

Coronary artery bypass grafting bundled payment proposal will have significant financial impact on hospitals



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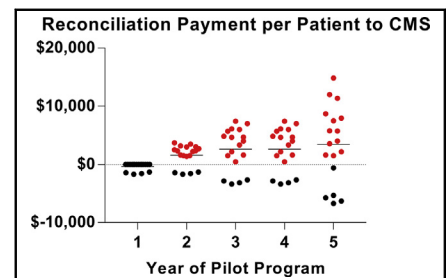
ABSTRACT

Objectives: The Centers for Medicare and Medicaid Services plans to institute a 5-year trial of bundled payments for coronary artery bypass grafting through 90 days after discharge. To investigate the impact, we reviewed actual inpatient costs for patients undergoing bypass surgery relative to the target price.

Methods: A total of 13,276 Medicare patients with estimated cost data underwent isolated coronary artery bypass grafting from 2008 to 2015 in 18 hospitals over 8 Medicare-defined regions within the Commonwealth of Virginia. Actual 2015 inpatient costs were compared with estimated target prices for each year of the pilot, based on the previous 3 years and stratified by Diagnosis-Related Group.

Results: The mean 2015 cost per patient was \$50,394 with high variation (range, \$27,862-\$74,169). On average, hospitals would receive a refund of \$17,682 in year 1, but then owe Medicare increasing amounts up to \$367,985 in year 5. If 2015 were the final year of the pilot, 13 of the 18 hospitals (72%) would have owed Medicare for cost overruns averaging \$614,270 (range, \$67,404-\$2,102,292). Costs were below the target price at 5 of 18 hospitals, and the Centers for Medicare and Medicaid Services would have paid them an extra \$272,355 on average (range, \$88,628-\$567,429).

Conclusions: Hospitals will face immediate financial pressure due to average cost increases of 3.6% per year and an automatic reduction in payment. As regional pricing is phased in, hospitals can expect to owe Medicare increasing amounts. The net effect is shifting of financial risks to hospitals, which could restrict access to care for higher-risk patients. (*J Thorac Cardiovasc Surg* 2018;155:182-8)



The mean CMS repayment per patient; positive red numbers indicate money owed to CMS.

Central Message

The bundled payment plan shifts financial risk to hospitals, possibly affecting access to care and hindering quality.

Perspective

The proposed bundled payment plan for isolated CABG will further shift financial responsibility to hospitals. The increased financial pressure has the potential to affect quality and access to care, making it paramount that administrators work with clinicians and researchers to ensure adequate risk adjustment, quality incentives, and guarantees for patient access.

See Editorial Commentary page 189.

The cost of health care in the United States of America has increased in an unsustainable manner for decades, is now a national burden at \$3.2 trillion per year, and is unaffordable for 53% of privately insured low-income individuals.¹⁻⁴

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The Virginia Cardiac Services Quality Initiative (VCSQI) has demonstrated that cardiac surgery has undergone similar cost increases, documented for both valve surgery and coronary artery bypass grafting (CABG).^{5,6} CABG is a prime target for cost reduction because it represents the largest cost expenditure of any single procedure.⁷ Efforts to contain cardiac surgery costs began with the establishment of the Centers for Medicare and Medicaid Services

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Abbreviations and Acronyms

CMS	= Centers for Medicare and Medicaid Services
CABG	= coronary artery bypass grafting
DRG	= Diagnosis-Related Group
MSA	= metropolitan statistical area
PROM	= predicted risk of mortality
PROMM	= predicted risk of morbidity or mortality
STS	= Society of Thoracic Surgeons
VCSQI	= Virginia Cardiac Services Quality Initiative

(CMS) Inpatient Prospective Payment System that bundled inpatient payments.^{8,9} Current efforts at payment reform began with passage of the Patient Protection and Accountable Care Act, which developed the Centers for Medicare and Medicaid Innovation under CMS in 2010.¹⁰ This has been accelerated with the recent passage of Medicare Access and CHIP Reauthorization Act of 2015 that addresses physician payments.

