Published in final edited form as:

Health Aff (Millwood). 2011 September ; 30(9): 1708–1717. doi:10.1377/hlthaff.2010.0394.

Medicare's Bundled Payment Pilot for Acute and Postacute Care: Analysis and Recommendations on Where to Begin

Neeraj Sood¹,

University of Southern California

Peter J. Huckfeldt,

RAND

José J Escarce,

UCLA and RAND

David C. Grabowski, and

Harvard Medical School

Joseph P. Newhouse

Harvard Medical School

Abstract

In the National Pilot Program on Payment Bundling, a subset of Medicare providers will receive a single payment for an episode of acute care in a hospital, followed by postacute care in a skilled nursing or rehabilitation facility, the patient's home, or other appropriate setting. This article examines the promises and pitfalls of bundled payments and addresses two important design decisions for the pilot: which conditions to include, and how long an episode should be. Our analysis of Medicare data found that hip fracture and joint replacement are good conditions to include in the pilot because they exhibit strong potential for cost savings. In addition, these conditions pose less financial risk for providers than other common ones do, so including them would make participation in the program more appealing to providers. We also found that longer episode lengths captured a higher percentage of costs and hospital readmissions while adding little financial risk. We recommend that the Medicare pilot program test alternative design features to help foster payment innovation throughout the health system.

Introduction

Obtaining greater value for money has been an issue in both Medicare - and American health care more generally - for decades. More specifically, over the past decade traditional Medicare has been criticized for failing to coordinate payments and services across health care providers and for rewarding quantity of care over quality or value. Lack of coordination between acute and post-acute care has attracted particular concern due to rapidly growing

¹Neeraj Sood (nsood@healthpolicy.usc.edu) is director of international programs at the Leonard D. Schaeffer Center for Health Policy and Economics and an associate professor in the Titus Family Department of Clinical Pharmacy, Pharmaceutical Economics, and Policy, both at the University of Southern California, in Los Angeles.

post-acute care costs in the early 1990s and again after 2000 and, for some conditions, high rates of readmission to acute care.

One proposed policy change is a system of bundled payments for acute and post-acute episodes.^(1, 2) The Patient Protection and Affordable Care Act of 2010 includes the voluntary “National Pilot Program on Payment Bundling”.⁽³⁾ In this program, a single health care provider such as a hospital or a physician group will receive a bundled payment for the provision of inpatient acute care (including physician services), post-acute care, and outpatient services during an episode of care. The law provides broad guidance on structuring this pilot program, but leaves many implementation details to be determined by the Secretary of Health and Human Services. For example, the law stipulates that an episode of care will start three days prior to acute care admission and end thirty days after discharge from acute care, but the Secretary can choose an alternate episode length. Similarly, the Secretary may choose up to eight health care conditions to include in the pilot program. Finally, the Secretary has wide discretion in designing payment contracts for the pilot program and defining the services covered by the bundled payment.

This paper addresses several issues that the Secretary must decide, but we start by describing the problems with current Medicare reimbursement that provided the impetus for the proposal to pilot bundled payments. We then examine the intended and possible unintended consequences of bundled payments. Finally, we use Medicare data to demonstrate metrics that can be used to select conditions and define an episode of care in the pilot, with the dual objectives of inducing provider participation and achieving the greatest gains possible in quality and efficiency of care.

Problems of Medicare’s Current Reimbursement System

Medicare’s current payment system differs for each setting in which care is delivered. As is well known, the Social Security Amendments of 1983 introduced the inpatient prospective payment system (IPPS), which set the marginal payment for additional inpatient hospital services to zero, except for selected diagnosis-related groups (DRGs) receiving higher payment if a procedure was carried out and a handful of outlier cases. However, post-acute providers continued to be reimbursed on a cost basis with upper limits, so that additional services generated additional revenue. The disparity in marginal payments produced powerful incentives to shift patients out of acute care and into post-acute facilities, resulting in large increases in post-acute care use and costs.^(4, 5)

The 1997 Balanced Budget Act addressed this problem by mandating prospective payment for post-acute providers, but it maintained separate payment systems for each post-acute setting. Evidence suggests that the resulting post-acute prospective payment systems eliminated some inefficient use of post-acute services.⁽⁶⁻⁹⁾ Nonetheless, the current payment systems contain worrisome incentives. Reimbursement in each post-acute setting is based on providers’ average costs, which differ across provider types. As a result, different provider types receive different levels of reimbursement for the same services for the same patient, resulting in incentives to send patients to the setting with the highest reimbursement rather than where value net of costs is the highest.

