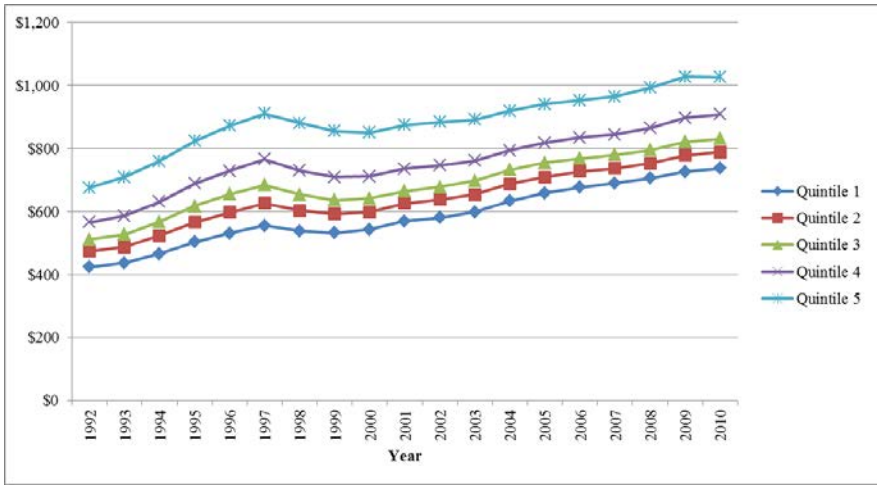
Although the analysis above suggests that regions experienced growth in expenditures and utilization over the period 1992 to 2010 on average, it is unclear whether some regions grew faster than others. This section examines whether HRRs classified as high-cost in 1992 are likely to also be classified as high-cost in 2010. If regions with high cost levels in 1992 experience similar or faster growth than regions with low cost levels, then regions with high cost levels in 1992 will likely remain high-cost in 2010, and regional expenditures and utilization will tend to diverge over time. Similarly, if regions with high cost levels in 1992 experience slower growth than with regions with low cost levels, then regions with high cost levels in 1992 may not remain high-cost in 2010, and regional expenditures and utilization will tend to converge over time. First, this section examines trends in region-level expenditures and utilization growth to determine if spending patterns are similar for high-cost and low-cost regions. Next, this section discusses whether regions that are high-cost in 1992 tend to remain high-cost.

Trends in expenditures levels are similar across high-cost and low-cost regions. Figure 3.2 presents average monthly expenditure levels from 1992 to 2010 for five cost levels. The graph classifies HRRs into quintiles based on expenditure levels in 1992 such that the same number of HRRs are included in each quintile.[34] The graph tracks the average expenditures each year for HRRs in each cost quintile. The cost quintiles are defined by 1992 expenditures, so each HRR remains in the same cost quintile throughout the graph. Quintile 1 includes the lowest-cost regions, and Quintile 5 includes the highest-cost regions. The movement of expenditures from

[34] Because there are 306 HRRs, four quintiles contain 61 HRRs and one contains 62 HRRs. Constructing quintiles such that each quintile contains approximately the same number of beneficiaries in 1992 (instead of the same number of HRRs) does not materially alter any of the conclusions presented in this report.

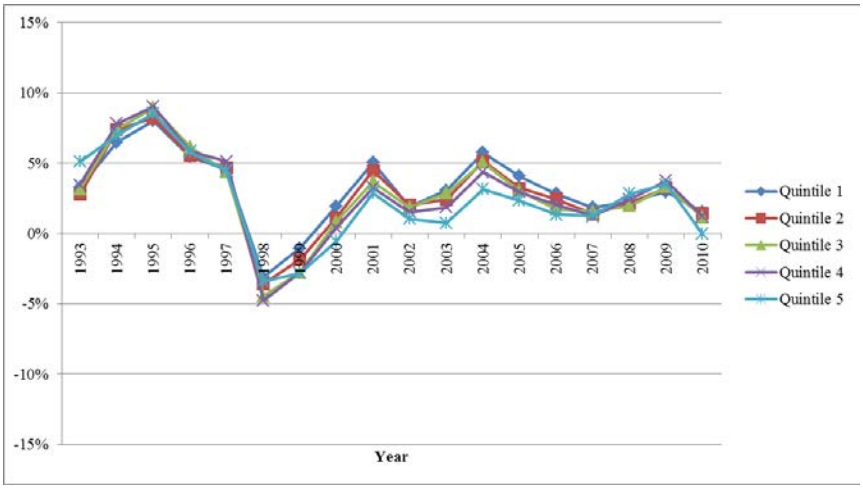
1992 through 2010 is similar for each quintile; expenditure levels are generally rising over this time period, with decreases in 1998 and 1999 that are primarily due to the BBA. Average expenditures in regions that are high-cost in 1992 do not appear to be growing faster than average expenditures in regions that are low-cost in 1992.

Figure 3.2: Average Monthly Expenditure, by HRR Quintile



Not only are long-term growth trends similar in high- and low-cost HRRs, but year-to-year changes in spending are also nearly identical for all region quintiles. Figure 3.3 displays the growth rate in average monthly expenditures from the previous year by HRR cost quintile. As in Figure 3.2, Figure 3.3 classifies HRRs into quintiles based on expenditure levels in 1992; thus, HRRs are classified into the same quintiles in Figure 3.3 as in Figure 3.2. Though the growth rates across cost quintiles are not identical, all cost quintiles have the same growth patterns, and growth rates for each cost quintile are generally within one to two percentage points of each other. As shown in both Figures 3.2 and 3.3, per-beneficiary monthly expenditures fell drastically in 1998 and 1999.

Figure 3.3: Expenditures Annual Growth Rate, by HRR Quintile



After removing variation in expenditures due to regional differences in prices, patient demographics, and observed beneficiary severity of illness, average monthly utilization levels and growth rates remain similar across cost quintiles. Figure 3.4 displays the average monthly utilization level for each cost level, where HRRs are classified into cost quintiles based on average monthly utilization levels in 1992. Quintile 1 shows the average monthly utilization level of the lowest-utilization HRRs, and Quintile 5 shows the average monthly utilization level of the highest-utilization HRRs. Figure 3.4 shows that trends in utilization from 1992 through 2010 mirror trends in expenditures. Utilization levels are even more closely related across cost quintiles than the expenditure levels presented in Figure 3.2, indicating that price-standardization and risk adjustment remove some variation across cost quintiles. Similarly, Figure 3.5 shows that utilization growth rates are slightly more related across cost quintiles than expenditure growth rates. Figure 3.5 also shows that HRRs with the highest utilization levels were the most affected by the BBA in 1998.

Figure 3.4: Average Monthly Utilization, by HRR Quintile

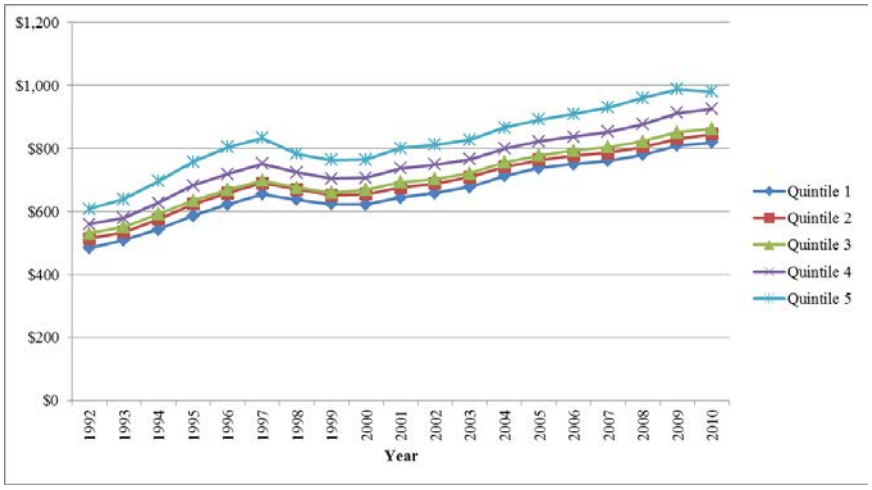
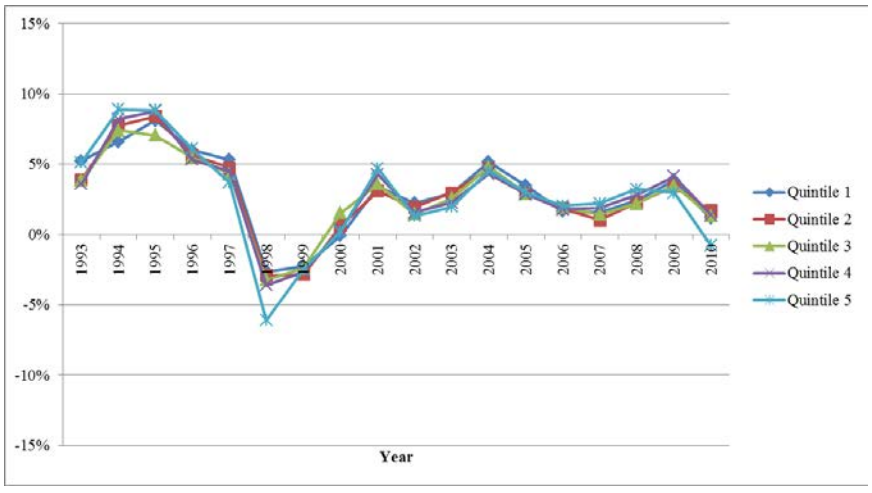