On July 25, 2016, the CMS issued a notice of a proposed rule for CABG bundled payments.¹¹ Although not the first bundled payment program, this is one of the first to provide a fixed sum of money for comprehensive inpatient and outpatient care. The proposal is for a 5-year trial of bundled payments for isolated CABG from admission through 90 days after discharge in 98 metropolitan statistical areas (MSAs). Any Medicare patient undergoing CABG with a designation of Diagnosis-Related Group (DRG) 231-236 (Table 1) and not participating in a separate alternative payment program would be eligible for the bundled payment program. Hospitals will be paid under the standard fee-for-service arrangement with inpatient hospital costs reimbursed on the basis of the procedure, with the CMS making payments based on the DRG. At the end of each year, the CMS will reconcile all payments compared with a target price that is based on cost data from the prior 3 years. It phases in regional pricing and increasing caps for the reconciliation payment. The pilot program will split their calculations by phase of care and set target prices for the hospitalization and postdischarge care separately. To investigate the impact of the inpatient component of the proposal, we reviewed actual costs for patients undergoing CABG relative to the expected target price.

MATERIALS AND METHODS**Patient Data**

The VCSQI is composed of 18 hospitals and cardiac surgical practices in Virginia that includes approximately 99% of adult cardiac surgery cases in the state. The hospitals are spread over 8 MSAs with a range of 1 to 5 hospitals per MSA. VCSQI clinical and cost data acquisition and matching have been described.^{5,12} Administrative, demographic, and clinical data are collected by each participating institution using the current Society of

Thoracic Surgeons (STS) clinical data entry form. The VCSQI database pairs STS data with hospital patient discharge information. Uniform Billing 04/92 files are matched to the STS data, with a successful matching rate of 99%. These identify charges that are classified on the basis of International Classification of Diseases, Ninth Revision–based revenue codes. Cost-to-charge ratios submitted to the CMS by each institution are used to estimate costs. Cost data were adjusted to 2015 dollars using the market basket for the CMS Inpatient Prospective Payment System to account for medical specific inflation.

Records for isolated CABG ($n = 13,290$) for patients insured by Medicare were identified for the period January 1, 2008, to December 31, 2015. Patients were excluded for missing cost data. Standard STS definitions were used, including operative mortality (in-hospital or 30-day mortality) and major morbidity (permanent stroke, prolonged ventilation, reoperation, renal failure, and deep sternal wound infection). This investigation was a secondary analysis of the VCSQI data registry without Health Insurance Portability and Accountability Act patient identifiers. Business associates agreements exist among VCSQI, member hospitals, and the database vendor (ARMUS Corporation, San Mateo, Calif). The study was granted exemption by the University of Virginia Institutional Review Board.

Bundled Payment Modeling

All hospitals were categorized by the MSA for analysis in a blinded manner. Historical pricing was calculated using inflation-adjusted total hospital costs from 2012 to 2014. Costs were stratified by DRG (Table 1) for risk-adjustment purposes. A target price was then calculated for each of the 3 phases of the pilot program: Phase 1 is based on two thirds hospital cost and one third regional cost; phase 2 is one third hospital and two thirds regional cost; phase 3 is 100% regional costs (Table 2). An across the board 3% reduction in the target price was incorporated; however, adjustment for high-quality hospitals could not be performed because of the lack of CMS quality data and cutoffs. This calculated target price was compared with actual costs for 2015. The reconciliation payment is the difference between the actual cost and the target price (actual 2015 costs – historical target price). As the pilot program progresses, there is an increasing cap on the reconciliation payment (Table 2). The first year precluded hospitals owing CMS reconciliation payments; however, this cap increased for years 2 to 5 and included both downside risk where hospitals owed CMS a reconciliation payment and upside risk where hospitals would receive money from CMS. Total hospital reconciliation payments were calculated using DRG-specific prices and volume. Hospitals were classified as penalized if they owed money to the CMS in the reconciliation payment for being over the target price, whereas hospitals that were paid by CMS for being under the target price were categorized as rewarded.