Additional payment system design features exacerbate this non-neutrality. For example, inpatient rehabilitation facilities and home health agencies are typically paid a fixed episode price. As a result, they receive close to zero marginal reimbursement and thus have an incentive to discharge patients early, even if patients might benefit from longer stays. In contrast, skilled nursing facilities are reimbursed on a per diem basis, creating incentives to place long-term patients in skilled nursing facilities and short-term patients in rehabilitation facilities, regardless of clinical appropriateness.(10) The lack of evidence-based guidelines on the most appropriate post-acute setting for patients with different conditions magnifies the effect of these incentives.(11)

The distinct prospective payment systems for each setting also fail to provide incentives for acute and post-acute care providers to communicate or coordinate with one another; instead, they offer incentives to focus on provision of specific services within a particular setting.(2) There is evidence that the problematic financial incentives and lack of provider coordination translate into the worst of all worlds: poor value for Medicare and adverse patient health outcomes. Jencks et al.(12) found that nearly 20% of Medicare fee-for-service patients were re-hospitalized within 30 days of their acute care discharge. Over half of such patients did not see a physician before their readmission, suggesting that poor provider coordination at discharge may have played a role in their readmission. Similarly, Mor et al.(13) found that 24% of skilled nursing facility users were readmitted within 30 days of hospital discharge, costing Medicare \$4.3 billion in 2006. Buntin et al.(14) found that episodes of post-acute care for lower extremity joint replacement were considerably more expensive for patients in rehabilitation facilities or skilled nursing facilities than for patients discharged to their homes, but that the higher cost at the rehabilitation and skilled nursing facilities did not translate to lower rates of mortality or institutionalization.

Bundling: a potential approach for addressing these issues

Payment bundling, in which one payment is provided for an entire acute and post-acute episode, has the potential to reduce costs without compromising outcomes. The entity receiving the bundled payment earns a higher margin if a patient is discharged to the community earlier, but also bears the financial risk of both a readmission and the cost of all post-acute care. This arrangement produces a strong incentive for the recipient of the bundled payment to coordinate care across settings and not to discharge patients inappropriately early. In addition, the Patient Protection and Affordable Care Act mandates that the pilot program pay providers for care coordination, medication reconciliation, discharge planning, transitional care, and other similar services, enhancing the incentive to provide patient centered care.(3) Bundled payments will likely change the incentives surrounding the choice of post-acute setting because the entity receiving the bundled payment is the residual claimant and thus has the incentive to reduce post acute care costs. For example, cost savings may be achieved by contracting with lower cost post acute care providers.

Evaluations of episode-based payment systems in other settings suggest that the potential benefits of bundled payment may be realized in practice. Medicare instituted a pilot program between 1990 and 1996 that bundled Parts A and B payment for Coronary Artery Bypass

Graft Surgery. The evaluation of this program found reduced costs and improved patient health.⁽¹⁵⁾ Similarly, the Geisinger Health Care System ProvenCare program, started in 2006, includes an episode-based payment for coronary artery bypass graft surgery, as well as an electronic checklist for best practices, a pay-for-performance scheme, and a patient “compact” on care. The evaluation of this program found improved compliance with best standards, decreased length of stay (although statistically insignificant), and improved likelihood of discharge to home. ⁽¹⁶⁾

Unintended consequences of bundling

Although bundled payment addresses some of the problematic incentives in the current reimbursement methods, it may create a new set of problems or exacerbate old ones. Incentives to skimp on care are inherent in any fixed-episode payment system since there is no payment for additional services. Bundling gives providers strong incentives to avoid readmissions, but depending on design, it does not necessarily reward valuable services that improve patient health but do not materially affect the probability of readmission in the short run.