Figure 3.5: Utilization Annual Growth Rate, by HRR Quintile



Whereas high- and low-cost HRRs in 1992 tend to grow at similar rates, there is some evidence that high-cost (and low-cost) areas tend to regress to the mean somewhat over time. To determine if cost levels are regressing toward the mean, Tables 3.2 and 3.3 display the relationship between an HRR's expenditure and utilization levels, respectively, in 1992 and in 2010 with the HRR's annual growth rate from 1992 to 2010.[35] Both expenditure and utilization levels in 1992 have moderate negative Pearson and Spearman rank correlations with overall growth rates. These negative correlations indicate that regions with high expenditure and utilization levels in 1992 tend to have low growth rates over the next 18 years. In addition, both expenditure and utilization levels in 2010 have positive Pearson and Spearman correlations with growth rates, suggesting that regions that were high-cost in 2010 tended to have high growth rates. These two patterns taken together provide some evidence that region-level costs are regressing toward the mean, though the degree of regression is small.[36]

Table 3.2: Correlation between Expenditure Levels and Overall Growth Rate

	Correlation Score	
	Pearson	**Spearman**
1992	-0.397	-0.468
2010	0.213	0.100

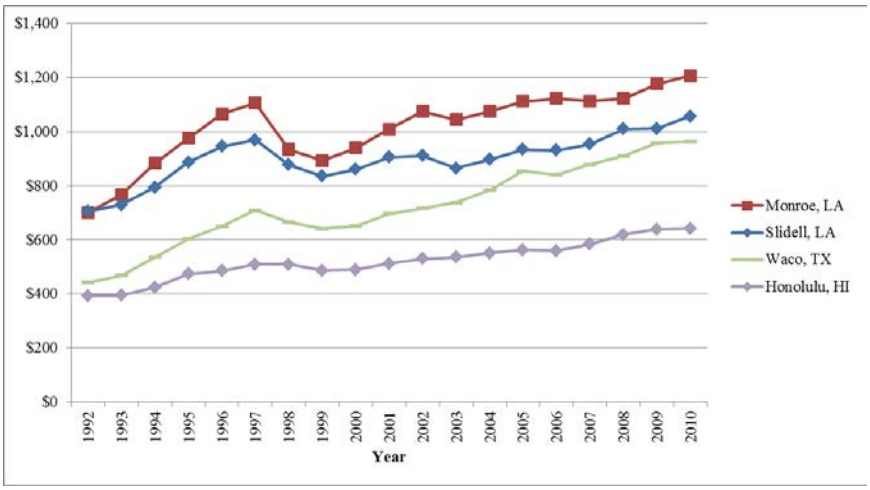
Table 3.3: Correlation between Utilization Levels and Overall Growth Rate

	Correlation Score	
	Pearson	**Spearman**
1992	-0.260	-0.222
2010	0.566	0.561

Examining specific HRRs further illustrates the phenomenon of moderate regression to the mean. Figure 3.6 displays the utilization levels over time for the highest-cost HRRs in 1992 (Monroe, LA, and Slidell, LA) and for the lowest-cost HRRs in 1992 (Waco, TX, and Honolulu, HI). Monroe and Slidell have very similar growth patterns, though Monroe's utilization levels outpaced Slidell's, and both remain in the top 15 utilizing HRRs in 2010. Waco and Honolulu, however, experience very different growth patterns, with Honolulu generally growing at a low rate and with only a fraction of the drop in expenditures in 1998 and 1999 that is seen in the other HRRs due to the BBA. Waco experiences much higher utilization rates than Honolulu, and, despite having the second-lowest utilization levels of all HRRs in 1992, is just below the highest cost quintile by 2010. This figure shows just one example of a slight trend toward the mean regional expenditure level.

[35] Annual growth rates are calculated as the geometric mean growth rate from 1992 to 2010.
[36] All of the correlations presented in Tables 3.2 and 3.3 are significant at the 95 percent significance level except for the Spearman correlation between expenditure levels in 2010 and the overall growth rate shown in Table 3.2.

Figure 3.6: Utilization Trends for Highest-Cost and Lowest-Cost HRRs



Though some regions' cost levels are regressing toward the mean, this phenomenon is weak; high-cost in 1992 tend to be high-cost in 2010. To determine if regions that are high-cost or low-cost in 1992 remain high-cost or low-cost in 2010, Table 3.4 presents the stability of each expenditure quintile. As in the earlier figures, the lowest-cost regions are included in Quintile 1, and the highest-cost regions are included in Quintile 5. For example, of all HRRs that were in the lowest-cost quintile in 1992, by 2010, 60.7 percent were still in the lowest cost quintile; 27.9 percent were in the second-lowest cost quintile; 9.8 percent were in the middle cost quintile; 1.6 percent were in the second-highest cost quintile; and 0 were in the highest cost quintile. Stability is slightly stronger for the highest-cost regions, with 69.4 percent of HRRs remaining in the highest-cost quintile in 1992 and 2010 compared to 60.7 percent remaining in the lowest-cost quintile. Similarly, Table 3.5 presents the stability of the utilization quintiles over time. Utilization levels have slightly weaker stability than expenditures; for example, only 45.9 percent of HRRs in the lowest-cost quintile in 1992 remained in the lowest-cost quintile in 2010, and only 58.1 percent of HRRs in the highest-cost quintile in 1992 remained so in 2010. The persistence of regional cost rankings over time suggests that the degree of convergence of region-level costs is small.

Table 3.4: Expenditures Quintile Stability

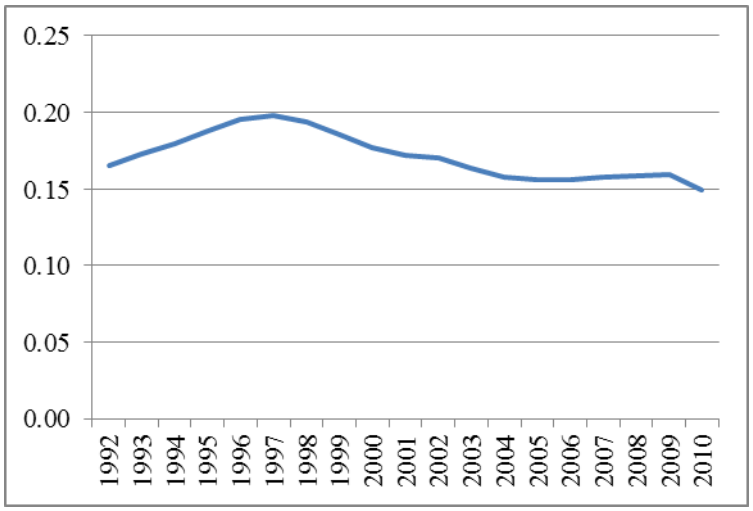
Quintile in 1992	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	60.7%	27.9%	9.8%	1.6%	0.0%
2	26.2%	41.0%	23.0%	6.6%	3.3%
3	13.1%	21.3%	37.7%	24.6%	3.3%
4	0.0%	8.2%	23.0%	44.3%	24.6%
5 (highest)	0.0%	1.6%	6.5%	22.6%	69.4%

Table 3.5: Utilization Quintile Stability

Quintile in 1992	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	45.9%	24.6%	16.4%	8.2%	4.9%
2	29.5%	32.8%	23.0%	13.1%	1.6%
3	21.3%	24.6%	24.6%	16.4%	13.1%
4	1.6%	13.1%	29.5%	32.8%	23.0%
5 (highest)	1.6%	4.8%	6.5%	29.0%	58.1%