Statistical Analysis

Categorical data were summarized by proportions, and continuous data were summarized by median and interquartile range because of skewedness, except for cost data, which were presented as mean and standard deviation. Baseline characteristics and short-term outcomes were compared by Mann-Whitney U test or chi-square test as appropriate. Multivariate generalized linear modeling was used to calculate inflation-adjusted total hospital cost as a function of MSA with nested models containing DRG and STS predicted risk of mortality (PROM) or morbidity or mortality (PROMM). All statistical analyses were performed using SAS version 9.4 (SAS Institute, Inc, Cary, NC). The significance level of all tests was set at $\alpha = 0.05$.

RESULTS

The baseline characteristics and short-term outcomes for penalized and rewarded hospitals are displayed in Table 3. Patients cared for in penalized hospitals were statistically higher risk as measured by STS PROM (1.5% [0.9%-2.8%] vs 1.4% [0.9%-2.6%], $P = .0005$). This

TABLE 1. Diagnosis-Related Group classifications

CABG DRG	Cardiac catheterization	Percutaneous transluminal coronary angioplasty	Major complication or comorbidity
DRG 231	Yes	Yes	Yes
DRG 232	Yes	Yes	No
DRG 233	Yes	No	Yes
DRG 234	Yes	No	No
DRG 235	No	No	Yes
DRG 236	No	No	No

CABG, Coronary artery bypass grafting; DRG, Diagnosis-Related Group.

trend translated into longer median crossclamp times at penalized hospitals (68 minutes [52-85] vs 60 minutes [45-76]). Considering that higher-risk patients were treated in penalized hospitals, the observed-to-expected ratio for operative mortality was calculated for both groups and was 0.87 for the penalized hospitals and 1.10 for the rewarded hospitals. The rate of major morbidity was significantly higher in penalized hospitals compared with rewarded ones (13.8% vs 11.2%, $P = .0002$).

Trends in Coronary Artery Bypass Grafting Cost

CABG demonstrates 2 significant trends; the first is a steady increase in adjusted total hospital costs, and the other is significant variation by hospital. The mean hospital cost in 2015 dollars increased from \$37,747 in 2008 to \$50,394 in 2015. There was also an increase in variability with the standard deviation increasing from \$19,401 to \$26,897 between 2008 and 2015. This equates to an average yearly increase of 3.6%. Despite these yearly increases, the proposal includes CMS reducing the target price by 3% (termed a discount), which compounds the financial pressure of the bundled payment system.

Total hospital cost from 2008 to 2015 varied widely across the state from a per patient average of \$25,858 to more than double that cost at \$67,527. This variation also is true within MSAs, where the range was nearly as large for the largest MSA as the entire state (\$33,171-\$67,527). Finally, looking at only 2015 costs we continue to see large

variation, with mean hospital costs demonstrated in Table 4 and ranging from \$26,591 to \$74,169. The mean cost for each MSA had less variation, but with a range of \$25,858 to \$51,980 is still an important consideration with the emphasis on regional pricing.

Impact on Reimbursement

The calculated reconciliation payment per patient (actual 2015 costs – historical target price) for each hospital is demonstrated in Figure 1 for each year of the pilot program and shown in detail in Table 4. Multiplying by the volume per DRG, Figure 2 demonstrates the total reconciliation payment for each hospital by year of the pilot program. The trend of increasing financial liability as the pilot program progresses is clear in Figures 1 and 2, driven by increasing caps. The average reconciliation payment to CMS in year 1 is -\$17,683 (additional reimbursement to hospital), compared with year 2: \$166,418; years 3 and 4: \$276,055; year 5: \$367,985 (all payments owed by hospitals to CMS). The average reconciliation payment for each phase of the pilot program was as follows: phase 1 (years 1 and 2): \$74,368; phase 2 (years 3 and 4): \$276,055; phase 3 (year 5): \$367,985. This equates to an average increase in the repayment owed to CMS of \$146,809 with each phase of the program.