If a hospital were the recipient of the bundled payment, its financial risk would increase because it would face increased variation in total (acute plus post-acute) costs across patients. This risk could deter some hospitals from participating. If an entity other than a hospital receives the payment, it would need to possess the capability to manage the entire risk.

Fortunately, there are a variety of policy options to mitigate both financial risk and incentives to stint on care. A robust outlier payment policy can reduce both financial risk and the incentive to stint on care. Essentially, outlier payments serve as an insurance policy – providers receive a lower base payment rate from Medicare and in return Medicare agrees to cover a significant fraction of costs in excess of a predetermined threshold. A downside arises, however, if an outlier payment is above marginal cost, resulting in incentives to over-provide services. This is not only difficult to observe but likely varies across facilities and across a length of stay.

Another option is gain and loss sharing. Under such a policy, Medicare would set a bundled payment target for providers who participate in the pilot program and would cover some portion of provider spending in excess of this payment target. In return, providers would share with Medicare any gains achieved if spending fell below the payment target. Such contracts can encourage participation by reducing providers’ risk, and it also limits the incentives to stint on care. Finally, combining bundled payments with pay-for-performance can help counter the incentive inherent in fixed payments to compromise the quality of care.

Evidence from Blue Cross Blue Shield of Massachusetts indicates that such provisions can be implemented in practice, but that a one-contract-fits-all strategy might not be optimal. ⁽¹⁷⁾ Providers participating in the Blue Cross Alternative Quality Contract receive a global payment for all care received during an episode of care (or a full capitation), and the global payment rates are negotiated for multi-year periods (up to five years). Reimbursement varies over time depending on changes in input costs and other drivers of health care costs. Risk is

limited in two ways; some providers share risk (the share of the risk borne by providers varies from 50% to 100%), and all participating providers are required to purchase a reinsurance policy that pays for spending above a certain threshold. Providers also have the option to participate in a pay-for-performance system where they can receive bonus payments of up to 10% for meeting certain quality-of-care targets. The experience with these global or bundled payment contracts might provide important lessons to Medicare for designing payment contracts under the national pilot program.

In principle, patients currently have a free choice of post-acute providers, and a change to. In a payment bundling scheme, however, there exist strong incentives for the entity receiving a bundled payment and coordinating care to take a more active role in overseeing post acute care. Hospitals could well contract the number of post-acute providers they use and/or increase use of their own hospital-based post-acute units to save costs. In addition, some hospitals might not have the managerial and administrative capabilities to maintain a large network of post-acute providers. Ultimately, the size of post acute referral networks might depend on how well hospitals or another entity can perform contracting and care management functions as well as on Medicare requirements for contracting with all willing post acute care providers. A possible contraction in the size of the network could adversely affect patient welfare if hospitals over weighted financial gain relative to patient welfare.

However, the issue of reduction in patient choice to achieve cost savings is not unique to bundled payments and is inherent in Medicare Advantage plans (Part C), the Medicare prescription drug benefit (Part D), and in Accountable Care Organizations (ACOs). In each case, combinations of oversight (e.g., accreditation) and regulation (e.g., with respect to network and formulary adequacy) have been effective at maintaining diversity of providers and patient choice.

Any regulation needs to consider effects on patient welfare and cost. Smaller referral networks may require patients to travel further for care or could lead to poorer matches between patient disease condition and provider skills or expertise. But maintaining a large number of post-acute providers in the network would probably result in higher payments for post-acute care providers, due to a weaker bargaining position for the hospital (or other entity) or use of expensive or inefficient providers by patients. In summary, payment bundling is likely to change the structure of post acute referral networks and may require the types of regulation and oversight now seen in other parts of Medicare.