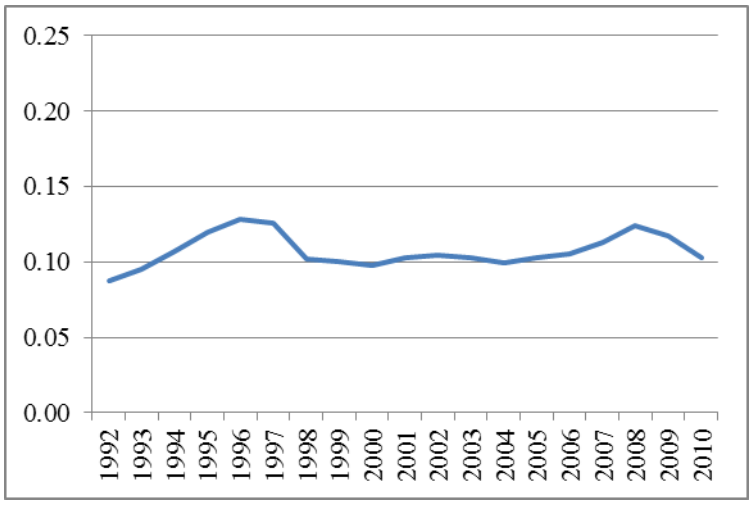
While the analysis presented above suggests that regions that are high-cost in one year tend to be high-cost in subsequent years, overall regional cost levels are also converging in recent years. To determine the degree of convergence, this analysis examines the coefficient of variation (CV) in HRR-level spending and utilization in each year, calculated as the standard deviation of HRR-level costs divided by the average of HRR-level mean costs. The CV is a measure of spread around mean HRR spending. Figure 3.7 presents the CV for expenditures and Figure 3.8 presents the CV for utilization. Based on the CV, the HRR spending diverges between 1992 and 1997 and then begins a slow trend of convergence between 1998 and 2010. HRR use of medical services does not appear to either converge or diverge over the time period considered.[37]

Figure 3.7: Trends in Coefficient of Variation, HRR-Level Expenditures



[37] Measuring convergence to the mean using the ratio of HRR-level average spending at the 90th percentile to the 10th percentile shows similar trends to the CV analysis.

Figure 3.8: Trends in Coefficient of Variation, HRR-Level Utilization



3.3 Medicare Expenditure and Utilization Growth for Specific Patient Groups

The annual growth rate of Medicare spending and utilization for each condition cohort closely tracks the overall Medicare growth rates, although year-to-year growth rates are somewhat more volatile for beneficiaries with these conditions. The geometric average annual growth rate of expenditures between 1992 and 2010 is similar for the overall program (2.8 percent) and each condition cohort (ranging from 1.9 to 2.7 percent). The average annual growth rate in utilization is also comparable between the aggregate cohort (2.9 percent) and the condition cohorts (ranging from 1.8 to 2.7 percent). Figures 3.7 and 3.8 present the yearly growth rates of expenditures and utilization, respectively, for the aggregate cohort and each condition cohort. These figures demonstrate that not only did overall per capita Medicare spending decline in 1998, but per capita spending also decreased in 1998 for beneficiaries in each of the four cohorts considered. In fact, the declines in spending and utilization were considerably more severe for beneficiaries with these conditions. For example, whereas the overall program contracted by 4.2 percent in 1998 due to the Balanced Budget Act (BBA) of 1997, monthly spending per capita for patients with diabetes fell by 18.3 percent. Conversely, when per capita spending began to rise again in 2000 after the Balanced Budget Refinement Act (BBRA), per capita spending for these four cohorts increased at a more rapid pace. For example, while overall per capita expenditures increased by 0.4 percent, expenditures for patients with diabetes increased by 13.1 percent. Beneficiaries with these conditions tend to have higher expenditure and utilization levels than Medicare beneficiaries overall. Thus, because the BBA and BBRA affected payment rates, they had a larger effect on the growth rates of costs for beneficiaries with these conditions.

Figure 3.9: Condition Cohort Expenditure Growth Rates

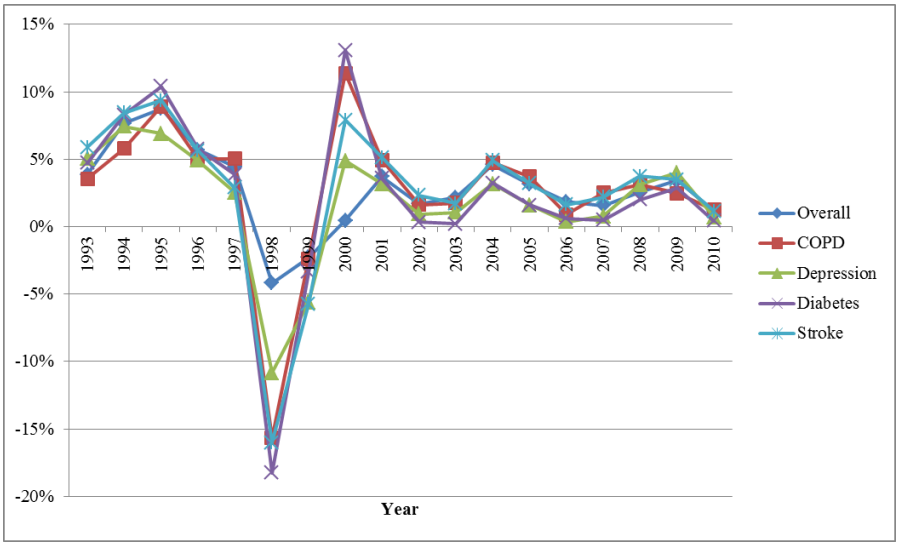
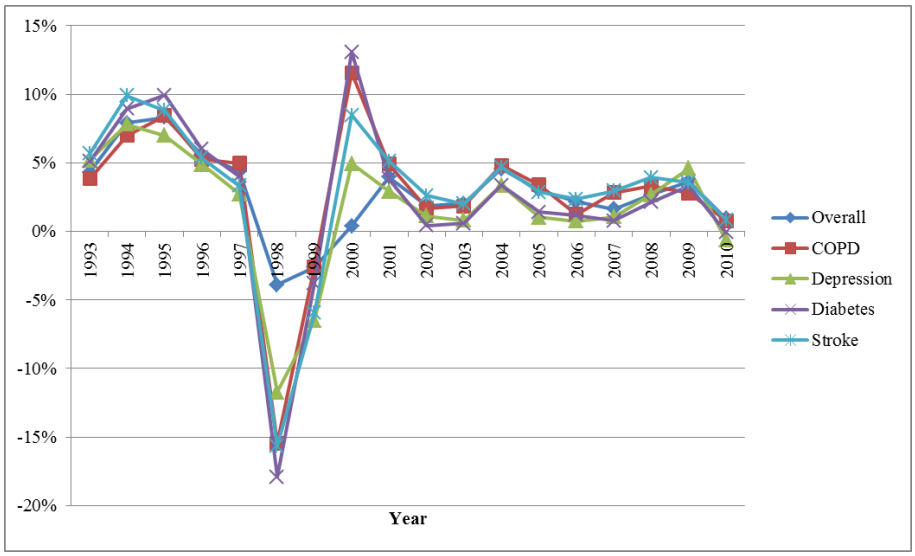


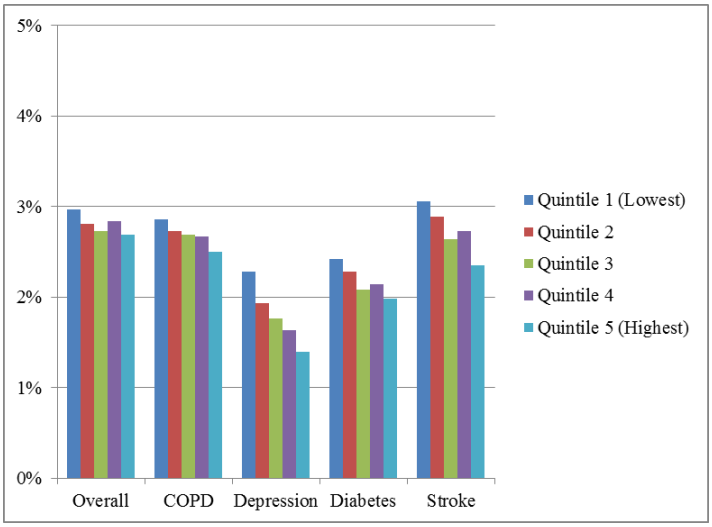
Figure 3.10: Condition Cohort Utilization Growth Rates



Regions with high and low Medicare utilization are growing at comparable rates for the program overall, and this trend holds across all condition cohorts included in the study. This analysis groups regions into quintiles by utilization based on 1992 levels and tracks growth for those regions over the 18-year study period. Quintile 1 includes the HRRs with the lowest utilization levels in 1992, and Quintile 5 includes the HRRs with the highest utilization levels in 1992. Figure 3.9 displays the average annual utilization growth rates for the quintiles in each cohort. All quintiles in each cohort have comparable growth rates; however, the quintiles with the lowest utilization in 1992 have a slightly higher growth rate for each cohort. This trend

suggests that there is slight convergence to the mean for the condition cohorts as well as for the aggregate cohort.

