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Impact of Surgical Quality Improvement on Payments in Medicare Patients

Christopher P. Scally, MD¹, Jyothi R. Thumma, MPH¹, John D. Birkmeyer, MD¹, and Justin B. Dimick, MD, MPH¹

¹University of Michigan, Department of Surgery, Center for Healthcare Outcomes and Policy Ann Arbor, MI

Abstract

Objective—To examine the financial impact of quality improvement using Medicare payment data.

Background—Demonstrating a business case for quality improvement – i.e. that fewer complications translates into lower costs – is essential to justify investment in quality improvement. Prior research is limited to cross-sectional studies showing that patients with complications have higher costs. We designed a study to better evaluate the relationship between payments and complications by using quality improvement itself as a measured outcome.

Methods—We used national Medicare data for patients undergoing general (n= 1,485,667) and vascular (n= 531,951) procedures. We calculated hospitals' rates of serious complications in two time periods: 2003-2004 and 2009-2010. We sorted hospitals into quintiles by the change in complication rates across these time periods. Costs were assessed using price-standardized Medicare payments, and regression analyses used to determine the average change in payments over time.

Results—There was significant change in serious complication rates across the two time periods. The top 20% of hospitals demonstrated a 38% decrease (14.3% vs. 11.6%, p<.001) in complications; in contrast the bottom 20% demonstrated a 25% increase (11.1% vs. 16.5%, p<.001). There was a strong relationship between quality improvement and payments. The top hospitals reduced their payments by \$1544 per patient (95% CI, \$1334-1755), whereas the bottom of hospitals had no significant change (average \$67 increase, 95% CI, -\$123 to \$258).

Conclusions—Hospitals that reduced their complications over time had significant reductions in Medicare payments. This demonstrates that payers are clearly incentivized to invest in quality improvement.

Introduction

Improving the quality of surgical care is a major goal for all stakeholders in healthcare. Recently, both the Center for Medicare and Medicaid Services (CMS) and private payers

have instituted numerous payment reforms aimed at providing incentives for quality improvement, including pay-for-performance and value based purchasing.¹⁻³ The assumption underlying these incentive programs is that the cost savings to CMS and insurers from improved performance will outweigh the expense of these programs themselves. Additionally, other stakeholders, for example professional societies such as the American College of Surgeons have also instituted programs for outcomes reporting and feedback systems, most notably the National Surgical Quality Improvement Program (NSQIP).⁴ In this era of healthcare reform, there is increasing hope that these programs, which focus on improving outcomes, can simultaneously reduce payers' expenses and thus reduce the overall costs of healthcare delivery.

Whether this hope is well-founded – i.e. whether a “business case” for surgical quality improvement exists – still remains uncertain. Previous studies have demonstrated that hospitals with low complication rates also have lower average payments.^{5, 6} Many criticize these studies, as they demonstrate only an association, but not causation, between payments and quality. It is possible that other factors at higher quality hospitals simultaneously drive both high-level performance and cost consciousness. While this existing research suggests a relationship, none of these studies have directly assessed and quantified the impact of quality improvement itself on hospital or payer costs over time.

In this context, we sought to identify hospitals that have demonstrated significant improvements in quality over time, and then determine whether these hospitals similarly demonstrated reduced Medicare payments. Studying the relationship between quality and cost over time will provide more direct evidence and strengthen casual inference. Quantifying the reduction in average payments may provide justification for payers to support the tremendous financial investment required for large-scale surgical quality improvement initiatives.

Methods

Data Source and Study Population

This study used complete inpatient Medicare claims data for patients undergoing select general and vascular surgery procedures during 2003-2004 and 2009-2010. Patients who were less than 65 years of age or over 99 years, as well as patients not enrolled in both Medicare parts A and B, were excluded from the study, as has been previously described by our group.⁷ Patients undergoing 11 general and vascular surgery procedures were identified from the inpatient file using the appropriate procedure codes from the *International Classification of Diseases*, version 9 (ICD-9). These eleven procedures were selected as they represent both common and relatively morbid operations (**Table 1**). Within the vascular surgery subgroup, patients undergoing emergent operation for rupture or dissection, and patients undergoing thoracic aneurysm repair were excluded.

