Published in final edited form as:

J Am Acad Orthop Surg. 2017 September ; 25(9): 654–663. doi:10.5435/JAAOS-D-16-00626.

Early Lessons on Bundled Payment at an Academic Medical Center

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Abstract

Introduction—Orthopedic care is shifting to alternative payment models. We examined whether NYU Langone Medical Center achieved savings under the CMS Bundled Payments for Care Improvement initiative.

Methods—Difference-in-differences study from April 2011–June 2012 and October 2013–December 2014 of Medicare fee-for-service patients hospitalized for lower extremity joint replacement, cardiac valve procedures or spinal surgery (intervention groups), or for congestive heart failure, major bowel procedure, medical peripheral vascular disorders, medical non-infectious orthopedic care, or stroke (control group). We examined total episode costs and cost categories.

Results—We included 2,940 intervention episodes and 1,474 control episodes. Relative to the trend in the control group, lower extremity joint replacement episodes achieved the greatest savings: adjusted average episode cost during the intervention period decreased by \$3,017 (95% CI, −\$6,066 to \$31). For cardiac procedures, the adjusted average episode cost decreased by \$2,999 (95% CI, −\$8,103 to \$2,105) and for spinal fusion, it increased by \$8,291 (95% CI, \$2,879 to \$13,703). Savings were driven predominantly by shifting post-discharge care from inpatient rehabilitation facilities to home. Spinal fusion index admission costs increased because of changes in operative technique.

Conclusion—Opportunities for savings under bundled payment may be greater for lower extremity joint replacement than other conditions.

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Conflicts of Interest:

The authors have no other conflicts of interest to disclose.

Keywords

Lower Extremity Joint Replacement; Spine Surgery; Health Reform; Health Spending; Health Services Research

INTRODUCTION

Healthcare is rapidly shifting to alternative payment models. In these models, providers take on greater financial risk for patients' healthcare expenditures. This shift is intended to incent providers to deliver more cost-effective, coordinated care. In 2015, the Department of Health and Human Services announced a goal of providing 30% of Medicare payments through alternative payment models by the end of 2016; this goal had already been met by March, 2016.^{1,2} One of the more common alternative payment models is bundled payment.¹ Bundled payment sets a fixed price for all services during a single episode of care.

In 2013, the Center for Medicare and Medicaid Innovation (CMMI) launched a voluntary bundled payment initiative, Bundled Payments for Care Improvement (BPCI).^{3,4} The initiative included 4 payment models for 48 clinical conditions, where each model bundled a different combination of acute and post-acute services. The most common clinical condition in which acute care hospitals enrolled to bear risk in BPCI was lower extremity joint replacement.⁵ On April 1, 2016, CMMI launched the first mandatory bundle payment program: Comprehensive Care for Joint Replacement (CJR). CJR applies to hospitals in 67 metropolitan statistical areas for lower extremity joint replacements (DRGs 469–470). The initiative bundles the index hospitalization and a 90-day period after discharge and includes both facility fees and professional services.⁶ Both BPCI and CJR are retrospective payment modalities. Medicare continues to pay for services in the traditional fee-for-service payment model, and later, the actual expenditures for the episode of care are reconciled against a target price to determine if there is a savings or loss. For BPCI, the target price is based on a fixed historical baseline from 2009–2012. In CJR, the historical baseline is updated every two years. In addition the composition of the baseline in CJR changes over time, shifting toward a greater proportion comprised of regional historical payments and a decreasing proportion based on the hospital's historical payments.^{3,6} Taking BPCI and CJR together, a large portion of orthopedic care is now under a bundled payment arrangement.

NYU Langone Medical Center (NYULMC) was an early entrant into bundled payment. In 2013, NYULMC started participation in BPCI for three conditions: lower extremity joint replacement, spinal fusion, and cardiac valve procedures. In this paper, we evaluate whether and how NYULMC was able to achieve cost savings under bundled payment by comparing costs overall and by service category before and after BPCI implementation, compared to a contemporaneous control group of conditions not included in the program.