In the final phase (year 5), 13 of the 18 hospitals (72%) would have owed CMS reconciliation payments for cost overruns averaging \$614,270 (range, \$67,404-\$2,102,292). Costs were below the target price at only 5 of 18 hospitals, and the CMS would have paid back an average reconciliation of only \$272,355 (range, \$88,628-\$567,429). Without the cap that is placed on these payments, the highest reconciliation payment owed to CMS would have remained at \$2,102,292, whereas the highest payment from CMS would have increased to \$1,544,141.

Predictive Power of Current Model

The pilot program is set to risk adjust by DRG, which accounts for cardiac catheterization, percutaneous coronary angioplasty, and major complication or comorbidity. However, linear regression shows that DRG accounts for only 24.5% of variation in inflation-adjusted total hospital cost after accounting for regional variation by MSA. STS PROM performs even worse, accounting for only 13.4%

TABLE 2. Pilot program components by year and phase of implementation

Phase	Year	Pricing	Repayment cap
1	1 (10/17-12/17)	Two thirds hospital, one third regional*	0% downside, 5% upside†
1	2 (2018)	Two thirds hospital, one third regional	5% both
2	3 (2019)	One third hospital, two thirds regional	10% both
2	4 (2020)	One third hospital, two thirds regional	10% both
3	5 (2021)	All regional	20% both

*Regional defined as all hospitals within the MSA. †Downside risk indicates potential reconciliation payments owed to the CMS by the hospital, and upside risk indicates potential reconciliation payments owed to the hospital by CMS.

TABLE 3. Baseline characteristics for Medicare cohort

Baseline characteristics	Penalized (n = 10,060)	Rewarded (n = 3230)	P value
Age [median, IQR]	71 [66-76]	71 [66-76]	.59
Female	2969 (29.5%)	988 (30.6%)	.24
Cerebrovascular disease	1987 (19.8%)	720 (22.4%)	.002
Hypertension	9026 (89.7%)	2861 (88.6%)	.06
3-vessel coronary disease	7906 (78.7%)	2432 (75.3%)	<.0001
Prior myocardial infarction	4933 (49.1%)	1640 (50.8%)	.09
Diabetes	4626 (46.0%)	1491 (46.2%)	.86
Prior cardiac surgery	364 (3.6%)	108 (3.3%)	.46
PROM [median, IQR]	1.5% [0.9%-2.8%]	1.4% [0.9%-2.6%]	.0005
Short-term outcomes			
Operative mortality	225 (2.2%)	83 (2.6%)	.27
Operative mortality O:E	0.87	1.10	
Major morbidity	1389 (13.8%)	362 (11.2%)	.0002
Postoperative LOS [d; median, IQR]	6 [5-8]	5 [4-7]	<.0001
Discharge to a facility	2643 (26.8%)	825 (26.0%)	.38
Readmission	966 (9.9%)	345 (11.0%)	.08

IQR, Interquartile range; PROM, predicted risk of mortality; O:E, observed to expected ratio; LOS, length of stay.

of cost variation. STS PROMM is a bit better with the R² for the model of 18.5%. However, there is substantial covariance between DRG and PROMM, where linear regression combining DRG and STS PROMM accounts for only 28.4% of variation.

DISCUSSION

There is significant variation in Medicare patient costs for CABG within the Commonwealth of Virginia and within individual MSAs. This variation in combination with the high cost of the surgery represents a potentially large source of