Outcome Measures

Quality Improvement—Hospital quality was assessed in terms of change in serious complication rate over the two time periods. Complications were identified using a subset of

8 complications from the *Complication Screening Project* by Iezzoni et al,⁸ which have been previously validated,⁵ demonstrating appropriate sensitivity and specificity for surgical conditions. These include pulmonary failure, pneumonia, myocardial infarction, deep venous thrombosis or embolism, acute renal failure, postoperative hemorrhage, surgical site infection, and gastrointestinal bleeding. Within this group of complications, serious complications were defined as the presence of one or more of the 8 complications and a length of stay greater than the 75th percentile for the specific procedure performed. The length of stay criterion was used in order to add clinical face validity – i.e. to identify complications serious enough to have meaningful clinical impact.

Medicare Payments—Medicare payment data, rather than submitted charges, was extracted for all inpatient services from the date of the index procedure (or hospital admission prior to the procedure) to 30 days post-hospital discharge. Diagnosis Related Group (DRG) payments, outlier payments, and payments for readmission were included to calculate a total inpatient hospital payment for the care episode. Post-discharge services such as home health, skilled nursing facility, and outpatient care were not included in this analysis. Payments were adjusted for time across our two study periods. Payments were also price-standardized, to account for regional differences in Medicare payment rates, using established methods described in the *Dartmouth Atlas of Healthcare* and elsewhere.⁹

Statistical Analysis

The goal of our analysis was to assess the impact of improvement in quality (defined by a change in serious complication rates) on Medicare payments. We conducted this analysis by first assessing the change in serious complication rates between the two time periods (03-04 and 09-10). Case-mix adjustment was performed using multiple linear regression to account for variations in patients' age, sex, race, and acuity. Further, individual comorbidities were adjusted for using the codes developed by Elixhauser.¹⁰ Reliability adjustment was also performed using hierarchical modeling, in order to minimize the effect of chance variation among smaller hospitals and place greater emphasis on the more reliable results from larger volume hospitals.^{11, 12} Because overall rates of coding of complications have increased across these two time periods,¹³ we adjusted for so called coding creep by including a time variable in our modeling.

After these adjustments were made, the hospitals were then ranked and sorted into quintiles using the change in their adjusted complication rates over the two time periods. We then created multivariate linear regression models, with total Medicare payments as the dependent variable. We entered our quintiles into this model and assessed the relationship between quintile performance improvement and 30-day inpatient Medicare payments. All statistical analyses were conducted using STATA, version 13.0 (Statacorp).

Results

Patient Characteristics

Medicare claims data was obtained from 1,485,667 general surgery patients and 531,951 vascular surgery patients undergoing inpatient procedures. Patient characteristics are shown

in **Table 1**. The patient composition was very similar across the two time periods, however there were small differences in patient race, age, minority status, and comorbidities that achieved statistical significance due to the extremely large sample size.

Evaluation of Quality Improvement

In comparing the serious complication rates across the two time periods, there was significant variation among the quintiles. For all operation types, the serious complication rate at the top 20% of hospitals improved from 14.27% in 2003-04 to 10.38% in 2009-10. By comparison, the bottom 20% actually started with a lower complication rate in 2003-04 (11.14%), but this worsened to 14.95% in 2009-10. The changes in complication rates for each quintile are shown in **Table 2**. Changes in complication rates were similar for both general surgery and vascular procedures. (**Table 2**)

Evaluation of Payments

When comparing Medicare payments across these groups, the top quintile of hospitals had a substantial reduction in their payments in 2009-10 as compared to 2003-04 (average reduction of \$1544, 95% confidence interval \$1333 to 1754). The middle quintiles also demonstrated reductions in payments, and the bottom quintile had no change in their overall payments (average increase of \$67, 95% CI \$-123 to +258). (**Figure 1**) When considering general surgery procedures alone, the bottom quintile actually had an increase in average Medicare payments (average increase of \$567, 95% CI \$351-784). (**Table 3**)

Discussion

Our findings support a relationship between surgical quality improvement and reduced payments. The group of hospitals with the greatest improvement in complication rates over time demonstrated significantly reduced Medicare payments, compared to hospitals with no improvement, who had no significant change in their payments, and actually had increased payments for certain procedure types. A second important finding was that many hospitals did not improve their complication rates or actually worsened over time. This demonstrates the difficulty in improving healthcare, with a minority of hospitals achieving any meaningful degree of quality improvement over this eight-year period.