METHODS

Intervention

NYULMC chose to participate in BPCI Model 2. This model allows participants to choose from 48 different clinical conditions, and bundles payments for the index hospitalization,

concurrent professional fees, and all services, including post-acute care and readmissions, delivered during a 30, 60, or 90-day period after discharge (episode length is selected by BPCI awardee). Providers continue to be paid traditional fee-for-service payments, and total episode spending is then reconciled retrospectively against a target price. The target price is set by CMS and is based on the provider's historic average episode cost, discounted 3% for 30- and 60-day episodes and 2% for 90-day episodes. Participants are eligible for any savings they achieve below the target price. Participants are required to pay CMS the difference if payments exceed the target price.³

In 2013, NYULMC joined BPCI Model 2 and took on financial risk for three conditions with episode lengths of 90-days. NYULMC selected conditions based on three criteria: sufficiently high volume, opportunity to reduce post-acute spending, and an opportunity to reduce readmission rates. Based on these criteria, the three conditions it selected were lower extremity joint replacement, spinal fusion except cervical, and cardiac valve procedures.

NYULMC invested in several initiatives to succeed in bundled payment.^{7,8} First, it created a bundled payment steering committee, consisting of department leaders, clinical champions, data analysts and administrative leaders. The committee's responsibilities included deciding how resources would be allocated, monitoring progress and challenges, and designing improvement strategies. Second, it created care pathways based on best practices to standardize care. Third, it formed pre-hospital, inpatient, and post-acute sub-committees to work on these phases of care for each condition. The sub-committees interfaced with IT and reporting teams to develop appropriate IT support for care strategies and patient progress monitoring, including robust analytic tools and frequently-updated dashboards. NYULMC also partnered with post-acute providers to standardize care, improve information exchange, and lower post-acute care costs while maintaining quality. Fourth, NYULMC provided gainsharing payments, positive financial incentives, to physicians who met quality of care targets and achieved financial savings among their patients participating in BPCI. Last, NYULMC deployed care management staff to coordinate care for patients across the episode of care.

Study Design and Data Sources

To evaluate the impact of the NYULMC interventions, we used a quasi-experimental, pre-post study design with a control group (difference-in-difference design) to determine the changes in average 90-day cost per episode between the baseline and risk periods. The unit of observation was a clinical episode.

The study used complete claims data provided by Medicare. Of note, Medicare did not provide data for the period from July 1, 2012 through December 31, 2012, and the hospital was closed from October 29 through December 27, 2012 because of superstorm Sandy. We divided the study period into two phases: (1) the baseline period in which we have data (April 1, 2011–June 30, 2012), and (2) the risk-bearing period (October 1, 2013–December 31, 2014), when cost incentives took effect.

The study was approved by the NYU Langone Medical Center Institutional Review Board, which granted a waiver of authorization and a waiver of informed consent.

Study Participants

The exposure group was comprised of Medicare fee for service patients who underwent a cardiac valve replacement (DRG 216–221, 266–267), major joint replacement of the lower extremity (DRG 469–470), or spinal fusion (DRG 459–460) at NYULMC during the study period. We selected control conditions from all 48 BPCI conditions based on having no exposure to the physicians or care teams treating the exposure group. The control conditions were congestive heart failure (DRG 291–293), major bowel procedure (DRG 329–331), medical peripheral vascular disorders (DRG 299–301), medical non-infectious orthopedic (DRG 537–538, 551–563), and stroke (DRG 61–66). The control group was comprised of Medicare fee for service patients who were hospitalized at NYULMC during the study period for one of these control conditions.

We adopted the same exclusion criteria as those of the BPCI model, which excluded patients enrolled in Medicare advantage plans, patients with end stage renal disease, patients who expired during the index hospitalization, patients not enrolled in both Parts A and B, and patients with Medicare as a secondary, not primary, payer at any time during the episode.

Study Variables

Our primary outcome was average 90-day episode expenditure. These expenditures were from the perspective of Medicare and did not take into account the actual costs or savings of NYULMC. We analyzed expenditure by service category. These categories included the index admission, post-acute facility, home health, readmission, and other (post discharge outpatient professional fees, durable medical equipment, inpatient psychiatric care, transfers to other hospitals, and hospice). All expenditures were in 2014 dollars based on a GDP deflator. We examined several secondary outcomes. We evaluated 90-day readmission and length of stay outcomes to assess for any adverse consequences of the BPCI implementation. We also evaluated post-acute facility length of stay to evaluate whether changes in costs in post-acute services were a result of changes in referral rates to post-acute care facilities or due to changes in the length of stay at the facilities. Last, we included the independent predictors of age, sex, and whether a clinical condition had major complications or comorbidity (as determined by a “major complication or comorbidity” principal diagnosis related group).

