Understanding Trends in Medicare Spending, 2007–2014

Laura M. Keohane , Robert J. Gambrel, Salama S. Freed, David Stevenson, and Melinda B. Buntin

Objectives. To analyze the sources of per-beneficiary Medicare spending growth between 2007 and 2014, including the role of demographic characteristics, attributes of Medicare coverage, and chronic conditions.

Data Sources. Individual-level Medicare spending and enrollment data.

Study Design. Using an Oaxaca–Blinder decomposition model, we analyzed whether changes in price-standardized, per-beneficiary Medicare Part A and B spending reflected changes in the composition of the Medicare population or changes in relative spending levels per person.

Data Extraction Methods. We identified a 5 percent sample of fee-for-service Medicare beneficiaries age 65 and above from years 2007 to 2014.

Results. Mean payment-adjusted Medicare per-beneficiary spending decreased by \$180 between the 2007–2010 and 2011–2014 time periods. This decline was almost entirely attributable to lower spending levels for beneficiaries. Notably, declines in marginal spending levels for beneficiaries with chronic conditions were associated with a \$175 reduction in per-beneficiary spending. The decline was partially offset by the increasing prevalence of certain chronic diseases. Still, we are unable to attribute a large share of the decline in spending levels to observable beneficiary characteristics or chronic conditions.

Conclusions. Declines in spending levels for Medicare beneficiaries with chronic conditions suggest that changing patterns of care use may be moderating spending growth.

Key Words. Medicare, spending growth, chronic conditions

As Medicare shifts toward greater use of value-based payments, identifying factors that drive spending growth is a pressing question for policy makers and health care organizations. Several new payment models, including accountable care organizations, incorporate incentives for providers to stay within spending growth targets. Better understanding of the sources of spending growth can inform budget and policy priorities and provide evidence for evaluating whether spending targets are reasonable.

An important distinction with policy and clinical implications is whether spending growth trends reflect changes in the health status of the Medicare population or changes in the relative spending levels associated with a given health status. For example, spending growth associated with diabetes can result from increased diabetes prevalence in the Medicare population, increased spending per beneficiary with diabetes, or an interaction of these factors. By distinguishing between sources of spending growth, we can better identify the potential for cost-saving opportunities and isolate the impact of reform efforts. For instance, payment reform efforts targeting treatment efficiency might hold particular promise for conditions where spending per case factors most prominently; however, longer-term prevention efforts might be more warranted for conditions where increasing disease prevalence plays a disproportionate role in shaping spending growth.

Previous spending growth trends suggest that changes in per-beneficiary spending levels outweigh population and disease prevalence changes in determining the rate of per-capita spending growth (Roehrig and Rousseau 2011; Starr, Dominiak, and Aizcorbe 2014; Dunn, Rittmueller, and Whitmire 2016). However, it is not clear whether those findings still apply to the most recent years of Medicare spending, which experienced historically low growth (White and Ginsburg 2012; Buntin and Levine 2013; Martin et al. 2016). The baby boomer generation began entering Medicare in 2011, shifting the Medicare population toward a younger average age. Other beneficiary attributes also have changed over time, including whether Medicare enrollees have prescription drug coverage and retiree benefits. Declines in smoking rates have improved population health, but rising levels of obesity suggest that associated diseases may increase in incidence and prevalence (Flegal et al. 2012; U. S. Burden of Disease Collaborators 2013). This combination of factors raises the possibility that changes in the Medicare population, including a shifting prevalence of disease, might play a prominent role in recent spending trends.

To inform policy makers and providers about potential factors that should be considered when setting targets for Medicare spending growth, we analyzed the extent to which changes in per-beneficiary Medicare spending

Address correspondence to Laura M. Keohane, Ph.D., Department of Health Policy, Vanderbilt University School of Medicine, 2525 West End Avenue, Suite 1200, Nashville, TN 37203-8684; e-mail: laura.keohane@vanderbilt.edu. Robert J. Gambrel, M.A., David Stevenson, Ph.D., and Melinda B. Buntin, Ph.D., are with the Department of Health Policy, Vanderbilt University School of Medicine, Nashville, TN. Salama S. Freed, M.S., is with the Department of Health Policy, Vanderbilt University School of Medicine, Nashville, TN, and Department of Economics, Vanderbilt University, Nashville, TN.

between 2007–2010 and 2011–2014 reflected shifts in the composition of the Medicare population or changes in relative spending levels associated with certain beneficiary-level factors. Our analysis included consideration of several key categories of factors, including demographics, Medicare coverage characteristics, chronic disease prevalence, and chronic disease incidence. We also examined how the sources of spending growth varied across major disease categories.

METHODS

Data Sources and Study Population

Using the 2007–2014 Master Beneficiary Summary File (MBSF), we selected a random 5 percent sample of Medicare enrollees age 65 and above. We excluded beneficiaries enrolled in Medicare Advantage as of July in a given calendar year. For beneficiaries who joined Medicare after July or died prior to July, we excluded those who had Medicare Advantage in their first or last month of Medicare benefits, respectively. Our sample size ranged from 1,527,010 to 1,639,724 beneficiaries per year, for a total of 12,599,955 observations.

Outcome Variable

Our main study outcome measured total Medicare spending per beneficiary, adjusted to 2007 payment rate levels. This outcome included total Medicare Part A and B spending and excluded any cost-sharing amounts and Part D spending. For comparison, Medicare spending was aggregated into two time periods: 2007–2010 and 2011–2014. We chose these time periods for two primary reasons. First, while per-beneficiary Medicare spending has been slowing since the mid-2000s, it slowed even more during the latter time period. For example, per-beneficiary Part A spending has declined between 2011 and 2014 (Medicare Trustees Report 2017). This pattern raises questions about what factors have changed, even over less than a decade, to account for this decline. Second, Part D benefits were available for the entirety of both time periods, which was important in light of evidence that prescription drug benefits may affect other medical costs (Zhang et al. 2009; Afendulis et al. 2011; McWilliams, Zaslavsky, and Huskamp 2011; Buntin and Hayford 2016).