The current size of acute care hospitals' post-acute referral networks is an important indicator for the potential importance of these issues. If referral networks are relatively small, then incentives to shrink them further may be modest. Exhibit 1 displays the cumulative distribution of post-acute referral network size for acute care hospitals in 2004 pooled across five conditions (hip fracture, stroke, lower extremity joint replacement, chronic obstructive pulmonary disease, and congestive heart failure) and separately for hip fracture and stroke patients. The values shown are the number of distinct post-acute care providers to which Medicare patients were referred from an individual acute provider following hospitalization.

Exhibit 1 shows that hospitals currently refer to a large number of post-acute providers. The pooled estimates (solid line) indicate that 50% of hospitals refer patients to 15 or more providers, and over 30 percent refer patients to over 30 providers. Juxtaposing the distribution of pooled referral networks with post-acute referrals for individual conditions (stroke and hip fracture- indicated by dotted and dashed lines) suggests that there may be limited overlap of post-acute referrals across conditions. In other words, hospital discharge planners appear to use different post-acute care providers for different conditions. Hence, if a hospital were to reduce the overall number of post-acute providers it used, there could be varying effects for different conditions. For example, if an acute provider or case-manager channels all patients to the post-acute provider that was best for stroke patients, hip fracture patients may be detrimentally affected. Thus, the data suggest that a reduction in network size may not be an important issue if the pilot program is implemented for just one or two conditions- it is likely that post-acute providers specializing in the included conditions would participate in the pilot. However, expanding the program to eight conditions (the maximum under the pilot program) with a limited network could adversely affect outcomes and may lead to tradeoffs between cost and patient outcomes. It is important to note that our estimates have been constructed with acute discharges from 2004- these analyses should be revisited using more recent data when policy makers design the pilot, as treatment patterns and payment policies have shifted somewhat in the interim.

Implementation Challenges

Many crucial details of the pilot program remain undefined, among them which providers to include, which and how many diagnoses to include, how to assess patients and measure quality of care, how to define an episode of care, and the specifics of payment design. In this section we use Medicare data to address two important design decisions for the pilot: (1) which diagnoses to include, and (2) the length of the episode.

Conditions or Diagnosis to Include in the Pilot Program

We focus on two key criteria for choosing the conditions to include. The first is the financial risk faced by providers. Given the voluntary nature of the program, provider participation can be increased by choosing conditions for which providers face less financial uncertainty. A standard measure of financial risk is *within* provider variation in costs for patients with a particular condition, while adjusting for health and demographic characteristics. A second criterion is the potential to reduce costs without compromising patient outcomes, which we measure by the *across* provider variation in adjusted costs and readmissions for a given condition. If variation in costs across providers is unrelated to patient outcomes, it reflects inefficiency. Indeed, much of the vast literature on geographic variation in Medicare spending uses that notion(18, 19); although recent evidence suggests that patient outcomes may vary with variation in spending(20). Similarly, variation in adjusted readmission rates across providers can indicate the potential for cost savings without compromising outcomes.

Exhibit 2 displays estimates of the variability of total episode costs, including the acute stay and the first 30 days after acute hospital discharge. We examine five common conditions precipitating hospital admission among Medicare patients: chronic obstructive pulmonary disease, congestive heart failure, stroke, lower extremity joint replacement, and hip fracture.

The statistics shown include the mean and standard deviation, the average unadjusted within-provider interquartile ratio, and the adjusted within-provider coefficient of variation. The within-provider coefficient of variation is constructed as the adjusted within-provider standard deviation in total episode costs divided by average total episode costs for a given condition. The adjusters include patient demographics, complications, and comorbid conditions derived from acute care claims, as well as hospital fixed effects to adjust for differences in wages and practice patterns across hospitals.

Exhibit 2 shows that providers face lower financial risks for treating patients with lower extremity joint replacement and hip fracture compared to other common disease conditions, suggesting their greater suitability as candidate conditions for the pilot program. For example, hip fracture and lower extremity joint replacement patients at the 75th percentile of the total cost distribution within an acute care hospital are 1.5 to 2 times more costly on average than patients at the 25th percentile of the total cost distribution. In contrast, there is greater variability in episode costs for conditions such as chronic obstructive pulmonary disease and stroke, where patients at the 75th percentile are 2.5 to 3 times more costly than patients at the 25th percentile. Analysis of financial risks using the within-provider coefficient of variation (adjusting for patient health characteristics and demographics and provider fixed effects) reinforces this finding. The coefficients of variation for congestive heart failure and stroke are substantially higher than joint replacement or hip fracture, implying the greater financial risk posed by these conditions.