Figure 3.11: Average Annual Utilization Growth Rates for Each Cohort, by HRR Quintile



Regions in which beneficiaries have above-average utilization rates in 1992 are likely to have above-average utilization rates in 2010. To demonstrate that this is the case, this study again divides regions into quintiles based on per capita utilization rates and examines changes to a region's quintile in 2010. This cross-tabulation exercise, presented in Appendix C, reveals that regions in the top or bottom quintiles in 1992 are very likely to remain in the top (or bottom) quintile in 2010. Regions in the highest utilization quintile (Quintile 5) in 1992, for instance, have a 56.5 percent chance of remaining in the highest quintile in 2010 for the overall cohort, while, for the disease cohorts, that rate ranges between 46.8 percent for the depression cohort to 58.1 percent for the stroke cohort. Similarly, for the overall cohort, regions in the lowest utilization quintile (Quintile 1) have a 45.9 percent chance of remaining in the same quintile, and for the condition cohorts that rate ranges from 34.4 percent for the diabetes cohort to 54.1 percent for the stroke cohort. Overall, the stability in spending is lowest for the diabetes cohort, which includes a large population that may be less homogenous than the COPD, depression, or stroke populations.

3.4 Growth in Quality of Care

This study quantifies health care quality and examines trends using three quality measures:

- AHRQ Prevention Quality Indicator Composite (PQI # 90);

- AHRQ Inpatient Quality Indicator Composite (IQI # 91); and
- All-cause, 30-day, unplanned hospital readmissions.

Table A.3 in Appendix A describes the quality measure specifications. The PQI indicator is a measure of admissions per beneficiary for several conditions; thus, the rate represents the likelihood that a beneficiary is admitted to the inpatient setting for one of the relevant conditions. The IQI indicator is a weighted measure of mortality for selected conditions. The measure is standardized so values greater than 1.0 indicate mortality rates that are higher than expected, given the region's patient case mix. The all-cause 30-day unplanned hospital readmission rate represents the percent of hospital admissions that result in a subsequent, unplanned readmission within 30 days. Because each of these measures represents a negative outcome, decreases in quality scores indicate quality improvement.

Annual changes in health care quality for Medicare beneficiaries varied across quality measures and across years at the national level from 1992 to 2010. Figures 3.12, 3.13, and 3.14 plot the national levels of the PQI composite, IQI composite, and all-cause 30-day readmissions measures, respectively, from 1992 to 2010. The PQI composite quality measure increased slightly from 1992 to 2010, though the overall trend was slightly negative, which indicates improved quality. The IQI composite measure was stable throughout the study period. Finally, the readmissions measure increased from 1992 to 2001 and decreased slightly from 2001 to 2010, with an overall increase from 1992 to 2010; thus, the readmissions measure indicates that quality has decreased over the 1992 to 2010 time period.

Figure 3.12: Trends in Medicare Quality, PQI Composite Measure

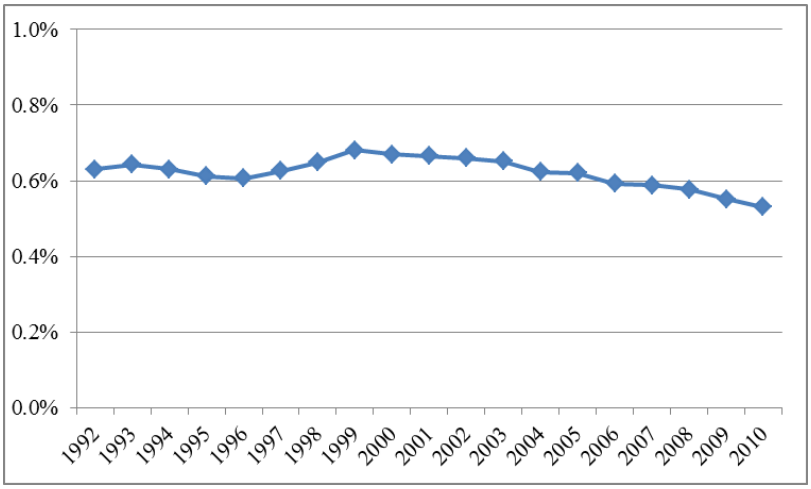


Figure 3.13: Trends in Medicare Quality, IQI Composite Measure

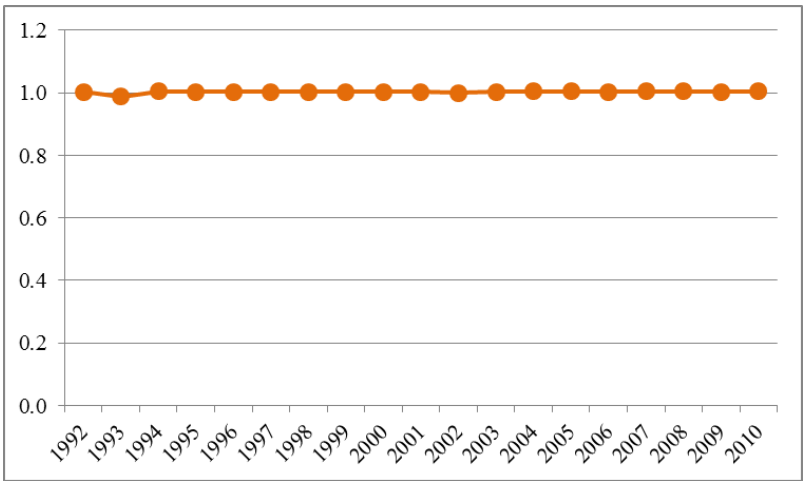
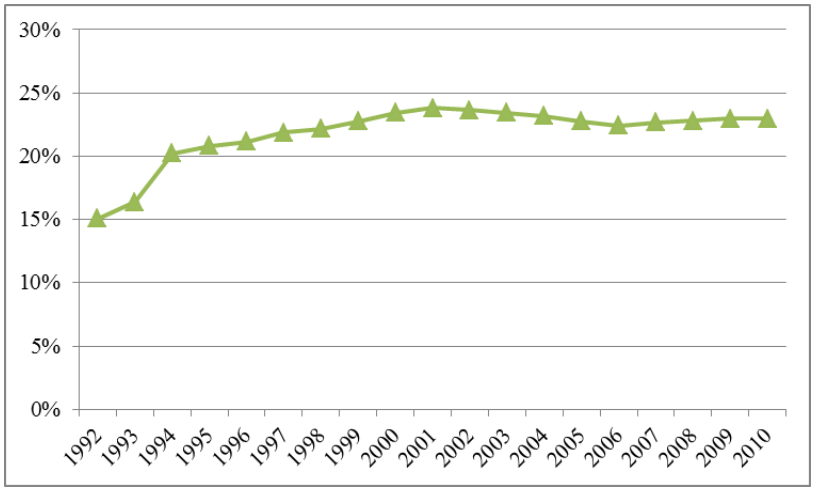


Figure 3.14: Trends in Medicare Quality, All-Cause 30-Day Readmissions

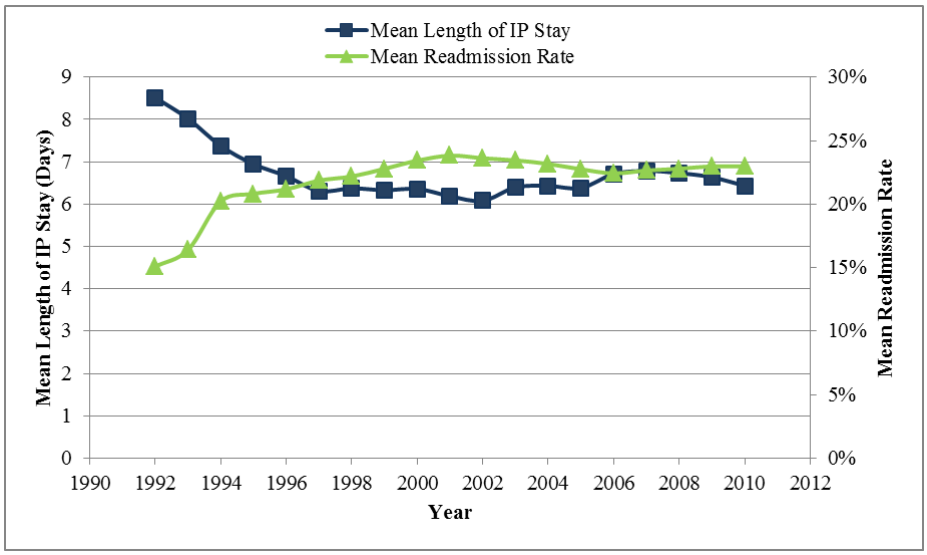


Though annual changes in measured quality of care suggest national variation in the quality of care provided, changes in coding practices could impact measured trends. Even if actual clinical outcomes and patient comorbidities remain the same, changes in the coding methods for outcomes and comorbidities may affect the quality measures examined in this study. For example, advancements in practices used to diagnose cause of death might impact the IQI composite since this measure represents mortality due to various conditions. Additionally, since this analysis risk adjusts quality measures to account for health status, the accuracy of coded patient comorbidities has an impact on measured quality.