The MBSF provided beneficiary-level annual summaries of Medicare spending for each sector: inpatient, outpatient hospital services, physician

services, Part B drugs, hospice care, skilled nursing facility care, home health care, dialysis and other Part B services, durable medical equipment, ambulatory surgical centers, and medical testing. Based on annual payment rate changes announced in the Federal Register, we applied category-specific payment adjusters to each spending category for the years 2008–2014 so that spending amounts would reflect 2007 payment rate levels. We applied the Consumer Price Index instead of payment rate updates for sectors that account for a minor share of overall Medicare spending: durable medical equipment, ambulatory surgery centers, and medical testing. To index payments for Part B drugs, we applied the Producer Price Index for Pharmaceutical preparation manufacturing (PPI Rx). Federal budget cuts to Medicare provider payments took effect in April 2013 under sequestration, so our adjusted measure inflated spending levels by 1.5 percent in 2013 and by 2 percent in 2014 for all sectors besides Part B and inflated Part B spending levels by 1.275 percent in 2013 and 1.7 percent in 2014 due to specific sequestration measures for this sector. We aggregated adjusted spending across all sectors into one measure of overall Medicare spending. By standardizing spending to 2007 payment rate levels, our results reflect changes in spending growth that are due to the volume or type of health care services provided rather than changes in price.

Covariates

To account for how spending changed, we examined several characteristics: demographics, types of Medicare coverage, prevalence of chronic conditions, and incidence of chronic conditions. To assess high end-of-life medical spending levels, we also identified decedents. Demographic factors included a categorical variable for age (65–69, 70–74, 75–79, 80–84, and 85+) and indicator variables for sex and race. Medicare coverage factors included binary variables indicating whether beneficiaries were new to traditional Medicare, either because their Medicare coverage began or they switched from Medicare Advantage participation in a given study year. Coverage factors also included binary indicators to identify beneficiaries with the following benefits: Part A coverage only, Part D prescription drug coverage, non-Part D prescriptive drug coverage, partial Medicaid benefits (coverage of Medicare premiums and, for lower-income beneficiaries, Medicare cost-sharing), and full Medicaid benefits (coverage of Medicare premiums and cost-sharing and other services not covered by Medicare such as long-term care).

The MBSF includes indicators for 26 common diseases, which we used as the basis for measuring the prevalence and incidence of chronic conditions (Chronic Conditions Data Warehouse 2016). These indicators identified whether beneficiaries had diagnosis codes in Medicare Part A and B claims that were consistent with having a specific condition. The lookback period for these algorithms ranged from 1 to 3 years, so even though our earliest study year is 2007, the identification of some chronic conditions was based on claims dating back as early as 2004. The MBSF also identified the month that beneficiaries first met the criteria for having a given condition, which we used as a proxy for chronic condition incidence. We created binary indicators to flag whether beneficiaries had specific incident chronic conditions. For beneficiaries who are new to Medicare or switching midyear to fee-for-service Medicare from Medicare Advantage, there is no claims history to distinguish between incident and pre-existing conditions. Therefore, for these beneficiaries, we did not categorize their chronic conditions as “incident” with the rest of our study population. Instead, we created two indicator variables to identify whether beneficiaries who were new to Medicare or switching from Medicare Advantage had any chronic conditions.

Analysis

To understand how these factors contributed to changes in per-beneficiary spending between 2007–2010 and 2011–2014, we conducted an Oaxaca–Blinder decomposition analysis with the Oaxaca *Stata* package (Blinder 1973; Oaxaca 1973; Jann 2008). We used this approach to determine how much of per-beneficiary spending growth can be attributed to (1) changes in the characteristics of the Medicare population, (2) changes in relative spending levels for beneficiaries with a given characteristic, and (3) any interaction between these two sources. In this context, a factor’s relative spending level is its marginal effect on spending, or how much greater (or lower) per-beneficiary spending would be if an individual had the characteristic in question.

In calculating the amount of spending growth attributable to changes in the Medicare population, we measured the change in prevalence for all characteristics of interest between 2007–2010 and 2011–2014. For each characteristic, we multiplied its change in prevalence by its initial relative spending level to determine how much the change in prevalence contributed to spending growth. Each characteristic’s initial relative spending level was determined by a linear regression model that predicted per-beneficiary spending in the 2007–2010 period based on all characteristics of interest.

Similar logic applied to estimating the amount of spending growth due to changes in relative spending levels. We estimated two separate linear regressions, one for each time period (2007–2010 and 2011–2014), that predicted per-beneficiary spending based on all characteristics of interest. By comparing the coefficients for each characteristic between these two models, we measured whether the relative spending levels associated with each characteristic changed. For each characteristic, we multiplied its change in relative spending levels by the initial prevalence of that characteristic in the population during the 2007–2010 period. The differences in the intercept terms between these two linear regression models can be considered unattributed sources of spending change. For more details on this approach, please see Appendix SA2.

For each characteristic, we summarized how much of the change in per-beneficiary spending can be attributed to changes in population, changes in relative spending levels, and an interaction between these two sources. The presence of an interaction term indicates that a particular characteristic experienced changes in both its prevalence and relative spending levels between the two time periods. The size of the interaction term is determined by the size of those two changes multiplied together. We report more detailed results for individual chronic conditions in two disease categories with the largest positive and negative contributions to Medicare spending growth.