The first columns of the panels of Exhibit 3 show the fraction of variation across patients in adjusted total 30-day episode costs and readmission rates attributable to variation across hospitals. The second column shows the interquartile range across hospitals in total episode costs and readmissions, also controlling for patient demographics, comorbidities, and complications. (The interquartile range shows the difference in 30 day post-acute episode costs between the 75th percentile and the 25th percentile.)

Exhibit 3 shows that not only are lower extremity joint replacement and hip fracture less financially risky overall, but that a greater portion of variability in their costs and readmissions occurs across providers. Joint replacement patients exhibit the greatest variation in total episode costs and the highest interquartile ratio across hospitals, and hip fracture patients exhibit the most variation in readmissions across hospitals and nearly the highest interquartile range. In short, the opportunities for cost savings also appear highest for those two conditions.

One must, of course, be concerned about possible adverse effects on outcomes. This would be an important focus of any pilot, and we know of no outcome data to help choose among conditions to include in the pilot. We see no particular reason, however, why any outcome effects should much differ for hip fracture and joint replacement than the other three conditions shown.

Length of Episode

Longer episode lengths provide greater assurance that patients have stabilized and have no need for ongoing care. However, longer episode lengths also imply more variation in costs

across patients and therefore place increased financial risk on the hospital or other coordinating entity. Exhibit 4 illustrates this tradeoff for lower extremity joint replacement patients. The data show that episodes that end thirty days after discharge from acute care capture a little less than 60% of readmissions and approximately 70% of post-acute care costs that occur within the first ninety days of discharge. Increasing episode length increases the fraction of readmission and post-acute care costs captured by the episode in a roughly linear fashion. For example, increasing the length of the episode to 60 days after acute care discharge captures roughly 80% of the readmissions and over 80% of post-acute care costs for joint patients that occurred in the 90 days following acute discharge. Longer episode lengths also increase the variation across patients and hence the financial risk faced by providers. However, the gradient of financial risks with respect episode length is less steep (as measured by the adjusted within-provider coefficient of variation) - suggesting that longer episode lengths capture significantly more costs and readmissions but do not add as much to financial risk faced by providers. Similar results are shown for hip fracture patients in supplementary materials. However, this conclusion should be balanced with consideration of the provider's ability to influence the likelihood of events and how this ability changes with time after discharge from acute care. For example, a hospital and its physicians may perceive it fairer to be held accountable for a readmission that happens shortly after a stay as opposed to one that occurs several weeks after discharge.

Discussion

Bundled payments are increasingly seen as a means to reduce Medicare costs, increase coordination of care, and improve quality. While bundling could potentially mitigate some of the negative incentives of the current system around lack of co-ordination and shifting site of care to maximize reimbursement, it may have unintended adverse consequences such as restricting patient choice of post-acute provider and stinting on care.

Fortunately, it may be possible to design mechanisms that mitigate the impact of such negative incentives. As the national pilot program for payment bundling moves forward, Medicare should consider including pay-for-performance, a quality monitoring and regulation system as a part of payment bundling, in order to alleviate incentives to skimp.⁽¹⁾ An outlier system that is applied to a substantial number of patients or even to all patients could reduce skimping, selection, and financial risk. The general principle would be to have some positive payment at the margin, however small. Finally, contracts that allow for gain and loss sharing can balance the need to achieve savings with the amount of risk placed on providers.

In addition to learning from experience with similar payment systems in other domains, analysis of existing Medicare data provides insights about how best to design a pilot project on bundled payment. Such data can be useful in determining the optimal length of the episode as well as the number and type of conditions to be included in the pilot program.