Changes in Medicare payment policies may also affect the quality of care provided. After Medicare adopted the Inpatient Prospective Payment System (IPPS) in 1983, hospital payment became based on the average length of stay (LOS) using a relative value system for classifying inpatient stays. Thus, physicians were incentivized to keep patients in the hospital for a shorter

length of time, and the average LOS stays began decreasing. As shown in figure 3.15, between 1992 and 1997 there exist contemporaneous trends of decreasing average inpatient LOS and increasing readmission rates. While the mean length of stay dropped sharply from 8.5 days in 1992 to 6.3 days in 1997, the mean readmission rate rose from 15 percent to 22 percent. Both rates remained fairly steady during the subsequent 13 years, and the mean length of stay in 2010 was 6.4 days while the mean readmission rate was 23 percent.

Figure 3.15: Comparing Length of Stay and Readmission Rate, 1992-2010



Though each of the three measures examined in this analysis represent quality of care, regions that are high-quality using one metric are not necessarily high-quality using another metric over this time period. These three measures represent different aspects of care and may be impacted by different social and technological factors over time. Table 3.6 presents the distribution of the yearly correlations between each pair of quality measures across regions from 1992 to 2010. The correlation between the PQI composite and the IQI composite measures is weak and ranges from 0.07 to 0.33 between 1992 and 2010, with an average value of 0.18. The correlation between the IQI composite and readmissions measures is also small in magnitude, ranging from -0.03 to 0.21, with an average value of 0.08. The relationship between the readmission and PQI composite measures, however, is robust. This correlation, however, occurs almost by definition as both metrics measure admission rates. The correlation between readmissions and PQI ranges from 0.48 to 0.66 between 1992 and 2010, with an average of 0.61.

Table 3.6: Distribution of Yearly Correlations between Quality Measures from 1992-2010

	Average	Minimum	Maximum
PQI vs. IQI	0.18	0.07	0.33
IQI vs. Readmissions	0.08	-0.03	0.21
Readmissions vs. PQI	0.61	0.48	0.66

Regions that provide a high quality of care in 1992 as measured by the PQI or readmissions measure are likely to continue to provide high-quality care in 2010. This study computes the probability that regions in each quintile based on quality of care in 1992 remain in the same quintile or transition to a new quintile in 2010. Tables 3.7, 3.8, and 3.9 display these probabilities for the PQI composite, IQI composite, and readmissions measures, respectively. For each table, the first quintile includes regions with the worst quality care and the fifth quintile includes the best quality care. Table 3.7 shows that high- or low-quality regions, as measured by the PQI measure in 1992, are likely to remain so in 2010. Of regions in the lowest quintile of PQI care quality in 1992, 73.8 percent remain in the lowest quintile of care in 2010. Table 3.8, however, shows that regions that are high- or low-quality as measured by the IQI composite in 1992 are not necessarily likely to remain so in 2010. For example, only 34.4 percent of HRRs that are ranked in the lowest-quality quintile in 1992 remain in the lowest-quality quintile in 2010, and only 14.5 percent of HRRs that are ranked in the highest quality quintile in 1992 remain so in 2010. Finally, Table 3.9 shows that regions with high- or low-quality in 1992 for the readmissions measure are also likely to remain high- or low-quality in 2010.

Table 3.7: Quality Quintile Stability, PQI Composite

		Quintile in 2010				
		1	2	3	4	5
Quintile in 1992	1 (worst)	73.8%	18.0%	6.6%	1.6%	0.0%
	2	14.8%	44.3%	24.6%	16.4%	0.0%
	3	8.2%	21.3%	34.4%	32.8%	3.3%
	4	3.3%	9.8%	24.6%	26.2%	36.1%
	5 (best)	0.0%	6.5%	9.7%	22.6%	61.3%

Table 3.8: Quality Quintile Stability, IQI Composite

		Quintile in 2010				
		1	2	3	4	5
Quintile in 1992	1 (worst)	34.4%	19.7%	18.0%	13.1%	14.8%
	2	23.0%	13.1%	21.3%	18.0%	24.6%
	3	14.8%	26.2%	18.0%	18.0%	23.0%
	4	6.6%	26.2%	24.6%	18.0%	24.6%
	5 (best)	21.0%	14.5%	17.7%	32.3%	14.5%

Table 3.9: Quality Quintile Stability, All-Cause 30 Day Unplanned Readmissions

		Quintile in 2010				
		1	2	3	4	5
Quintile in 1992	1 (worst)	49.2%	21.3%	11.5%	8.2%	9.8%
	2	14.8%	37.7%	19.7%	19.7%	8.2%
	3	24.6%	23.0%	24.6%	21.3%	6.6%
	4	8.2%	11.5%	31.1%	27.9%	21.3%
	5 (best)	3.2%	6.5%	12.9%	22.6%	54.8%

3.5 The Relationship between Resource Use and Quality

Table 3.10 presents the distribution of the Spearman rank correlation between HRR quality and utilization from 1992 to 2010. The correlation between quality and utilization is negative over the entire study period when the PQI composite or readmissions measures are used to measure quality and is near zero when the IQI composite measure is used to measure quality. The correlation between the PQI composite and utilization is strongest and ranges from -0.68 to -0.58 between 1992 and 2010, with an average value of -0.64. The correlation between the readmissions measure and utilization is also moderately negative, ranging from -0.40 to -0.24 between 1992 and 2010, with an average value of -0.34. The strong negative correlations between utilization levels and the PQI or readmissions measures suggests that regions with lower utilization levels tend to provide a higher quality of care for these measures; however, the relationship may be mechanical. Both the PQI and readmissions measures count admissions which, when observed, simultaneously increase utilization rates and decrease quality outcomes. Thus, the definition of the PQI and readmission measures mechanically induces a negative correlation. The composite IQI measure, on the other hand, evaluates mortality rates for selected conditions. This analysis finds that inpatient mortality and cost are unrelated at the aggregate level. The correlation between the IQI composite and utilization ranges from -0.20 to 0.23 between 1992 and 2010, with an average value of 0.01.

Table 3.10: Distribution of Correlation with Utilization from 1992-2010

	Average	Minimum	Maximum
PQI	-0.64	-0.68	-0.58
Readmissions	-0.34	-0.40	-0.24
IQI	0.01	-0.20	0.23

4 SUMMARY OF FINDINGS

The Institute of Medicine enlisted Acumen to conduct a study on geographic variation in the growth of spending and utilization for Medicare beneficiaries from 1992 to 2010. The study examines national trends to determine overall growth and regional trends to determine whether region-level costs are converging or diverging over time. This study also replicates all analyses for specific patient groups to compare with the aggregate results. Finally, this study examines national and region-level trends in quality measures over time. The following sections summarize these findings.

4.1 National Growth in Medicare Expenditures and Utilization

Between 1992 and 2010, the Medicare program has grown steadily in terms of average expenditures and utilization rates per beneficiary. Medicare expenditures grew for 16 of the 18 years between 1992 and 2010, with 2010 expenditures 57.3 percent higher than 1992 expenditures after accounting for inflation. Utilization, computed as price-standardized and risk-adjusted expenditures, grew by 62.7 percent over the same period. As a result of national legislation, Medicare expenditures contracted for a short period in 1998 and 1999 but rebounded again in 2000. During 1998 and 1999, per-beneficiary monthly expenditures fell by 4.2 and 2.3 percent from the previous year, respectively. However, prior to 1997, expenditures grew by between 3.9 and 8.8 percent each year.[38]

This decrease in expenditures in 1998 and 1999 is likely due to the implementation of the Balanced Budget Act (BBA) in 1997, which reduced Medicare payments for many services and restrained the update factors for payment.[39] The Medicare Balanced Budget Refinement Act (BBRA) of 1999 was created to offset the larger-than-expected gains in Medicare savings and resulted in positive expenditure growth in 2000.[40] Expenditures continued to rise from 2000 through 2010 and grew from between 0.4 and 4.6 percent each year. Growth in expenditures after accounting for variation in Medicare payment policies and in patient case mix mirrors growth in unadjusted expenditures. Utilization growth rates are generally within a percentage point of expenditure growth rates, and the correlation between these rates is 0.99.