To analyze whether our results changed based on the choice of the study population, we repeated our analysis for two different subpopulations. First, we limited the population to beneficiaries who had Part D coverage. Second, we excluded beneficiaries who were new to Medicare, had died, or switched from MA during the year in order to analyze results for beneficiaries with 12 months of Medicare participation.

RESULTS

After adjusting for payment increases, the mean total Medicare spending per beneficiary declined from \$7,683 to \$7,502 between 2007–2010 and 2011–2014 (Table 1). As context to determine the impact of beneficiary traits on spending, we observed multiple differences in demographics, aspects of Medicare coverage, and prevalence and incidence of chronic conditions (Table 1). The age distribution shifted toward younger beneficiaries, with the proportion of beneficiaries who are under age 70 increasing from 30 to 33 percent. The share of beneficiaries with a Part D plan increased from an average of 44 to 51

Table 1: Prevalence of Key Factors in Medicare Population and Associated Adjusted Spending Amount per Beneficiary, 2007–2010 and 2011–2014

	2007–2010	2011–2014	2007–2010	2011–2014
Annual number of beneficiaries (Mean)	1,535,613	1,614,376		
Total spending amount per-beneficiary (unadjusted)			7,682.7	7,502.3
Demographic characteristics (%)				
Age 65–69	29.8	32.7	4,536.9	4,395.5
Age 70–74	22.0	22.4	6,748.2	6,738.0
Age 75–79	17.8	16.6	8,573.3	8,567.3
Age 80–84	14.6	12.9	10,175.7	10,187.0
Age 85+	15.7	15.5	11,636.2	11,816.2
Male	43.4	44.6	7,499.2	7,252.6
Female	56.6	55.4	7,823.7	7,703.0
White	85.7	84.4	7,600.4	7,487.0
Black or other race	14.3	15.6	8,177.4	7,585.0
Decedents (%)	4.6	4.4	29,203.1	29,241.5
Medicare coverage (%)				
New beneficiaries	6.3	7.4	1,578.6	1,535.9
New beneficiaries with chronic condition	2.0	2.2	4,571.2	4,760.0
Switched from MA to FFS	0.4	0.4	8,944.4	9,502.9
MA to FFS with chronic condition	0.2	0.2	14,061.9	14,824.3
Part A only	8.1	9.5	613.2	550.9
Part D prescription drug coverage	43.6	50.6	9,858.4	9,597.4
Other prescription drug coverage	36.9	27.9	6,804.6	5,707.8
Medicare only	86.9	87.1	6,833.4	6,668.5
Medicare with full Medicaid	10.6	10.1	14,055.7	14,021.4
Medicare with partial Medicaid	2.5	2.8	10,220.8	9,983.1
Any chronic conditions [†]				
Cognitive	17.4	18.6	18,414.0	18,699.7
Cardiovascular	37.6	34.6	15,590.4	16,020.7
Pulmonary	12.4	12.4	20,895.7	21,127.4
Cancer	8.2	8.3	16,561.3	17,385.9
Endocrine and renal	37.0	39.2	14,275.7	13,926.3
Skeletal and joint	29.6	30.3	13,492.2	13,973.0
Ophthalmic	28.7	25.9	8,381.7	8,470.1
Other	65.3	63.9	11,161.2	11,288.7
Incident chronic conditions [†]				
Cognitive	4.3	4.3	25,022.2	25,857.9
Cardiovascular	8.2	7.1	24,878.3	25,909.8
Pulmonary	3.2	2.9	23,509.7	24,057.6
Cancer	1.5	1.4	26,691.5	27,100.1

Continued

Table 1. *Continued*

	2007–2010	2011–2014	2007–2010	2011–2014
Endocrine and renal	7.2	6.9	21,262.2	20,575.8
Skeletal and joint	5.7	5.2	16,905.1	17,746.7
Ophthalmic	4.9	4.6	8,209.1	8,084.8
Other	11.4	9.8	13,611.8	13,981.0

Notes. Authors’ calculations using a 5% sample of fee-for-service Medicare beneficiaries over age 65, years 2007–2014. Reported percentages are the average annual percent for time period indicated. Prices were deflated to 2007 values using Federal Register publications on annual fee index changes. Adjusted Spending Amount Per-Beneficiary calculated based on linear regression models for each time period that includes all listed characteristics as covariates.

[†]Results for prevalent and incidence chronic conditions are aggregated across multiple individual conditions.

percent between the two time periods, while the percentage of beneficiaries with other sources of drug coverage declined from an average of 37 to 28 percent. Cardiovascular disease, a common chronic condition, declined in prevalence from 38 to 35 percent and from 8 to 7 percent in incidence. In contrast, the prevalence of endocrine and renal conditions increased from 37 to 39 percent across the two time periods, even though incidence of these conditions remained fairly constant.

When comparing how per-beneficiary spending associated with different characteristics changed between 2007–2010 and 2011–2014, several trends stand out (Table 1). First, adjusted spending levels declined at least slightly for almost every demographic group and every group with different kinds of Medicare-related coverage options. Only older beneficiaries had greater spending levels in the latter time period. For example, adjusted spending levels for beneficiaries age 85 and above increased from \$11,636 to \$11,816. Second, spending levels increased for most categories of chronic conditions. One notable exception was a decline in per-beneficiary spending for beneficiaries with endocrine and renal conditions. Decedents consistently had high spending levels, averaging \$29,203 and \$29,242 in annual costs in 2007–2010 and 2011–2014, respectively.