Statistical Analyses

We described episode characteristics for both the baseline period (April 2011–June 2012) and the risk-bearing period (October 2013–December 2014) using proportions for categorical data and mean and standard deviation for continuous data. We calculated average episode costs for each of the three at-risk conditions and as a weighted, combined set for the control conditions.

We used a difference-in-differences model to assess the change in average episode costs between baseline and risk-bearing periods. We estimated the model using generalized estimating equation methods that accounted for potential clustering among cases that shared the same surgeon or primary physician. To account for cost data which are highly skewed to

the right, the generalized linear model assumed a gamma distribution with an identity link. We generated estimates of standard errors using bootstrap methods.

For each of the three at-risk episode conditions and the combined control group, we estimated differences over time in average cost, along with 95% confidence intervals. We then estimated the primary outcomes, the difference-in-differences for the three at-risk episodes, by assessing the interaction of time and treatment group. The model controlled for age, sex, and major complications or comorbidity (as determined by a “major complication or comorbidity” principal diagnosis related group).

We conducted three additional analyses to place the intervention in context. We were interested in understanding how the services that composed each episode’s costs compared in the baseline and risk-bearing periods. First, we calculated the risk-standardized average expenditure for each service category (i.e. index admission, home health, post-acute facility, readmission, and other) in both the risk-bearing and baseline periods, and plotted the ratio of risk period to baseline period, along with 95% confidence bars estimated by bootstrap methods to provide a boundary of uncertainty. Second, we estimated risk-standardized 90-day readmission rates and index hospital length of stay for the three at-risk episode conditions and the combined control group for the baseline and risk-bearing periods. Third, we estimated post-acute facility length of stay, at both skilled nursing facilities and inpatient rehabilitation facilities, for the three at-risk episode conditions and for the combined control group in both periods. In all three analyses, we estimated risk-standardized values first by stratifying by complication status and then averaging across both complication groups using the risk period distribution of complication status.

RESULTS

In the baseline period, there were 1352 episodes in the exposure group and 669 in the control group. During the intervention period, there were 1588 episodes in the exposure group and 805 episodes in the control group. The demographic characteristics by episode type are described in Table 1.

Episode Cost Outcomes

During the intervention period, average episode costs decreased for major joint replacement of the lower extremity, remained unchanged for cardiac valve, and increased for spine fusion (Figure 1). For major lower extremity joint replacement, relative to the trend in the control group, the adjusted average episode cost during the intervention period decreased by \$3,017 (95% CI, −\$6,066 to \$31). For cardiac valve, relative to the trend in the control group, the adjusted average episode cost during the intervention period decreased non-significantly by \$2,999 (95% CI, −\$8,103 to \$2,105). For spinal fusion, relative to the trend in the control group, the adjusted average episode cost during the intervention period increased by \$8,291 (95% CI, \$2,879 to \$13,703) (Figure 1).

Compared to the baseline period, index hospitalization costs remained unchanged for all conditions except spinal fusion, which increased by \$4,178 (95% CI, \$2,202 to \$6,258). Post-acute facility costs decreased for major lower extremity joint replacement (−\$4,777, CI,

–\$5,802 to –\$3,821) and cardiac valve (–\$7,982, CI, –\$10,101 to –\$5,708), but they remained unchanged for spinal fusion (–\$619, CI, –\$3,040 to \$2,033) and the control group (–\$1,541, CI, –\$3,208 to \$144). Home health agency expenditures increased for all conditions in the exposure group and remained unchanged for the control group (Figure 2). Readmission expenditures remained unchanged for all conditions (Figure 2). Appendix Table 1 illustrates the cost associated with each service category, by condition, for the baseline and risk periods.

Utilization

Relative to the trend in the control group, 90-day readmission rates decreased by 4.6% (CI, –7.4% to –1.6%) for major lower extremity joint replacement, remained unchanged for cardiac valve (0.4%, CI, –6.8% to 7.6%), and remained unchanged for spinal fusion (2.6%, CI, –3.7% to 9.0%) (Figure 3).

The index hospitalization length of stay decreased across two conditions in the exposure group. For major lower extremity joint replacement episodes, the length of stay decreased from 5.3 to 4.4 days (CI for change, –1.1 to –0.7). For cardiac valve episodes, the length of stay decreased from 10.6 to 9.9 days (CI for change, –1.6 to 0.1). For spinal fusion episodes, the length of stay was unchanged, going from 5.6 to 5.5 days (CI for change, –0.5 to 0.3) (Supplemental exhibit 1).