4.2 Regional Variation in Growth of Medicare Expenditures and Utilization

Long-term trends in expenditures levels are similar for both high-cost and low-cost regions. Average expenditures in regions that are high-cost in 1992 do not appear to be growing faster than average expenditures in regions that are low-cost in 1992. Though the growth rates

[38] This trend mirrors the trend found in National Health Expenditures data. "National Health Expenditure Data".
[39] Crippen, "CBO Testimony on the Impact of the Balanced Budget Act on the Medicare Fee-for-Service Program."
[40] The Lewin Group and the American Hospital Association, "Trend Watch: The Impact of the BBA and the BBRA".

across expenditure and utilization quintiles are not identical, regions in each quintile have the same growth patterns, and growth rates across quintiles are generally within one to two percentage points of each other.

Further, regions that are high-cost in 1992 tend to be high-cost in 2010. For example, of all HRRs that were in the lowest-cost quintile in 1992, by 2010, 60.7 percent were still in the lowest cost quintile and 0 were in the highest cost quintile. Utilization levels have slightly weaker stability than expenditures; for example, only 45.9 percent of HRRs in the lowest-cost quintile in 1992 remained in the lowest-cost quintile in 2010, and only 58.1 percent of HRRs in the highest-cost quintile in 1992 remained so in 2010.

Despite remarkable stability in HRR expenditure and utilization rankings, the highest—and lowest cost HRRs do exhibit a weak pattern of regressing toward the mean. Both expenditure and utilization levels in 1992 have negative Pearson and Spearman rank correlations with overall growth rates. These negative correlations indicate regions with high expenditure and utilization levels in 1992 tend to have low growth rates over the next 18 years. These two patterns taken together provide some evidence that region-level costs are regressing toward the mean, though the degree of regression is small.

Although there is evidence of regressing to the mean, the distribution of healthcare spending and utilization across all HRRs is fairly stable over time. Based on the coefficient of variation, the spending across HRRs diverges between 1992 and 1997 and then begins a slow trend of convergence between 1998 and 2010. The distribution of average HRR utilization, on the other hand, exhibits a fairly stable distribution with no notable convergence or divergence trends over the period of study.

4.3 Medicare Expenditure and Utilization Growth for Specific Patient Groups

The annual growth rate of Medicare spending and utilization for each of the four condition cohorts analyzed closely tracks the overall Medicare growth rates, although year-to-year growth rates are somewhat more volatile for beneficiaries with these conditions. Not only did overall per capita Medicare spending decline in 1998, but per capita spending also decreased in 1998 for beneficiaries in each of the cohorts considered. In fact, the declines in spending and utilization due to the BBA were considerably more severe for beneficiaries with these conditions. Conversely, when per capita spending began to rise again in 2000 after the BBRA, per capita spending for these four cohorts increased at a more rapid pace. Beneficiaries with these conditions tend to have higher expenditure and utilization levels than Medicare beneficiaries overall. Thus, because the BBA and BBRA affected payment rates, they had a larger effect on the growth rates of costs for beneficiaries with these conditions.

Regions with high and low Medicare utilization are growing at comparable rates for all Medicare beneficiaries, and this trend holds across all four condition cohorts considered. All utilization quintiles in each cohort have comparable growth rates; however, the quintiles with the lowest utilization in 1992 have a slightly higher growth rate for each cohort. This trend suggests that there is slight convergence to the mean for the condition cohorts as well as for the aggregate cohort. Similar to the findings of the aggregate analysis, regions that have above-average utilization rates in 1992 are likely to have above-average utilization rates in 2010.

4.4 Growth in Quality of Care

Annual changes in health care quality for Medicare beneficiaries varied across quality measures and across years at the national level from 1992 to 2010. Of three quality measures considered in this study, one showed an improvement in quality over time, one had little change, and the final measure indicated that quality had worsened over the study period. Additionally, although each of the three measures examined in this analysis represent quality of care, regions that are high-quality using one metric may not be high-quality using another metric. For example, the correlation between the IQI composite and readmissions measures is weak, with an average value of 0.08 across years.

Regions that provide a high quality of care in 1992 may or may not provide high-quality care in 2010 depending on how quality is measuring. Measuring quality using PQI or readmissions metrics, high-quality regions somewhat more likely to continue providing high-quality care in 2010. For example, of regions in the highest quintile of PQI care quality in 1992, 61.3 percent remain in the highest quintile of care in 2010, while among regions in the lowest quintile, 73.8 percent remain in the lowest quintile of care. Conversely, regions that are high-quality or low-quality as measured by the IQI composite in 1992 are not necessarily likely to remain so in 2010. For example, only 34.4 percent of HRRs that are ranked in the lowest-quality quintile in 1992 remain in the lowest-quality quintile in 2010, and only 14.5 percent of HRRs that are ranked in the highest quality quintile in 1992 remain so in 2010.

4.5 The Relationship between Quality and Resource Use

The correlation between quality and utilization is negative over the entire study period when the PQI composite or readmissions measures are used to measure quality and is near zero when the IQI composite measure is used to measure quality. The correlation between the PQI composite and utilization is strongest and ranges from -0.68 to -0.58 between 1992 and 2010, with an average value of -0.64. The strong negative correlations between utilization levels and the PQI measure may seem to suggest that regions with lower utilization levels tend to provide a higher quality of care for this measure; however, this measure counts admissions which, when observed, simultaneously increase utilization rates and decrease quality outcomes.

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APPENDIX A: METHODOLOGY

Table A.1: Condition Cohort Definitions

Condition	2008 HCC Number(s)	ICD-9 Diagnosis Codes
Chronic Obstructive Pulmonary Disease	108	491.0, 491.1, 491.20, 491.21, 491.22, 491.8, 491.9, 492.0, 492.8, 493.20, 493.21, 493.22, 496, 518.1, 518.2
Depression	55	296.00, 296.01, 296.02, 296.03, 296.04, 296.05, 296.06, 296.10, 296.11, 296.12, 296.13, 296.14, 296.15, 296.16, 296.20, 296.21, 296.22, 296.23, 296.24, 296.25, 296.26, 296.30, 296.31, 296.32, 296.33, 296.34, 296.35, 296.36, 296.40, 296.41, 296.42, 296.43, 296.44, 296.45,296.46, 296.50, 296.51, 296.52, 296.53, 296.54, 296.55, 296.56, 296.60, 296.61, 296.62, 296.63, 296.64, 296.65, 296.66, 296.7, 296.80, 296.81, 296.82, 296.89, 296.90, 296.99, 297.0, 297.1, 297.2, 297.3, 297.8, 297.9, E9500, E9501, E9502, E9503, E9504, E9505, E9506, E9507, E9508, E9509, E9510, E9511, E9518, E9520, E9521, E9528, E9529, E9530, E9531, E9538, E9539, E954, E9550, E9551, E9552, E9553, E9554, E9555, E9556, E9557, E9559, E956, E9570, E9571, E9572, E9579, E9580, E9581, E9582, E9583, E9584, E9585, E9586, E9587, E9588, E9589, E959
Diabetes	15, 16, 17, 18, 19	250.40, 250.41, 250.42, 250.43, 250.70, 250.71, 250.72, 250.73, 250.60, 250.61, 250.62, 250.63, 250.80, 250.81, 250.82, 250.83, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 250.50, 250.51, 250.52, 250.53, 250.90, 250.91, 250.92, 250.93, 250.00, 250.01, 250.02, 250.03, V5867
Stroke	96	433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, 436

Table A.2: Price Standardization Methodology

Setting	Unit of Analysis	Method	Notes
Inpatient (IP)	Diagnosis Related Group (DRG)	Average the payment of all claims in an inpatient stay with a given DRG.	DRGs are used to determine payment in the inpatient setting.
Outpatient (OP)	Revenue Center Lines	Average the payment weighted by number of lines (i.e., services) in the claim.	Outpatient settings are currently paid by service, but specific service payments were not billed prior to 2000.
Physician (PB)	Healthcare Common Procedure Coding System (HCPCS) Modifier	Average the payment weighted by number of units for each HCPCS and modifier combination.	The analysis considers only the professional and technical component modifiers.
Home Health (HH)	Revenue Center Lines	Average the payment weighted by number of lines (i.e., services) in the claim.	Home health agencies are currently paid in 60-day bundles based on Home Health Resource Groups (HHRGs), which indicate the level of care provided, but HHRGs are

Setting	Unit of Analysis	Method	Notes
			not available prior to 2000.
Hospice (HS)	Days	Average the payment over number of days covered.	Hospice agencies are currently paid each day based on the level of hospice care provided, but day-level payments are not available prior to 2004.
Skilled Nursing Facility (SNF)	Covered Days	Average the payment weighted by number of covered days.	Skilled nursing facilities are currently paid each day based on Resource Use Groups (RUGs), which indicate the level of care provided, but RUGs are not available prior to 1998.
Durable Medical Equipment (DME)	HCPCS Modifier	Average the payment weighted by number of units for each HCPCS and modifier combination.	The analysis only considered the modifiers indicating a new purchase, used purchase, or rental.