TABLE 4. Statewide financial impact modeling the final year of the pilot

Hospital	MSA	Actual cost	Uncapped repayment per person	Capped repayment per person	Capped total repayment
A	1	\$46,183	\$(624)	\$(624)	\$(88,628)*
B	1	\$59,931	\$17,603	\$11,986	\$1,018,830
C	2	\$69,883	\$8690	\$8690	\$504,020
D	2	\$74,169	\$27,304	\$14,834	\$949,360
E	2	\$31,524	\$(17,157)	\$(6305)	\$(567,429)
F	2	\$28,731	\$(18,199)	\$(5746)	\$(206,860)
G	2	\$60,880	\$11,350	\$11,350	\$1,044,229
H	3	\$46,354	\$5771	\$5771	\$138,513
I	3	\$53,564	\$3548	\$3548	\$67,404
J	3	\$46,789	\$5747	\$5747	\$856,262
K	4	\$63,607	\$7488	\$7488	\$262,088
L	4	\$33,684	\$(15,779)	\$(6737)	\$(222,314)
M	4	\$26,591	\$(21,557)	\$(5318)	\$(276,545)
N	4	\$63,328	\$7933	\$7933	\$2,102,293
O	5	\$27,347	\$2171	\$2171	\$138,964
P	6	\$39,641	\$1494	\$1494	\$144,965
Q	7	\$46,270	\$1606	\$1606	\$134,895
R	8	\$50,309	\$4024	\$4024	\$623,693

MSA, Metropolitan statistical area. *Parentheses indicate negative reconciliation payments (CMS owes money back to the hospital).

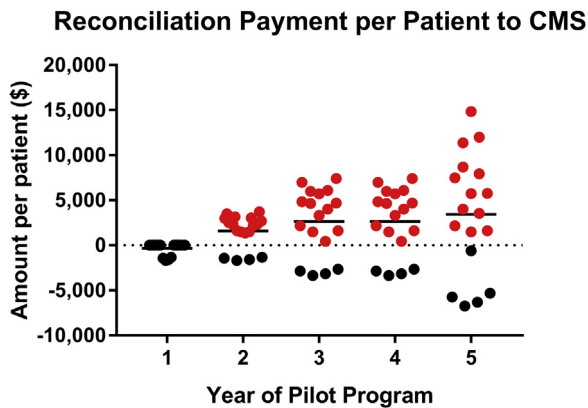


FIGURE 1. The mean CMS repayment per patient by hospital if 2015 had been each of the 5 years of the pilot. Positive red numbers indicate money owed by the hospital to CMS for being above the target price. *CMS*, Centers for Medicare and Medicaid Services.

savings for CMS. However, it also creates the potential for fiscal risk that hospitals may not be able to absorb.¹³ This places cardiac practices at risk, but more importantly places patient access to care in jeopardy. The 72% of hospitals that are going to owe reconciliation payments to CMS at the end of the year are going to look for cost savings measures going forward. This will hopefully include quality improvement, care coordination, and other measures to improve patient care. However, the financial risk could lead to an aversion by hospitals and practices to accept patients at risk for high costs.

Multiple investigations of the large variation in inpatient costs for CABG have demonstrated hospital-specific variation independent of patient factors.^{13,14} Although there is a dearth of data regarding what exactly the hospital-specific factors are and how great the potential for savings are with standardization of care, these health care system-based opportunities are the focus of the CMS payment

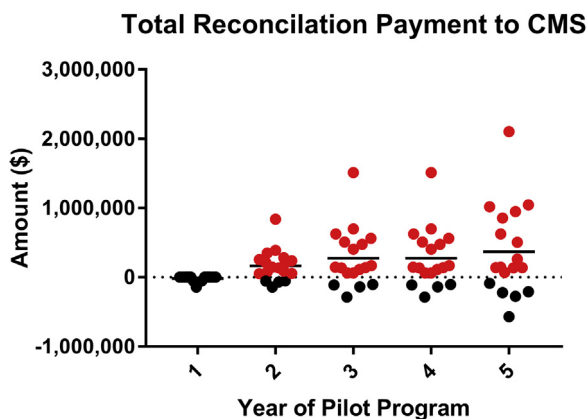


FIGURE 2. The total reconciliation payment for each hospital calculated for 2015 costs as each year of the pilot program. *CMS*, Centers for Medicare and Medicaid Services.

reform models. The shift to regional pricing should help to force collaboration and standardization. However, the bundled payment model that has been proposed is also designed to extract overall savings. The 3% reduction that the CMS is applying to lower the target price compounds the 3.6% average CABG cost increases seen year over year in this analysis. Although postdischarge data are not currently available, a similar trend is likely to exist with previous estimates demonstrating an 8.3% increase per year.⁸ Although the adjustment for high-quality, high-value centers helps slightly mitigate this impact, the overall design is a decrease in reimbursement. The capping of repayments also benefits CMS disproportionately where the largest payment owed to CMS (\$2,102,292) was not capped, but the largest payment CMS owes to a hospital was capped (\$567,429) and much lower than the potential payment of \$1,544,141.