Our findings on how financial risk and opportunities to reduce cost differ among conditions point toward lower extremity joint replacement and hip fracture as good candidates for conditions to include in a pilot. Our findings also suggest longer episode lengths as they

capture significantly more costs and readmissions but do not add as much to financial risk faced by providers.

The most useful pilot program would not only estimate the costs and benefits of bundled payments but also provide evidence on effects of alternative design features. Such evidence is not only of value to Medicare, but also to Medicaid and the private insurance market in promoting payment innovation across the health care system.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This research was supported by a grant (No. R01 AG031260) from the National Institute on Aging and a grant (No. R01 HS018541) from the Agency for Healthcare Research and Quality. The authors thank Mark Totten for his excellent research programming support.

References

1. Hackbarth G, Reischauer R, Mutti A. Collective accountability for medical care- toward bundled Medicare payments. *N Engl J Med*. 2008; 359(1):3–5. [PubMed: 18596270]
2. Medicare Payment Advisory Commission. Report to the Congress: Reforming the Delivery System. Washington, D.C.: Medpac; Jun. 2008 A path to bundled payment around a hospitalization.
3. U.S. Senate. 111th Congress 2nd Session. H.R. 3590, The Patient Protection and Affordable Care Act, S.3023. 2010.
4. Newhouse, JP. Pricing the priceless: a health care conundrum. Cambridge (MA): The MIT Press; 2002.
5. Kahn KL, Keeler EB, Sherwood MJ, Rogers WH, Draper D, Bentow SS, et al. Comparing outcomes of care before and after implementation of the DRG-based prospective payment system. *JAMA*. 1990 Oct 17; 264(15):1984–8. [PubMed: 2120477]
6. Sood N, Buntin MB, Escarce JJ. Does How Much and How You Pay Matter? Evidence from the Inpatient Rehabilitation Care Prospective Payment System. *J Health Econ*. 2008 Jul; 27(4):1046–59. [PubMed: 18423657]
7. McCall N, Korb J, Petersons A, Moore S. Reforming Medicare payment: early effects of the 1997 Balanced Budget Act on post-acute care. *The Milbank Quarterly*. 2003; 81(2):277–303. [PubMed: 12841051]
8. McCall N, Petersons A, Moore S, Korb J. Utilization of home health services before and after the Balanced Budget Act of 1997: what were the initial effects? *Health Serv Res*. 2003; 38(1):85–106. [PubMed: 12650382]
9. McKnight R. Home care reimbursement, long term care utilization, and health outcomes. *Journal of Public Economics*. 2004; 90:293–323.
10. Regulations on number of hours in therapy in a day and the mix of diagnoses in IRFs constrain this behavior.
11. Medicare Payment Advisory Commission. Post-acute care providers. Report to the Congress: Medicare Payment Policy. 2006
12. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med*. 2009; 360(14):1418–28. [PubMed: 19339721]
13. Mor V, Intrator O, Feng Z, Grabowski DC. The revolving door of rehospitalization from skilled nursing facilities. *Health Aff (Millwood)*. 2010; 29(1):57–64. [PubMed: 20048361]
14. Buntin MB, Deb P, Escarce J, Hoverman C, Paddock S, Sood N. Comparison of Medicare spending and outcomes for beneficiaries with lower extremity joint replacements. *Medpac Report*. 2005:WR-271.

15. Health Care Financing Administration. Medicare Participating Heart Bypass Center Demonstration. Sep.1998 Extramural Research Report.
16. Casale AS, Paulus RA, Selna MJ, Coll MC, Bothe AE, McKinely KE, et al. "ProvenCare": A provider-driven pay-for-performance program for acute episodic cardiac surgical care. *Ann Surg.* 2007; 246(4):613–23. [PubMed: 17893498]
17. Chernew ME, Mechanic RE, Landon BE, Safran DG. The private-payer innovation in Massachusetts: The 'Alternative Quality Contract'. *Health Aff (Millwood)*. 2011; 30(1):51–61. [PubMed: 21209437]
18. Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 2: health outcomes and satisfaction with care. *Ann Intern Med.* 2003 Feb; 138(4):288–98. [PubMed: 12585826]
19. Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 1: the content, quality, and accessibility of care. *Ann Intern Med.* 2003 Feb 18; 138(4):273–87. [PubMed: 12585825]
20. Romley JA, Jena A, Goldman D. Hospital Spending and Inpatient Mortality: Evidence from California. *Ann Intern Med.* 2011; 143(3):160–7. [PubMed: 21282695]
21. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. *Med Care.* 1998 Jan; 36(1):8–27. [PubMed: 9431328]

Exhibit 1.