Table A.3: Quality Measure Definitions

Quality Measure	Definition
Inpatient Quality Indicator Composite: Mortality for Selected Conditions (IQI #91)	IQI #15 Acute Myocardial Infarction (AMI) Mortality Rate
	IQI #16 Congestive Heart Failure (CHF) Mortality Rate
	IQI #17 Acute Stroke Mortality Rate
	IQI #18 Gastrointestinal Hemorrhage Mortality Rate
	IQI #19 Hip Fracture Mortality Rate
	IQI #20 Pneumonia Mortality Rate
Prevention Quality Indicator Composite (PQI #90)	PQI #01 Diabetes Short-Term Complications Admission Rate
	PQI #03 Diabetes Long-Term Complications Admission Rate
	PQI #05 Chronic Obstructive Pulmonary Disease (COPD) or Asthma in Older Adults
	PQI #07 Hypertension Admission Rate
	PQI #08 Congestive Heart Failure (CHF) Admission Rate
	PQI #10 Dehydration Admission Rate
	PQI #11 Bacterial Pneumonia Admission Rate
	PQI #12 Urinary Tract Infection Admission Rate
	PQI #13 Angina without Procedure Admission Rate
	PQI #14 Uncontrolled Diabetes Admission Rate
	PQI #15 Asthma in Younger Adults Admission Rate
	PQI #16 Rate of Lower-Extremity Amputation Among Patients with Diabetes
All-Cause Unplanned Readmissions	**Denominator**: All Medicare FFS patients aged 65 or older who are admitted to a hospital and survive the index hospitalization. **Denominator exclusions**: Admissions for patients without at least 30 days of Medicare enrollment after the discharge; admission to any hospitals that are not paid using the inpatient prospective payment system; admissions for the treatment of cancer; admissions for the treatment of psychiatric disease; admission for rehabilitation care; admissions ending in patient discharge against medical advice. **Numerator**: All patients who are readmitted to a hospital within 30 days of the index admission.

Quality Measure	Definition
	Numerator exclusions: Readmissions for maintenance chemotherapy or rehabilitation; readmissions for other planned procedures unless they have a discharge condition category considered acute or a complication of care.

Table A.4: Beneficiary-Level Characteristics Used in Risk Adjustment

Beneficiary-Level Variable	Data Source	Description
Age	EDB	Five-year age bands tied to 65 (e.g., 65-69), one age band for under 65, and one age band for over 90, indicating beneficiary age as of first month of enrollment in calendar year.
Sex	EDB	Male/female
Age*Sex Interaction	EDB	Age-sex interaction (e.g., 65-69 and female, 70-75 and female, etc.)
Health Status	CWF	CMS 2008 HCC health status and enrollment indicators and interactions during the prior year. HCCs include one originally disabled indicator and an ESRD indicator. (HCC interactions do not include interactions with Medicaid status.)
New Enrollee Indicator	CWF	Indicator for whether beneficiary has a full year of claims history (enrollment in B) in the year prior. This variable is not used in risk-adjusting the quality measures.
Partial Year Enrollment	EDB	Included in Part D analysis only from 2006 onward. Indicator if beneficiary did not have full A, B, and D enrollment for a given year. This variable is not used in risk-adjusting the quality measures.

APPENDIX B: MEDICARE SPENDING & UTILIZATION, INCLUDING PRESCRIPTION DRUG USE

This appendix presents the results of the analysis including costs from Part D prescription drugs. These results are broadly similar to the results presented in the body of the report, which exclude Part D costs. In general, monthly expenditures and utilization levels are markedly higher when including Part D costs, and the variation across cost levels is also greater. Though overall trends in costs including Part D are not identical to trends excluding part D, trends in cost levels and growth rates are still similar across high-cost and low-cost HRRs. Stability in costs including Part D may appear higher than the stability in costs excluding Part D that is presented in the body of this report simply because stability in costs including Part D can only be measured from 2006 to 2010. Thus, this appendix also includes stability in costs excluding Part D from 2006 to 2010 for comparison. These results indicate that regions that are high-cost in 2006 are very likely to be high-cost in 2010. Finally, some convergence in utilization levels exists from 2006 to 2010; Table B.6 shows that the correlation between utilization levels including Part D and overall growth rates from 2006 to 2010 is also negative in 2006. This negative correlation indicates that region that are high-cost in 2006 tend to have lower growth rates from 2006 to 2010.

Table B.1: Growth in Average Costs from Previous Year Including Part D

Year	Expenditures		Utilization	
	Not Including Part D	Including Part D	Not Including Part D	Including Part D
2007	1.6%	-1.1%	1.1%	-0.5%
2008	2.5%	2.3%	3.7%	2.8%
2009	3.4%	3.0%	2.6%	3.6%
2010	1.1%	0.7%	0.2%	-1.8%