Overall Medicare per-beneficiary spending declined by \$180 between the 2007–2010 and 2011–2014 time periods (Figure 1). Declines in relative spending levels for beneficiaries, rather than a population shift toward beneficiaries with less expensive health care needs, account for the majority of this decline. The decomposition analysis suggests that Medicare per-beneficiary spending would have declined by \$245 based on reduced spending levels if

Figure 1: Decomposition of Mean Medicare Per-Beneficiary Spending Growth 2007–2010 versus 2011–2014

Notes. Authors' calculations using a 5 percent sample of fee-for-service Medicare beneficiaries over age 65, years 2007–2014. Medicare spending was deflated to 2007 payment rates using sector-specific information on annual market basket updates.

the composition of the Medicare population had not changed (Table 2). In fact, given the compositional changes in the Medicare population and their disease prevalence, we would have expected Medicare per-beneficiary spending to increase by \$97 (holding payment rates constant) if there had been no change in spending levels. A modest amount of the decline (−\$33) was attributable to the interaction of these two factors (see Table S1 in Appendix SA2 for full decomposition results).

A large part of the decline in marginal spending levels was not associated with any particular characteristic or chronic condition that we measured, which we describe as unattributed changes (−\$115). According to the decomposition approach, this term represents the change in the coefficient on the constant term for predicting Medicare spending between the two time periods. An alternative way to conceptualize this difference is the change in spending levels for the reference population in our analysis: namely beneficiaries with no chronic conditions and none of the other demographic or coverage attributes that were included in the decomposition models.

Demographic characteristics were associated with net increased Medicare spending (\$40) when taking into account changes in the population and spending levels (Figure 1). Some of this increase reflects changes in the age

Table 2: Decomposition of Mean Medicare Per-Beneficiary Spending, 2007–2010 versus 2011–2014

	<i>Amount of Spending Growth Associated with Changes (\$)</i>		
	<i>Population Changes</i>	<i>Changes in Relative Spending Levels</i>	<i>Interaction</i>
Total	96.9**	−244.8**	−32.5**
Demographics			
Age 70–74	−0.1*	−18.8**	−0.3**
Age 75–79	4.5**	−30.6**	2.2**
Age 80–84	19.1**	−32.6**	3.9**
Age 85+	6.5**	−33.2**	0.6**
Female	2.3**	46.9**	−0.9**
White	7.5**	64.0**	−1.0**
Decedents	−22.8**	−15.6**	0.8**
Medicare coverage			
New beneficiaries	6.1**	−1.2	−0.2
New beneficiaries with chronic condition	−0.2*	−0.5	0.0
Switched from MA to FFS	−0.1**	1.0	−0.1
MA to FFS with chronic condition	−0.1	0.6	0.0
Part A only	9.2**	−0.6	−0.1
Part D drug coverage	−10.8**	44.9**	7.2**
Non-D drug coverage	35.8**	30.0**	−7.3**
Partial Medicaid	−0.4**	−5.3**	−0.6**
Full Medicaid	−0.4**	−8.3**	0.4**
Prevalence of chronic conditions			
Cognitive	83.8**	42.3**	−0.7
Cardiovascular	−156.9**	−34.0**	−0.7
Pulmonary	−2.5*	−39.1**	2.6**
Cancer	2.4**	5.8*	0.8**
Endocrine and renal	214.1**	−298.5**	−47.5**
Skeletal and joint	2.8*	64.9**	0.2
Ophthalmic	−1.7**	27.3**	−3.6**
Other	−16.5**	56.0**	14.6**
Incidence of chronic conditions			
Cognitive	−6.5**	13.1**	−1.2**
Cardiovascular	−42.7**	5.4	−1.8**
Pulmonary	−5.5**	7.8**	−0.9**
Cancer	−7.8**	−6.9**	0.5**
Endocrine and renal	−4.8**	−12.7**	1.2**
Skeletal and joint	−8.6**	7.2**	−1.3**
Ophthalmic	−1.2**	−3.2	0.3
Other	−7.6**	−6.0*	0.4
Unattributed (change in intercept)		−114.9**	

Notes. Authors' calculations using a 5% sample of fee-for-service Medicare beneficiaries over age 65, years 2007–2014. Prices were deflated to 2007 values using Federal Register publications on annual fee index changes.

FFS, fee-for-service; MA, Medicare Advantage.

* $p < .05$, ** $p < .01$.

distribution of the Medicare population. On average, per-beneficiary spending is lower for younger individuals than older beneficiaries. However, when we compare younger and older beneficiaries who are identical in terms of their chronic conditions and other factors, younger beneficiaries have greater marginal spending levels (Table S1 in Appendix SA2). When the younger share of Medicare beneficiaries increased between the two time periods, this population change was associated with expected increases in spending amounts. Between these two time periods, there were also sizeable increases in marginal spending levels for beneficiaries who were white (\$64) or female (\$47) (Table 2).

The decomposition analysis suggests that per-beneficiary Medicare spending would have increased by \$99 if we consider only the spending changes associated with Medicare-related coverage attributes (Figure 1). Marginal spending levels for beneficiaries with Part D and other forms of prescription drug coverage increased between these two time periods relative to spending levels for beneficiaries without any prescription drug coverage (Table S1 in Appendix SA2). In contrast, marginal spending levels for beneficiaries with full Medicaid coverage decreased modestly over this time period. Changes in spending levels for other attributes of Medicare coverage, such as having only Part A coverage, did not make a significant contribution to changes in overall per-beneficiary spending.

When the net changes in spending associated with chronic condition prevalence (−\$84) and incidence (−\$83) are combined, disease-related factors are the largest contributor to the overall spending decline, totaling −\$167 (Figure 1, Table 2). Even though increases in disease prevalence would be expected to increase per-beneficiary spending by \$125, these population changes were offset by even larger decreases in marginal spending levels for beneficiaries who have chronic conditions (−\$175). The reverse scenario occurs with disease incidence: Decreases in disease incidence were associated with a modest spending decline (−\$85) that was slightly offset by very small increases in marginal spending levels for beneficiaries with new chronic conditions (\$5).