Examining post-acute care facility use, the proportion of patients referred to inpatient rehabilitation facilities upon discharge decreased for major lower extremity joint replacement, cardiac valve, and spinal fusion, and remained unchanged for the control group. Among patient referred to an inpatient rehabilitation facility, between the baseline and intervention periods, the proportion with an MCC increased from 28% to 37% for the at-risk episodes and increased from 20% to 33% for the control conditions. The proportion of patients referred to skilled nursing facilities upon discharge remained unchanged or increased for the three at-risk episode conditions. For the control conditions, the proportion of patients referred to skilled nursing facilities decreased for those without complications and remained unchanged for those with complications. Length of stay at the inpatient rehabilitation facilities and skilled nursing facilities remained unchanged or increased between baseline and risk bearing period for the at-risk episode conditions. For the control group, length of stay at post-acute facilities remained unchanged (Appendix Table 2).

DISCUSSION

NYULMC succeeded at decreasing average episode Medicare spending for patients undergoing major lower joint replacement by approximately 16%, or \$3017 per episode. The evidence for cost reductions was not as strong for patients undergoing cardiac valve procedures, and costs increased for patients undergoing spinal fusion.

Across all service categories, the single category that achieved savings from the perspective of Medicare was post-acute facility-based spending. Savings in this category were achieved in cardiac valve replacement and major lower joint replacement. This finding is in keeping with work examining the variation in Medicare spending, in which the largest portion of

spending variation is found in post-acute care services.^{9,10} Because variation may indicate discretionary spending and therefore opportunity to reduce costs, it is not surprising that this was the single area that NYULMC and others have been able to achieve cost reductions.¹¹ We have previously shown that NYULMC markedly reduced the proportion of patients discharged to post-acute care facilities.^{8,12} In this study, we show that the change in post-acute spending was predominantly driven by reducing discharges to inpatient rehabilitation facilities, and not by reducing discharges to skilled nursing facilities or shortening post-acute facility length of stay. Among patients discharged to an inpatient rehabilitation facility, the proportion of patients with an MCC increased between the baseline and intervention periods. This finding suggests that the substantial decrease in the number of patients discharged to inpatient rehabilitation was largely among less acutely ill patients, increasing the average severity of illness among the patients who were still discharged to inpatient rehabilitation in the risk-bearing period. At the same time, home health expenditures did increase across conditions, suggesting that NYULMC shifted some post-acute care to home health services.

It is important to note that our study investigates costs and savings from the perspective of Medicare. Under the terms of BPCI, Medicare takes a 2–3% discount off of baseline expenditures and then shares 100% of the achieved savings relative to target with the participating entity. Our paper focuses on changes in costs to Medicare under BPCI. Program costs and actual hospital costs incurred by NYULMC are not considered. We therefore do not know whether the hospital itself saved money.

Our results were strongest for lower extremity joint replacement procedures, in which substantial changes in post-acute facility use resulted in large cost decreases. We observed similar significant cost decreases in post-acute care facility use for patients undergoing cardiac valve procedures; however, statistically significant Medicare savings were not achieved for the condition overall. The lack of overall savings to Medicare was not explained by a rise costs in other areas, as there were no observed changes in costs for other service categories. Instead, in the cardiac valve procedures, post-acute care accounted for a smaller portion of the total episode cost than it did in lower extremity joint replacement procedures and therefore had less impact on overall spending. Given that post-acute care is an area that providers can influence, the relative distribution of costs for each episode is likely an important predictor of how likely one is to achieve savings under bundled payment. Although NYULMC achieved savings in post-acute care in lower extremity joint replacement and cardiac valve procedures, such savings were not seen in spinal fusion. There is substantial variation nationally in post-acute care for spine surgery, indicating the potential for discretionary spending in post-acute care for this condition is similar to that for joint replacement and cardiac valve surgery.¹² However, at NYULMC the decrease in the rate of discharges to post-acute care facilities was smallest for patients undergoing spine surgery. Spine patients had the lowest rate of post discharged facility based care in the baseline leave less opportunity for improvement. The minimal change may also be partially be explained by changes in patient case mix and surgical practice during the study. During the risk-bearing period, NYULMC experienced a change in patient referral patterns, resulting in a higher rate of complex revision surgeries than were conducted during the baseline period. In addition, NYULMC also began conducting more transforaminal lumbar interbody fusion (TLIF) procedures. Compared with the traditional posterior lumbar fusion

(PLF), the TLIF (interbody fusion) is added to improve fusion rates¹³ and improve spinal alignment. The TLIF, however, often increases surgical time, morbidity, and cost of the procedure. Further, these changes may have resulted in longer recovery periods, creating additional barriers for discharging patients to home.