Figure B.1: Average Monthly Expenditure Levels Including Part D

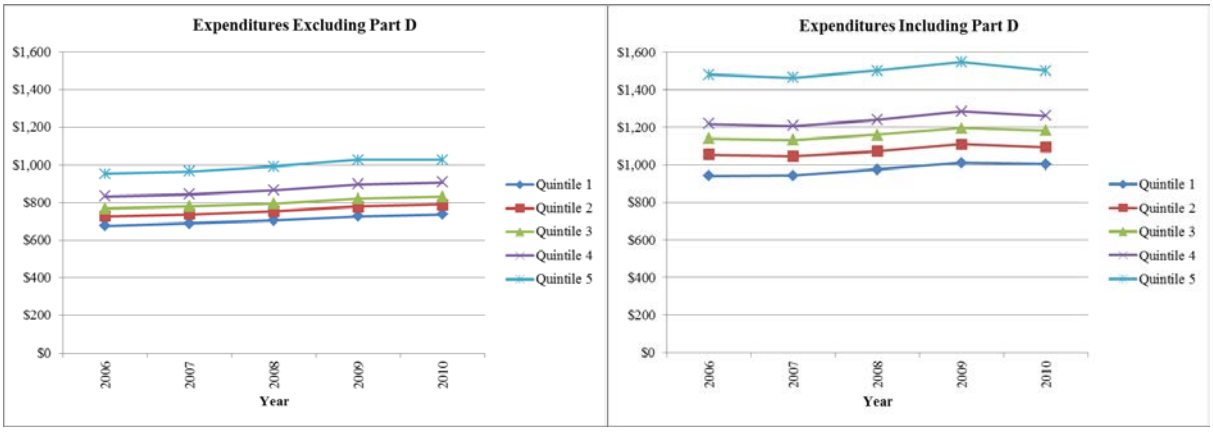

Figure B.2: Expenditures Including Part D Growth Rate from Previous Year

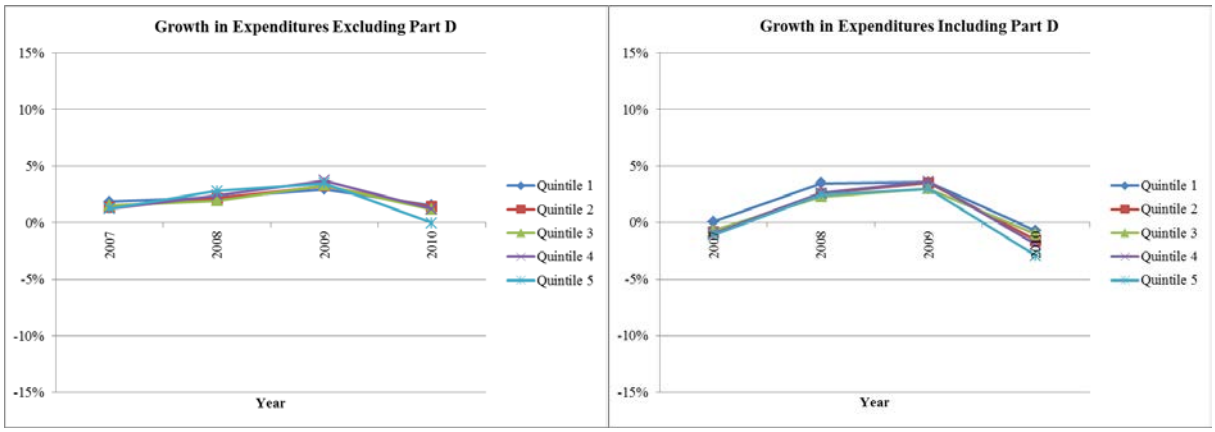

Figure B.3: Average Monthly Utilization Levels Including Part D

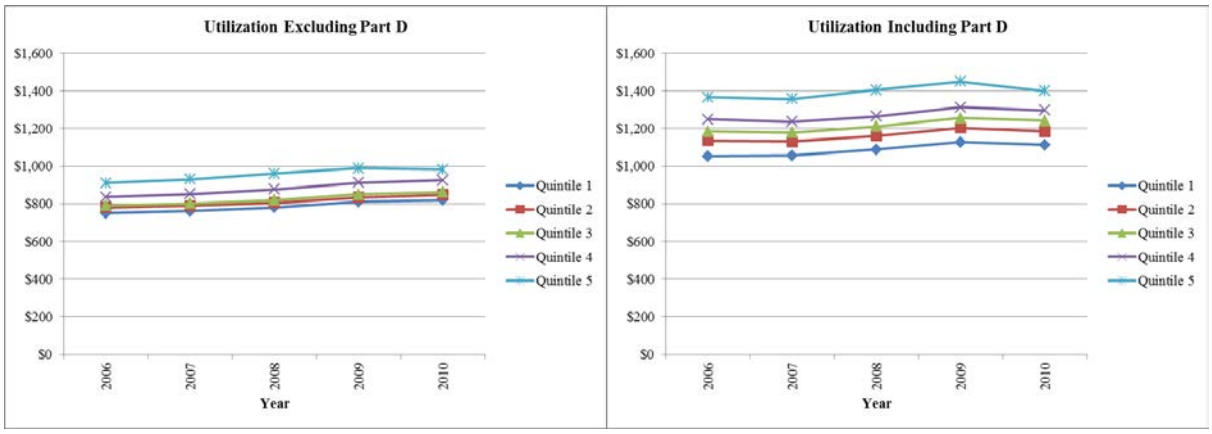

Figure B.4: Utilization Including Part D Growth Rate from Previous Year

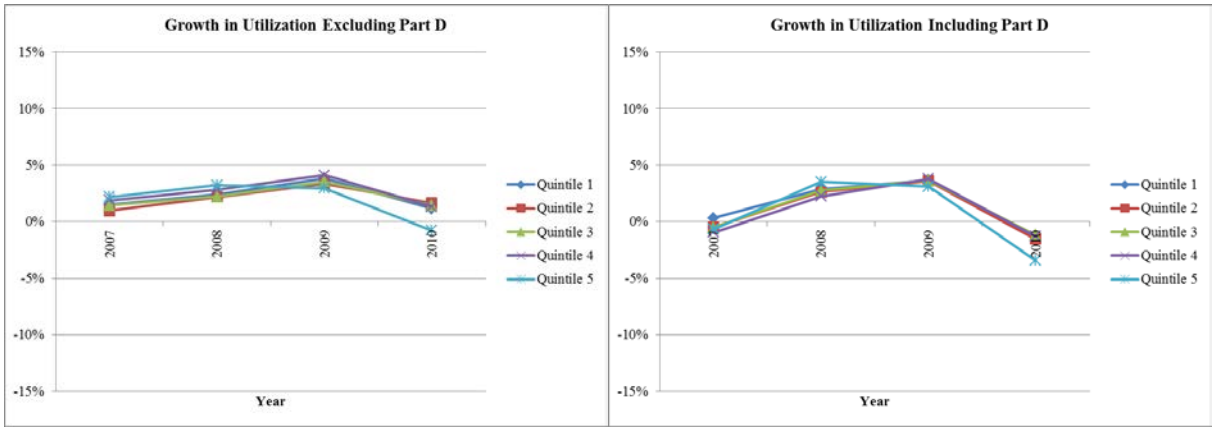

Table B.2: Expenditures Quintile Stability Excluding Part D (2006-2010)

Quintile in 2006	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	89.9%	9.8%	0.0%	0.0%	0.0%
2	8.2%	67.0%	22.9%	1.6%	0.0%
3	1.6%	22.9%	62.1%	13.1%	0.0%
4	0.0%	0.0%	14.7%	70.3%	14.7%
5 (highest)	0.0%	0.0%	0.0%	14.7%	86.6%

Table B.3: Expenditures Quintile Stability Including Part D

Quintile in 2006	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	85.3%	14.8%	0.0%	0.0%	0.0%
2	13.1%	72.1%	13.1%	1.6%	0.0%
3	1.6%	13.1%	72.1%	13.1%	0.0%
4	0.0%	0.0%	14.8%	72.1%	13.1%
5 (highest)	0.0%	0.0%	0.0%	12.9%	87.1%

Table B.4: Utilization Quintile Stability Excluding Part D (2006-2010)

Quintile in 2006	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	81.7%	14.7%	3.3%	0.0%	0.0%
2	14.7%	62.1%	21.2%	1.6%	0.0%
3	3.3%	18.0%	55.6%	22.9%	0.0%
4	0.0%	4.9%	16.3%	57.2%	21.2%
5 (highest)	0.0%	0.0%	3.3%	18.0%	80.1%

Table B.5: Utilization Quintile Stability Including Part D

Quintile in 2006	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	83.6%	16.4%	0.0%	0.0%	0.0%
2	16.4%	63.9%	19.7%	0.0%	0.0%
3	0.0%	18.0%	62.3%	19.7%	0.0%
4	0.0%	1.6%	16.4%	65.6%	16.4%
5 (highest)	0.0%	0.0%	1.6%	14.5%	83.9%

Table B.6: Correlation between Utilization Levels Including Part D and Overall Growth Rate

	Correlation Score	
	Pearson	Spearman
2006	-0.286	-0.196
2010	0.098	0.127

APPENDIX C: STABILITY OF RELATIVE REGIONAL UTILIZATION RATES

Table C.1: Stability of Relative Regional Utilization Rates, Overall

Quintile in 1992	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	45.9%	24.6%	16.4%	8.2%	4.9%
2	29.5%	32.8%	23.0%	13.1%	1.6%
3	21.3%	24.6%	24.6%	16.4%	13.1%
4	1.6%	13.1%	29.5%	32.8%	23.0%
5 (highest)	1.6%	4.8%	6.5%	29.0%	58.1%

Table C.2: Stability of Relative Regional Utilization Rates, COPD Cohort

Quintile in 1992	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	45.9%	26.2%	18.0%	4.9%	4.9%
2	31.2%	21.3%	26.2%	11.5%	9.8%
3	16.4%	26.2%	24.6%	24.6%	8.2%
4	4.9%	21.3%	21.3%	31.2%	21.3%
5 (highest)	1.6%	4.8%	9.7%	27.4%	56.5%

Table C.3: Stability of Relative Regional Utilization Rates, Depression Cohort

Quintile in 1992	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	41.0%	18.0%	18.0%	16.4%	6.6%
2	19.7%	32.8%	26.2%	9.8%	11.5%
3	21.3%	24.6%	24.6%	13.1%	16.4%
4	11.5%	9.8%	21.3%	37.7%	19.7%
5 (highest)	6.5%	14.5%	9.7%	22.6%	46.8%

Table C.4: Stability of Relative Regional Utilization Rates, Diabetes Cohort

Quintile in 1992	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	34.4%	24.6%	27.9%	8.2%	4.9%
2	27.9%	23.0%	21.3%	23.0%	4.9%
3	19.7%	32.8%	14.8%	18.0%	14.8%
4	16.4%	11.5%	27.9%	21.3%	23.0%
5 (highest)	1.6%	8.1%	8.1%	29.0%	53.2%

Table C.5: Stability of Relative Regional Utilization Rates, Stroke Cohort

Quintile in 1992	Quintile in 2010				
	1	2	3	4	5
1 (lowest)	54.1%	23.0%	18.0%	3.3%	1.6%
2	31.2%	34.4%	18.0%	11.5%	4.9%
3	9.8%	29.5%	32.8%	14.8%	13.1%
4	3.3%	9.8%	24.6%	39.3%	23.0%
5 (highest)	1.6%	3.2%	6.5%	30.7%	58.1%