The two prevalent disease categories with the largest spending decreases were cardiovascular and endocrine conditions (Figure 2). Every cardiovascular condition except atrial fibrillation declined in prevalence. Furthermore, almost all cardiovascular conditions also had reductions in relative spending levels, especially ischemic heart disease (−\$68). In contrast, heart failure had an increase in marginal spending levels from the early to

Figure 2: Spending Decomposition for Disease Categories with Largest Declines in Mean Medicare Per-Beneficiary Spending, 2007–2010 versus 2011–2014

Notes. Authors' calculations using a 5 percent sample of fee-for-service Medicare beneficiaries over age 65, years 2007–2014. Medicare spending was deflated to 2007 payment rates using sector-specific information on annual market basket updates. Atrial Fib., atrial fibrillation; Total Cardio., total cardiovascular; Total Endo., total endocrine.

the late period. If the prevalence of heart failure had not declined, this increase would have translated to a \$60 increase in overall Medicare per-beneficiary spending.

Among endocrine-related disorders, the findings for chronic kidney disease (CKD) stand out because of the magnitude of changes in marginal spending levels and spending related to prevalence. CKD refers to impaired kidney functioning that can range from mild function loss to end-stage renal disease. A large increase in the proportion of beneficiaries with CKD suggests that overall per-beneficiary Medicare spending would have increased by \$189 in the absence of other changes. However, this population-related change was offset by large declines in marginal spending levels for beneficiaries with CKD (–\$175), which suggests that the net amount of spending decline associated with CKD was –\$28 per beneficiary after including the interaction between these two effects. In contrast, spending associated with diabetes decreased because marginal spending levels for beneficiaries with diabetes declined (–\$96), but spending associated with diabetes prevalence rates had small increases (\$6).

Some chronic condition categories did see increases in associated per-beneficiary spending (Figure 3). Among cognitive diseases, increased

prevalence of depression and increased marginal spending levels for beneficiaries with Alzheimer's disease or dementia contributed \$89 and \$41, respectively, to overall increases in per-beneficiary Medicare spending. Spending associated with skeletal and joint conditions also contributed to spending growth, almost entirely due to increases in relative spending levels for these conditions, especially for beneficiaries with rheumatoid arthritis or osteoarthritis (RA/OA). Increases in prevalence and spending levels contributed to a net increase of \$72 in associated spending for RA/OA.

The sensitivity analyses conducted for different segments of the Medicare population consistently demonstrated that a large share of the spending decline was related to changes in relative spending levels (Figures S1 and S2 in Appendix SA2). Like our main cohort, changes in marginal spending levels were mainly associated with spending on chronic conditions or could not be attributed to a specific characteristic. However, the amount of the spending decline differed between populations. Beneficiaries with Part D benefits had larger declines in spending levels, dropping by \$261 from \$9,858 to \$9,597 in per-beneficiary spending. When the analysis excluded decedents, new Medicare beneficiaries, and switchers from MA, the remaining beneficiaries

Figure 3: Spending Decomposition for Disease Categories with Largest Increases in Mean Medicare Per-Beneficiary Spending, 2007–2010 versus 2011–2014

Notes. Authors' calculations using a 5 percent sample of fee-for-service Medicare beneficiaries over age 65, years 2007–2014. Medicare spending was deflated to 2007 payment rates using sector-specific information on annual market basket updates. RA/OA, rheumatoid arthritis/osteoarthritis.

had a small decline in spending levels, decreasing by \$78 from \$6,992 to \$6,914.

DISCUSSION

After adjusting for changes in Medicare payment rates, we found that mean Medicare per-beneficiary spending decreased by \$180 between 2007–2010 and 2011–2014. This change reflected large reductions in relative spending levels for Medicare beneficiaries that were partially offset by greater spending associated with changes in the characteristics of the Medicare population. Key factors that contributed to the spending decline were lower marginal spending levels for beneficiaries with chronic conditions and lower spending associated with decreases in disease incidence among beneficiaries. Notably, a large share of the spending decline could not be attributed to any particular demographic, coverage, or disease-related characteristic.

We observed significant variation across chronic conditions in how prevalence and spending levels influenced spending patterns. A combination of declining prevalence and associated spending levels contributed to lower spending on cardiovascular diseases. In contrast, spending declines associated with lower spending levels for beneficiaries with endocrine and renal disorders, particularly CKD, were partially offset by increased spending due to the rising prevalence of CKD. Per-beneficiary spending associated with cognitive conditions as well as skeletal and joint conditions increased, although the role of changes in composition of the population versus changes in spending levels differed across conditions.

Like other decompositions of per-capita spending growth, we found that changes in spending levels, rather than changes in the composition of the population, explained most of the difference in per-capita spending growth (Roehrig and Rousseau 2011; Starr, Dominiak, and Aizcorbe 2014; Dunn, Rittmueller, and Whitmire 2016; Roehrig and Lake 2017). Furthermore, our results are supported by recent work demonstrating that population changes in disease prevalence explain only a small share of total spending growth in the United States (Dieleman et al. 2017). Most of the previous work on this topic has relied on relatively small samples from survey data. Using Medicare administrative data, we have a large study population that enables us to model the joint effect of multiple factors. By accounting for payment rate changes, our analysis focuses on spending growth from changes in the volume or type of health care services provided.