NYULMC's inability to reduce Medicare costs in the spinal fusion condition highlights the fact that the CMMI bundled payment initiative does not account for changes and innovations in medical care. Medical innovations may increase the costs of care in absolute terms, but if they may improve patient outcomes, they may in fact be cost effective. As currently structured, the BPCI initiative negatively incentivizes providers from implementing such innovations since the provider would bear the difference in cost of the new innovation compared to traditional care if the DRG payment remains constant. To remain effective, the BPCI initiative will need to monitor for and adapt to innovations in medical care.

Our findings were very reassuring in examining other potential unintended consequences of bundled payment. For example, despite reduction in facility-based post-acute spending in cardiac valve and major lower joint replacement, there was no corresponding increase in readmission rates. In fact, 90-day readmission rates remained unchanged in cardiac valve and dropped 4.6% for major lower joint replacement. This is in keeping with our earlier work examining 30-day readmissions.¹² While our study does not investigate the causes of this reduction in readmission, there are a number of possible reasons for this finding. For one, post-acute care facilities may be associated with higher rates of readmission than patients discharged to home. Therefore, shifting patients from post-acute care facilities to home could lead to a reduction in readmissions. A second possible cause is the provision of more care coordination services. Patients in the BPCI initiative at NYULMC received more robust telephonic care coordination services upon discharge than patients in the control group.

Not only was reducing facility-based post-acute spending not associated with an increase in readmissions, it was also not associated with an increase in length of stay for the index hospitalization. Length of stay decreased or remained unchanged across all conditions, as has been the case at other institutions.¹⁴ This finding may provide reassurance to providers that shifting post-acute care to lower cost settings does not impact upstream costs or patient outcomes.

Our study has important strengths. Prior analyses have largely been limited to single conditions, have lacked control groups, or have included only 3 months of follow up.^{4,11,16,17} By including control conditions, we can account for secular trends in healthcare costs, which have been important in the Affordable Care Act era. By including multiple conditions, we were able to identify important differences in outcomes among conditions, even though our institution conducted an integrated intervention. And our 15 months of follow up are an important indicator of sustainability.

Nonetheless, our study includes some limitations. First, institutional initiatives related to bundled payments may have affected non-bundled conditions: a conservative bias that would mitigate any apparent effect of the bundles. To minimize contamination, we excluded

conditions from the control group that shared the same group of physicians and care teams as the exposure groups. Second, however, these efforts to minimize contamination produced differences between our exposure group and our control group. While the exposure group was comprised of surgical or procedural conditions, the control group was largely non-surgical. The difference-in-difference model is based on the assumption in that the trend in average costs (not necessarily the absolute costs) would be the same for control and at-risk episodes over time in the absence of any intervention. While the differences in composition between groups might have resulted in different trends in cost, we compared the pre-intervention trends in expenditures for both groups, and the trends were similar. We therefore have confidence that our control groups were appropriate. Third, we may have had inadequate sample size to measure an effect. This may have particularly impacted the cardiac valve bundle, in which we observed a non-statistically significant decrease in costs over time. Last, we did not measure quality of life or functional status of the participants in the study. To understand the full impact of the bundled payment program, it would be important to include such measures in addition to expenditures.

Our study found largely positive effects of bundled payment at NYULMC. It reduced total episode costs in patients undergoing lower extremity joint replacement and reduced post-acute spending in patients undergoing lower extremity joint replacement and cardiac valve surgery. These cost reductions were not associated with any increase in hospital length of stay or readmission. One area where bundled payment may have an adverse effect is on adoption of newer technologies. If a new technology is developed that is costly and for which the improvement in outcomes is not manifested for several years, then a bundled care provider may be disincented from adopting this innovation. Despite this potential unintended consequence, our findings suggest that bundled payment may be an effective way of lower health care costs across an episode of care without impacting quality, and in particular, for lower extremity joint replacement.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

No funding source had any role in the study design; in the collection, analysis, and interpretation of data; or in the writing of the report. CMS approved the submission of the manuscript for publication. The statements contained in this document are solely those of the authors and do not necessarily reflect the views or policies of CMS or of the Agency for Healthcare Research and Quality. The authors assume responsibility for the accuracy and completeness of the information contained in this document.