Distribution of distinct post-acute provider referrals

Source: Medicare acute and post-acute claims data.

Notes: Unit of observation is acute care provider. Data come from Medicare 100 percent acute and post-acute claims for acute discharges in 2004. Figure includes acute discharges pooled across stroke, lower extremity joint replacement, hip fracture, congestive heart failure, and chronic obstructive pulmonary disease; and separately for hip fracture and stroke.

Exhibit 4.

Fraction of 90-day post-discharge costs and readmissions, and coefficient of variation in total costs, by post-discharge day

Source: Medicare and post-acute claims data, provider cost report data.

Notes: Data come from Medicare 100 percent acute and post-acute claims. Costs were calculated using cost-to-charge ratios from provider cost reports. Coefficients of variation calculated using within discharging acute-provider standard deviation in total costs and adjusted for patient characteristics.

Exhibit 2

Within-provider variation in spending across tracer conditions

Total costs (acute stay+ 30-day post-acute episodes)			
	Mean (standard deviation)	Average within-provider interquartile ratio	Coefficient of variation (using adjusted-within provider standard deviation)
Chronic obstructive pulmonary disease	9,442 (10,743)	2.57	1.03
Congestive heart failure	12,560 (16,121)	2.94	1.16
Stroke	14,610 (16,883)	3.12	0.96
Joint replacement	18,225 (9914)	1.47	0.42
Hip fracture	16,953 (12883)	1.96	0.63

Notes: Authors calculated measures using 100 percent Medicare acute and post-acute claims for acute discharges occurring in 2004, and the subsequent 30-day post-acute episode. Costs were calculated using cost-to-charge ratios from provider cost-reports. Coefficient of variation calculated using within provider standard deviation adjusting for patient demographics and comorbid conditions derived from acute care claims, as well as hospital fixed effects to adjust for differences in wages and practice patterns across hospitals. Specifically, we control for the list of comorbidities identified by Elixhauser et al.(21), complications including post-operative pulmonary compromise; post-operative gastrointestinal hemorrhage; cellulitis or decubitus ulcer; septicemia; pneumonia; mechanical complications due to a device, implant, or graft; shock or arrest in the hospital; post-operative myocardial infarction; post-operative cardiac abnormalities other than AMI; procedure-related perforation or laceration; venous thrombosis and pulmonary embolism; acute renal failure; miscellaneous complications; delirium, and dementia; hip fracture for non-hip fracture patients; stroke for non-stroke patients; and demographic information such as gender, age, and race.

Exhibit 3

Between acute provider variation in total episode costs and acute readmissions

	Fraction of adjusted variation between discharging acute providers	Interquartile range for provider fixed effects
<i>Total costs</i>		
Chronic obstructive pulmonary disease	0.34	3,432
Congestive heart failure	0.15	4,643
Stroke	0.20	6,091
Joint replacement	0.51	7,588
Hip fracture	0.35	7,498
<i>Acute readmissions</i>		
Chronic obstructive pulmonary disease	0.04	0.06
Congestive heart failure	0.06	0.09
Stroke	0.12	0.11
Joint replacement	0.10	0.06
Hip fracture	0.20	0.10

Notes: Authors calculated measures using 100 percent Medicare acute and post-acute claims for acute discharges occurring in 2004, and the subsequent 30-day post-acute episode. Costs were calculated using cost-to-charge ratios from provider cost-reports. Between provider variation and interquartile range for provider fixed effects adjusting for patient characteristics.