Our results are also distinct in that previous studies have parsed out spending according to whether medical treatments and visits are for a specific condition. In contrast, we focus on total spending for a person with a given chronic condition, while controlling for the presence of other conditions and multiple characteristics. This approach is consistent with the premise that the presence of a chronic condition, even if not directly treated during a medical encounter, can influence spending associated with different chronic conditions.

For policy makers seeking to understand which chronic conditions have greater influence on Medicare spending changes, our disease-specific findings are particularly relevant for targeting future payment and delivery reform initiatives. Our findings on spending patterns correspond to national prevalence and incidence trends, as well as recent changes in health care delivery for some diseases. The prevalence of cardiovascular disease has declined, along with Medicare hospitalizations for these conditions and the use of expensive surgical procedures such as coronary artery bypass grafts (Chen et al. 2010, 2011; Epstein et al. 2011; Likosky et al. 2013; U. S. Burden of Disease Collaborators 2013; Fang et al. 2014). Greater spending due to increasing prevalence of CKD among Medicare beneficiaries parallels long-term trends of increased early-stage CKD and end-stage renal disease among older adults (Coresh et al. 2007; U.S. Renal Data System 2015). Two factors might have contributed to lower spending levels over time for CKD: a new bundled payment method for dialysis in 2011 and reduced use of high-cost anemia treatments (Iglehart 2011; Swaminathan et al. 2012; Winkelmayer et al. 2014). If beneficiaries with milder cases of CKD were more likely to be diagnosed in the latter period, that pattern might also explain why spending levels associated with CKD declined.

Even though there was an overall decline in spending for chronic conditions, the diseases that had positive spending growth per-beneficiary merit close attention. The increased prevalence of mental illness, including depression, contributed to national per-capita spending growth between 2000 and 2010 (Dunn, Rittmueller, and Whitmire 2016), which supports our finding that a greater prevalence of depression contributed to Medicare spending growth. The increasing spending levels for Alzheimer's and dementia are particularly concerning because health care services covered by Medicare account for only a small share of the overall costs for dementia. It is not clear whether long-term care costs, which are the largest component of overall dementia spending (Hurd et al. 2013), also increased over this time period. Finally, in light of how orthopedic procedures and subsequent follow-up care are being

targeted for bundled payment reforms, it will be important to follow whether the increases in spending levels associated with skeletal and joint conditions continue. Although bundled payments may contain the costs of surgery, spending levels could still increase if a greater proportion of beneficiaries opt for surgical procedures to treat these conditions (Dummit et al. 2016; Fisher 2016). Some data suggest that the growing rate of knee replacements began to level off in the mid-2000s after steady growth for the previous 15 years (Cram et al. 2012).

A large share of the decline in spending levels cannot be attributed to any specific beneficiary characteristic, which raises questions about the potential influence of other factors that we do not directly measure, such as policy changes. Over the time period of our study, CMS launched multiple initiatives to improve health care delivery in traditional Medicare and potentially bend the cost curve. National financial incentive programs, for example, encouraged multiple providers to adopt electronic health records and to reduce hospital readmissions. A select group of providers opted to participate in accountable care organizations and bundled payment initiatives that promoted greater efficiency in how health services are delivered. Under the Affordable Care Act and sequestration, the federal government reduced payment rates to hospitals and other providers. Although our analysis of payment-adjusted spending does not consider the direct effects of these measures, such actions could have prompted providers to respond with increases or decreases in service volume. In the short term, these initiatives are premised on the assumption that Medicare can achieve greater efficiency, especially for beneficiaries with costly conditions. Our analysis is not designed to identify whether these initiatives have decreased costs, but our findings that relative spending levels for beneficiaries with chronic conditions have decreased are consistent with the possibility that health care delivery has changed.

Furthermore, participation in the Medicare Advantage program has dramatically increased over this time period from 22 percent of Medicare beneficiaries in 2008 to 31 percent in 2014 (Jacobson et al. 2016). There is some evidence that increased Medicare Advantage participation can moderate health care spending in traditional Medicare through spillover effects on health care delivery patterns (Chernew, DeCicca, and Town 2008; Baicker, Chernew, and Robbins 2013). On the other hand, there are mixed results about whether healthier Medicare beneficiaries still selectively participate in Medicare Advantage, even after recent risk adjustment reforms that were intended to encourage enrollment among sicker beneficiaries (McWilliams, Hsu, and Newhouse 2012; Brown et al. 2014). The net effect of increased

Medicare Advantage participation on spending levels for traditional Medicare beneficiaries is not clear.

Several aspects of our study limit the conclusions that can be drawn from our findings. Disease identification is based on claims, so we cannot observe beneficiaries who had chronic conditions but no associated treatment, nor can we observe disease severity. Our results may be sensitive to “upcoding” the number of diagnoses on Medicare claims if the extent of upcoding changed between our two comparison periods. If our analysis had included Part D spending, results may have changed for several conditions that are treated with expensive medications, such as rheumatoid arthritis. We do not account for several factors that are difficult to measure and could have influenced beneficiaries’ spending levels, such as income, assets, and Medicare supplemental coverage other than Medicaid. Because Medicare Advantage claims are not available to researchers, we could not assess whether spending decomposition results were similar for Medicare Advantage members. Our analysis does not evaluate whether changes in Medicare spending affected the quality of care for Medicare beneficiaries. Finally, we examined changes in Medicare spending over a relatively short time period when there was exceptionally low growth, so our results might not generalize to other time periods.