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Figure 1. Average episode expenditures by period

SOURCE: Authors' analysis of Medicare claims data from April 1, 2011–June 30, 2012 (baseline period) and October 1, 2013–December 31, 2014 (risk-bearing period). NOTES: The figure shows mean episode costs for each condition during three different time periods. The Pre-baseline period (July 2009 through March 2011) is included to show the general trend before the start of the risk period. Baseline period is April 2011 through June 2012. Risk period is October 2013 through December 2014. All averages are adjusted to reflect changes in the proportion of cases with complications.

Figure 2. Ratio of risk period to baseline episode costs

SOURCE: Authors' analysis of Medicare claims data from April 1, 2011–June 30, 2012

(baseline period) and October 1, 2013–December 31, 2014 (risk-bearing period). NOTES:

The estimated ratios for each expenditure category and condition are based on average expenditures in each time period, adjusted for different distribution of complication status.

The control condition estimates were further adjusted to account for changes in the mix of types reflected in the group. The “Other” expenditure category includes post discharge outpatient professional, durable medical equipment, inpatient psychiatric care, transfers to other hospitals, and hospice expenditures.

Figure 3. 90-day all cause readmission rates by condition and average length of stay during index admission

SOURCE: Authors' analysis of Medicare claims data from April 1, 2011–June 30, 2012 (baseline period) and October 1, 2013–December 31, 2014 (risk-bearing period). NOTES: The figure shows all cause readmission rates for each condition during three different time periods. The pre-baseline period (July 2009 through March 2011) is included to show the general trend before the start of the risk period. Baseline period is April 2011 through June 2012. Risk period is October 2013 through December 2014. All averages are adjusted to reflect changes in the proportion of cases with complications.

Table 1

Characteristics of Bundled Payment Episodes by Type

Characteristics	Baseline Period	Risk-Bearing Period
Major lower joint replacement, No.	805	1021
Female, No. (%)	538 (67)	669 (66)
Age, mean (SD), y	73.9 (8.6)	72.6 (8.5)
DRG with MCC, No. (%)	48 (6)	35 (3)
Cardiac valve, No.	297	338
Female, No. (%)	153 (52)	154 (46)
Age, mean (SD), y	77.3 (8.1)	77.4 (8.3)
DRG with MCC, No. (%)	207 (70)	171 (51)
Spinal fusion, No.	250	229
Female, No. (%)	139 (56)	134 (59)
Age, mean (SD), y	72.4 (9.1)	71.1 (9.4)
DRG with MCC, No. (%)	12 (5)	15 (7)
Control, No.	669	805
Female, No. (%)	390 (58)	430 (53)
Age, mean (SD), y	80 (10.2)	79.5 (10.8)
DRG with MCC, No. (%)	122 (18)	205 (26)
Episode types		
<i>Congestive heart failure</i>	169 (25)	378 (47)
<i>Major bowel procedure</i>	142 (21)	138 (17)
<i>Medical non-infectious orthopedic</i>	157 (23)	115 (14)
<i>Medical peripheral vascular disorders</i>	71 (11)	48 (6)
<i>Stroke</i>	130 (19)	126 (16)

Abbreviations: DRG, diagnosis related group; MCC, major complication or comorbidity.

Table 2

Estimated Difference-in-Differences (in thousands of dollars)

Condition	Baseline		Risk-Bearing		Difference		Diff-in-Diff	
	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted
Major lower joint replacement	35.2	35.7	28.7	29.9	-6.6	-5.8 (-7.0, -4.5)	-5.0	-3.0 (-6.1, 0.0)
Cardiac Valve	60.2	60.1	54.6	54.3	-5.6	-5.8 (-10.0, -1.5)	-4.0	-3.0 (-8.1, 2.1)
Spinal fusion	48.4	49.6	53.8	55.1	5.4	5.5 (0.9, 10.1)	6.9	8.3 (2.9, 13.0)
Control *	28.1	28.3	26.5	25.5	-1.6	-2.8 (-5.6, 0.0)	-	-

* Control group includes 5 conditions