Although it may seem intuitive that complication rates and costs are closely correlated, to date the research to support this has been limited. Administrative data has been used previously to estimate the cost to payers of specific complications,⁶ and then actuarial projections applied to estimate the financial impact of quality improvement. Previous work within our group has shown that the relationship between higher quality hospitals and reduced payments exists across a variety of procedures.^{5, 14} By focusing on only one point in time, these studies rely on the assumption that the observed lower complication rates are directly causing the reduced payments.

However, alternate mechanisms may be in place at these higher quality hospitals that contribute to these “savings” – a more efficient, cost-conscious hospital culture, improved post-discharge services and coordination of care to reduce costly readmissions, and other unmeasured factors. This tendency toward efficiency at high quality hospitals may be the

driving factor in their lower overall payments, irrespective of their complication rates. This is a potential confounding variable that is unmeasured in previous studies. In this regard, our study goes above and beyond prior research by using quality improvement itself as a measured outcome across two time periods. Demonstrating a temporal association rather than a cross-sectional one, our study more directly evaluates the relationship between complication rates and payments. These findings supply stronger evidence to support the “business case” for quality improvement.

Our study has several limitations. The first is its use of administrative claims data, and the inherent limitations in coding as well as in adjusting for patient risk factors.^{5, 8} We utilized the best available measures of risk adjustment for administrative data,¹⁰ but there remains a potential for confounding from unmeasured patient characteristics. To minimize the limitations in administrative coding of postoperative complications, we limited our assessment to a subset of more serious complications that impacted length of stay. Further, for case mix to confound our temporal analysis, there would have to be substantial changes in hospital-level case mix between the two study periods. Any random differences in case mix over time would bias our findings toward a null effect. In addition to these limitations of administrative data, the use of Medicare data limits our study population to patients over 65 years of age and may limit the generalizability of our findings. However, for the procedure mix chosen for this study, more than two thirds of all patients and the most high-risk patients are under Medicare coverage. The CMS institution of non-repayment in 2008 for so called “never events”, or hospital acquired conditions, is another potential confounder. However, the cases considered for inclusion in our analysis were not among those initially selected for non-reimbursement; and our complication profile from the CSP does not include these hospital-acquired conditions. Another limitation is the phenomenon of code creep,¹³ which may affect the overall rates of coding of complications between the two study time periods. We attempted to minimize this effect of by including an adjustment factor for overall rate of coding of complications in our model.

These findings have significant implications for both practice and policy. Given that our study was designed to view quality improvement from the payer perspective, these findings have the most direct implications for CMS and other healthcare payers. Clearly, quality improvement reduces the overall Medicare payments and has potential for significant healthcare savings, supporting the business case for quality improvement from the payers’ perspective. Payers are increasingly investing in collaborative programs and delivery system innovations to help improve care for high-risk patient populations. There is evidence that these payer-sponsored regional collaboratives have great potential to improve the quality of surgical care.³ However, these large-scale programs require an investment of capital both for measurement infrastructure as well as implementation. For example, Blue Cross/Blue Shield of Michigan has invested heavily in a series of 12 quality improvement collaboratives, with an estimated cost per year to the payer of \$3-5 million for each of these initiatives.³ This study demonstrates the potential for significant return on investment, which is critical in order to incentivize payers to continue supporting these promising collaborative initiatives.

The implications of our study for providers and hospitals are perhaps more controversial. With CMS' prospective payment models, postoperative complications may allow hospitals to qualify for higher levels of reimbursement through upcoding of DRGs, or shifting patients to an outlier mechanism and increase their total Medicare payments. Our data suggests that reducing your complications may in turn reduce those payments, and therefore the hospital's revenue. This is consistent with prior work, demonstrating a paradoxical relationship in which hospitals themselves may not have a business case to support quality improvement.^{15, 16} Providers of course are motivated to improve outcomes irrespective of costs, however when doing the right thing costs money it is increasingly difficult to invest already-limited resources into effective quality improvement efforts. Moreover, quality improvement itself is expensive, requiring both cost and resource investment. It has been estimated that participating in a clinical registry to track patient outcomes such as NSQIP costs hospitals as much as \$135,000 per year.¹⁷ A prior single institution study has estimated that the incremental cost per patient of participation in NSQIP is approximately \$832 during the start-up period; and it may cost as much as \$25,471 to avoid a single postoperative event.¹⁸ The additional resources that go above and beyond measurement are largely unknown, but clearly substantial.