The success of Medicare payment reforms, at least in the short term, relies upon providers being able to reduce spending levels for beneficiaries with a given set of health care needs. For policy makers and health care organizations who are concerned about the feasibility of reducing health care spending, these results can be interpreted with some optimism. The magnitude of spending level declines for beneficiaries with chronic conditions may be an indication that there are opportunities for health care organizations to provide care more efficiently. However, the extent to which reduced spending levels are offset by spending growth due to increased prevalence of chronic conditions suggests that there is an equally important role for policies that promote disease prevention.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: This study was funded by the Commonwealth Fund. A previous version of the study was presented at the Gerontological Society of America’s 2016 Annual Scientific Meeting in New Orleans, LA. The authors would like to thank Sunita Thapa and Lucas Stewart

for assistance with manuscript revisions and Christine Whitmore for assistance with project management. At the time this manuscript was submitted, Robert Gambrel worked as an analyst in the Vanderbilt University School of Medicine's Department of Health Policy.

Disclosures: None.

Disclaimer: None.

REFERENCES

- Afendulis, C. C., Y. He, A. M. Zaslavsky, and M. E. Chernew. 2011. "The Impact of Medicare Part D on Hospitalization Rates." *Health Services Research* 46 (4): 1022–38.
- Baicker, K., M. E. Chernew, and J. A. Robbins. 2013. "The Spillover Effects of Medicare Managed Care: Medicare Advantage and Hospital Utilization." *Journal of Health Economics* 32 (6): 1289–300.
- Blinder, A. S. 1973. "Wage Discrimination: Reduced Form and Structural Estimates." *Journal of Human Resources* 8 (4): 436–55.
- Brown, J., M. Duggan, I. Kuziemko, and W. Woolston. 2014. "How Does Risk Selection Respond to Risk Adjustment? New Evidence from the Medicare Advantage Program." *American Economic Review* 104 (10): 3335–64.
- Buntin, M., and T. Hayford. 2016. "Evidence of Inefficiencies in Practice Patterns: Regional Variation in Medicare Medical and Drug Spending." *Forum for Health Economics and Policy* 19 (2): 299–331.
- Buntin, M. B., and M. Levine. 2013. "Why Has Growth in Spending for Fee-for-Service Medicare Slowed?" [accessed on February 16, 2017]. Washington, DC: Congressional Budget Office. Available at <https://www.cbo.gov/publication/44513>
- Chen, J., S. L. Normand, Y. Wang, E. E. Drye, G. C. Schreiner, and H. M. Krumholz. 2010. "Recent Declines in Hospitalizations for Acute Myocardial Infarction for Medicare fee-for-Service Beneficiaries: Progress and Continuing Challenges." *Circulation* 121 (11): 1322–8.
- Chen, J., S. L. Normand, Y. Wang, and H. M. Krumholz. 2011. "National and Regional Trends in Heart Failure Hospitalization and Mortality Rates for Medicare Beneficiaries, 1998–2008." *Journal of the American Medical Association* 306 (15): 1669–78.
- Chernew, M., P. DeCicca, and R. Town. 2008. "Managed Care and Medical Expenditures of Medicare Beneficiaries." *Journal of Health Economics* 27 (6): 1451–61.
- Chronic Conditions Data Warehouse. 2016. "CCW Condition Algorithms" [accessed on February 16, 2017]. Available at https://www.ccwdata.org/cs/groups/public/documents/document/ccw_chronic_cond_algos.pdf
- Coresh, J., E. Selvin, L. A. Stevens, J. Manzi, J. W. Kusek, P. Eggers, F. Van Lente, and A. S. Levey. 2007. "Prevalence of Chronic Kidney Disease in the United States." *Journal of the American Medical Association* 298 (17): 2038–47.

- Cram, P., X. Lu, S. L. Kates, J. A. Singh, Y. Li, and B. R. Wolf. 2012. "Total Knee Arthroplasty Volume, Utilization, and Outcomes among Medicare Beneficiaries, 1991–2010." *Journal of the American Medical Association* 308 (12): 1227–36.
- Dieleman, J. L., E. Squires, A. L. Bui, M. Campbell, A. Chapin, H. Hamavid, C. Horst, Z. Li, T. Matyas, A. Reynolds, and N. Sadat. 2017. "Factors Associated with Increases in us Health Care Spending, 1996–2013." *Journal of the American Medical Association* 318 (17): 1668–78.
- Dummit, L. A., D. Kahvecioglu, G. Marrufo, R. Rajkumar, J. Marshall, E. Tan, M. J. Press, S. Flood, L. D. Muldoon, Q. Gu, A. Hassol, D. M. Bott, A. Bassano, and P. H. Conway. 2016. "Association between Hospital Participation in a Medicare Bundled Payment Initiative and Payments and Quality Outcomes for Lower Extremity Joint Replacement Episodes." *Journal of the American Medical Association* 316 (12): 1267–78.
- Dunn, A., L. Rittmueller, and B. Whitmire. 2016. "Health Care Spending Slowdown from 2000 to 2010 Was Driven by Lower Growth in Cost Per Case, According to a New Data Source." *Health Affairs* 35 (1): 132–40.
- Epstein, A. J., D. Polsky, F. Yang, L. Yang, and P. W. Groeneveld. 2011. "Coronary Revascularization Trends in the United States, 2001–2008." *Journal of the American Medical Association* 305 (17): 1769–76.
- Fang, M. C., M. Coca Perrailon, K. Ghosh, D. M. Cutler, and A. B. Rosen. 2014. "Trends in Stroke Rates, Risk, and Outcomes in the United States, 1988 to 2008." *American Journal of Medicine* 127 (7): 608–15.
- Fisher, E. S. 2016. "Medicare's Bundled Payment Program for Joint Replacement: Promise and Peril?" *Journal of the American Medical Association* 316 (12): 1262–4.
- Flegal, K. M., M. D. Carroll, B. K. Kit, and C. L. Ogden. 2012. "Prevalence of Obesity and Trends in the Distribution of Body Mass Index among US Adults, 1999–2010." *Journal of the American Medical Association* 307 (5): 491–7.
- Hurd, M. D., P. Martorell, A. Delavande, K. J. Mullen, and K. M. Langa. 2013. "Monetary Costs of Dementia in the United States." *New England Journal of Medicine* 368 (14): 1326–34.
- Iglehart, J. K. 2011. "Bundled Payment for ESRD—Including ESAs in Medicare's Dialysis Package." *New England Journal of Medicine* 364 (7): 593–5.
- Jacobson, G., G. Casillas, A. Damico, T. Neuman, and M. Gold. 2016. "Medicare Advantage 2016 Spotlight: Enrollment Market Update" [accessed on July 17, 2017]. Menlo Park, CA: Kaiser Family Foundation. Available at <http://kff.org/medicare/issue-brief/medicare-advantage-2016-spotlight-enrollment-market-update/>
- Jann, B. 2008. "A Stata Implementation of the Blinder-Oaxaca Decomposition." *Stata Journal* 8 (4): 453–79.
- Likosky, D. S., W. Zhou, D. J. Malenka, W. B. Borden, B. K. Nallamotheu, and J. S. Skinner. 2013. "Growth in Medicare Expenditures for Patients with Acute Myocardial Infarction: A Comparison of 1998 through 1999 and 2008." *Journal of the American Medical Association Internal Medicine* 173 (22): 2055–61.
- Martin, A. B., M. Hartman, J. Benson, A. Catlin, and the National Health Expenditure Accounts Team. 2016. "National Health Spending in 2014: Faster Growth