Current policy initiatives, however, may be increasingly shifting financial risk to providers – penalizing for readmissions, non-payment for so-called “never” events such as surgical site infections, bundled payments, and the institution of fully global payment models such as accountable care organizations. As these mechanisms shift both financial risk and mechanisms for sharing in payers' savings onto providers, the incentives for improving quality are increasingly aligned between payers and providers. Our data demonstrate the potential financial benefits for payers, and may aid in efforts to incentivize payers to participate and fund quality improvement initiatives. Further, in the evolving policy environment as financial risk is shifted onto providers, the potential for cost savings may be relevant to hospitals and providers as well as payers. As this shift from a strictly fee for service environment to a future where both payers and providers are aligned in their financial incentives continues, our data demonstrate that there is a growing business case for quality improvement.

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References

1. Rosenthal MB, Frank RG, Li Z, et al. Early experience with pay-for-performance: from concept to practice. *JAMA*. 2005; 294:1788–93. [PubMed: 16219882]
2. Birkmeyer JD, Dimick JB. Potential benefits of the new Leapfrog standards: effect of process and outcomes measures. *Surgery*. 2004; 135:569–75. [PubMed: 15179361]

3. Share DA, Campbell DA, Birkmeyer N, et al. How a regional collaborative of hospitals and physicians in Michigan cut costs and improved the quality of care. *Health Aff (Millwood)*. 2011; 30:636–45. [PubMed: 21471484]
4. Fink AS, Campbell DA Jr, Mentzer RM Jr, et al. The National Surgical Quality Improvement Program in non-veterans administration hospitals: initial demonstration of feasibility. *Ann Surg*. 2002; 236:344–53. discussion 353–4. [PubMed: 12192321]
5. Birkmeyer JD, Gust C, Dimick JB, et al. Hospital quality and the cost of inpatient surgery in the United States. *Ann Surg*. 2012; 255:1–5. [PubMed: 22156928]
6. Dimick JB, Chen SL, Taheri PA, et al. Hospital costs associated with surgical complications: a report from the private-sector National Surgical Quality Improvement Program. *J Am Coll Surg*. 2004; 199:531–7. [PubMed: 15454134]
7. Birkmeyer JD, Gust C, Baser O, et al. Medicare payments for common inpatient procedures: implications for episode-based payment bundling. *Health Serv Res*. 2010; 45:1783–95. [PubMed: 20698899]
8. Iezzoni LI, Daley J, Heeren T, et al. Identifying complications of care using administrative data. *Med Care*. 1994; 32:700–15. [PubMed: 8028405]
9. Gottlieb DJ, Zhou W, Song Y, et al. Prices don't drive regional Medicare spending variations. *Health Aff (Millwood)*. 2010; 29:537–43. [PubMed: 20110290]
10. Elixhauser A, Steiner C, Harris DR, et al. Comorbidity measures for use with administrative data. *Med Care*. 1998; 36:8–27. [PubMed: 9431328]
11. Dimick JB, Staiger DO, Birkmeyer JD. Ranking hospitals on surgical mortality: the importance of reliability adjustment. *Health Serv Res*. 2010; 45:1614–29. [PubMed: 20722747]
12. Miller DC, Gust C, Dimick JB, et al. Large variations in Medicare payments for surgery highlight savings potential from bundled payment programs. *Health Aff (Millwood)*. 2011; 30:2107–15. [PubMed: 22068403]
13. Seiber EE. Physician code creep: evidence in Medicaid and State Employee Health Insurance billing. *Health Care Financ Rev*. 2007; 28:83–93. [PubMed: 17722753]
14. Englesbe MJ, Dimick JB, Fan Z, et al. Case mix, quality and high-cost kidney transplant patients. *Am J Transplant*. 2009; 9:1108–14. [PubMed: 19422336]
15. Krupka DC, Sandberg WS, Weeks WB. The impact on hospitals of reducing surgical complications suggests many will need shared savings programs with payers. *Health Aff (Millwood)*. 2012; 31:2571–8. [PubMed: 23077139]
16. Eappen S, Lane BH, Rosenberg B, et al. Relationship between occurrence of surgical complications and hospital finances. *JAMA*. 2013; 309:1599–606. [PubMed: 23592104]
17. Hammermeister K. The National Surgical Quality Improvement Program: learning from the past and moving to the future. *Am J Surg*. 2009; 198:S69–73. [PubMed: 19874938]
18. Hollenbeak CS, Boltz MM, Wang L, et al. Cost-effectiveness of the National Surgical Quality Improvement Program. *Ann Surg*. 2011; 254:619–24. [PubMed: 22039608]