- Driven by Coverage Expansion and Prescription Drug Spending.” *Health Affairs* 35 (1): 150–60.
- McWilliams, J. M., J. Hsu, and J. P. Newhouse. 2012. “New Risk-Adjustment System Was Associated with Reduced Favorable Selection in Medicare Advantage.” *Health Affairs* 31 (12): 2630–40.
- McWilliams, J. M., A. M. Zaslavsky, and H. A. Huskamp. 2011. “Implementation of Medicare Part D and Nondrug Medical Spending for Elderly Adults with Limited Prior Drug Coverage.” *Journal of the American Medical Association* 306 (4): 402–9.
- Medicare Trustees Report. 2017. “Table V.D1. HI and SMI Average Incurred per Beneficiary Cost; 2017 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds” [accessed on September 18, 2017]. Washington, DC. Available at <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/TR2017.pdf>
- Oaxaca, R. 1973. “Male-Female Wage Differentials in Urban Labor Markets.” *International Economic Review* 14 (3): 693–709.
- Roehrig, C., and C. Lake. 2017. “An Updated Analysis of the Roles of Cost per Case and Treated Prevalence in Health Spending Growth” [accessed on December 13, 2017]. Ann Arbor, MI: Altarum Institute. Available at <https://www.bea.gov/papers/pdf/Cost-per-Case-and-Treated-Prevalence-Update-Aug-2017.pdf>
- Roehrig, C. S., and D. M. Rousseau. 2011. “The Growth in Cost per Case Explains far More of US Health Spending Increases Than Rising Disease Prevalence.” *Health Affairs* 30 (9): 1657–63.
- Starr, M., L. Dominiak, and A. Aizcorbe. 2014. “Decomposing Growth in Spending Finds Annual Cost of Treatment Contributed Most to Spending Growth, 1980–2006.” *Health Affairs* 33 (5): 823–31.
- Swaminathan, S., V. Mor, R. Mehrotra, and A. Trivedi. 2012. “Medicare’s Payment Strategy for End-Stage Renal Disease Now Embraces Bundled Payment and Pay-for-Performance to Cut Costs.” *Health Affairs* 31 (9): 2051–8.
- U. S. Burden of Disease Collaborators. 2013. “The State of US Health, 1990–2010: Burden of Diseases, Injuries, and Risk Factors.” *Journal of the American Medical Association* 310 (6): 591–608.
- U.S. Renal Data System. 2015. “Chapter 1: Incidence, Prevalence, Patient Characteristics, and Treatment Modalities; Volume II: End-Stage Renal Disease (ESRD) in the United States; 2015 Annual Data Report” [accessed on February 16, 2017]. Available at https://www.usrds.org/2015/download/vol2_01_IncidenceandPrevalence_15.pdf
- White, C., and P. Ginsburg. 2012. “Slower Growth in Medicare Spending—Is This the New Normal?” *New England Journal of Medicine* 366 (12): 1073–5.
- Winkelmayer, W. C., A. A. Mitani, B. A. Goldstein, M. A. Brookhart, and G. M. Chertow. 2014. “Trends in Anemia Care in Older Patients Approaching end-Stage Renal Disease in the United States (1995–2010).” *Journal of the American Medical Association Internal Medicine* 174 (5): 699–707.

Zhang, Y., J. M. Donohue, J. R. Lave, G. O'Donnell, and J. P. Newhouse. 2009. "The Effect of Medicare Part D on Drug and Medical Spending." *New England Journal of Medicine* 361 (1): 52–61.

SUPPORTING INFORMATION

Additional supporting information may be found online in the supporting information tab for this article:

Appendix SA1: Author Matrix.

Appendix SA2: Oaxaca-Blinder Decomposition.

Table S1: Detailed Decomposition of Mean Medicare Per-Beneficiary Spending, 2007–2010 versus 2011–2014.

Figure S1: Decomposition of Mean Medicare Per-Beneficiary Spending Growth Part D Only 2007–2010 versus 2011–2014.

Figure S2: Decomposition of Mean Medicare Per-Beneficiary Spending Growth 12 months Medicare 2007–2010 versus 2011–2014.