Figure 1.
Average Change in Medicare Payments for all procedure types between 2003-2004 and 2009-2010 for each Hospital Quintile of quality improvement

Table 1

Characteristics of Patients within the two study time periods, 2003-2004 and 2009-2010

	2003-2004	2009-2010
<i>Patient Characteristics</i>		
Median age	73.1	72.6
Gender (% male)	47.4%	48.9%
Black Race	13%	14.3%
Obesity	3.8%	6.5%
<i>Presence of Comorbidities</i>		
No (0) comorbidities	11.9%	10.0%
1-3	75.3%	77.0%
>3	12.8%	12.9%
<i>Most Common Comorbidities</i>		
Congestive Heart Failure	11.4%	7.5%
Diabetes	20.9%	22.1%
Hypertension	53.7%	56.7%
Peripheral Vascular Disease	10.2%	10.9%
Pulmonary Disease	20.9%	16.9%
<i>General Procedure</i>		
Cholecystectomy	27.2%	25.2%
Colon Resection	23.6%	23.1%
Incisional Hernia Repair	12.6%	13.9%
Appendectomy	6.5%	6.9%
Gastrectomy	2.0%	2.0%
Pancreatic Resection	0.6%	1.0%
Liver Resection	0.6%	0.9%
Esophagectomy	0.7%	0.7%
<i>Vascular Procedure</i>		
Abdominal Aortic Aneurysm Repair	5.2%	5.8%
Lower Extremity Bypass	9.5%	7.3%
Carotid Endarterectomy	6.5%	6.9%

Table 2

Change in serious complication rates between 2003-2004 and 2009-2010 within each Hospital Quintile of quality improvement, subdivided by General Surgery and Vascular Surgery Procedures

Quintile of Quality Improvement	Risk Adjusted Serious Complication Rate (%)	
	2003-2004	2009-2010
<i>All Procedures</i>		
<i>Overall</i>	<i>12.01</i>	<i>12.05</i>
1 (Top 20%)	14.27	10.38
2	12.15	10.84
3	11.45	11.42
4	10.95	12.27
5 (Bottom 20%)	11.14	14.95
<i>General Surgery Procedures</i>		
<i>Overall</i>	<i>11.99</i>	<i>12.09</i>
1	14.29	11.58
2	12.16	12.13
3	11.43	12.7
4	10.87	13.63
5	10.29	16.44
<i>Vascular Surgery Procedures</i>		
<i>Overall</i>	<i>12.06</i>	<i>11.94</i>
1	14.23	11.44
2	12.13	11.82
3	11.53	12.64
4	11.14	13.57
5	11.37	16.6

Table 3

Adjusted Medicare Payments in each time period, as well as regression analysis of payment change across 2003-2004 and 2009-2010 for each Hospital Quintile of quality improvement, subdivided by procedure type.

Quintile of Quality Improvement	Average Medicare Payments (\$)		Regression Model: Estimated Change in Payments (\$)
	2003-2004	2009-2010	
<i>All Procedures</i>			
1 (Top 20%)	\$16334	\$14629	-\$1544
2	\$15820	\$14698	-\$1147
3	\$15333	\$14708	-\$763
4	\$15567	\$15311	-\$535
5 (Bottom 20%)	\$15591	\$16319	\$67
<i>General Surgery Procedures</i>			
1	\$16681	\$15420	-\$1264
2	\$16321	\$15637	-\$864
3	\$15763	\$15567	-\$454
4	\$15929	\$16266	-\$102
5	\$15973	\$17354	\$567
<i>Vascular Surgery Procedures</i>			
1	\$15256	\$12429	-\$2357
2	\$14501	\$12288	-\$1892
3	\$14089	\$12222	-\$1678
4	\$14579	\$12694	-\$1716
5	\$14553	\$13262	-\$1350