The current model relies heavily on DRG to risk adjust the target prices. However, this only accounts for limited factors including cardiac catheterization, angioplasty, and presence of major complications or comorbidity. The addition of clinical factors, even as an aggregate such as STS PROM or PROMM, improves the predictive power of the model. However, it still accounts for only 28.4% of cost variation. The limitations of PROM to risk adjust bundled payments have been well described.¹³ In a high-volume center with a high-risk population using the proposed methodology, the 75.5% of unexplained cost variation represents a potentially large financial risk. One institution would have owed CMS more than \$2 million (12.5% of their total cost) if 2015 had been the final year of the pilot program.

These results have the potential to reshape hospital policy and limit access to care for vulnerable populations. The shifting of financial responsibility to hospitals places them at the center of decisions regarding patient care. This is contrary to the movement to have patient-centered decisions. The best interests of the patient are put further in jeopardy by 2 findings regarding risk and quality. First, hospitals that would be penalized under the proposed program performed CABG on statistically higher-risk patients. Second, these same hospitals had a lower observed to expected mortality rate than hospitals that would be rewarded under the pilot program. These findings corroborate prior research demonstrating a lack of correlation between quality and cost.¹⁵ These results suggest that the current risk stratification methodology using DRG is inadequate and high-quality centers may be disproportionately penalized.

Models that incorporate adverse events vastly outperform those that contain only preoperative patient characteristics.¹⁵ This is not surprising considering the additive costs of postoperative complications.^{16,17} The costs of complications may range from a low of \$9000 for atrial fibrillation up to \$63,000 for mediastinitis.^{16,18} The STS

PROMM outperforms PROM because it better incorporates some of the factors that increase risk for these expensive complications. The development of a cost model that performs well will require careful consideration of potential risks for complications. Because PROM uses fixed parameter estimates derived to predict risk of mortality, these are likely not optimized to predict costs, and a new model derived using CMS financial data has the potential to dramatically improve predictive power. It is imperative that administrators work with physicians and researchers to use a combination of clinical, socioeconomic, administrative, and financial data to develop the best possible payment models.

The history of bundled payments for cardiac surgery is one of incremental expansion extending back to the establishment of the DRG payment structure, which bundled inpatient care.⁹ Although this helped slow the increase in Medicare payments, it was taken further in 1991 with the creation of the Medicare Participating Heart Bypass Center Demonstration with bundling of inpatient, physician, and readmission costs.⁸ By the end of the project in 1996, 7 hospitals had participated and showed a 10% decrease in costs over 5 years. Only 5% of the decrease in costs was associated with postdischarge care expenses. The noneconomic impacts, such as on outcomes and quality of care, were less clear, but there was a small increase in complications. More recently, the Geisinger Health Plan implemented a comprehensive bundled payment system that covered preoperative, inpatient, physician, postacute care, and readmissions.¹⁹ They also paired pay-for-performance with 40 best practices. They found modest cost and resource improvements, but compliance with the best practices increased from 40% to 100%. Although lessons certainly can be learned from their experience, their uniquely integrated hospital and insurance structure within a specific region may limit translation of their model on a national scale.

The current proposal is based on previous work by the Centers for Medicare and Medicaid Innovation, which was established by the Affordable Care Act. However, it seems to lack some of the lessons learned from previous bundled payment efforts in cardiac care.²⁰ A clear focus has been cost savings, but these have been modest in past programs. Achieving such savings through a 3% discount risks jeopardizing quality and access. The 1.5% adjustment for high-quality hospitals may not be sufficient to prevent such consequences without increasing stop-loss protection for high cost cases, risk corridors to allow hospitals time to adapt, or risk pooling among many hospitals. Risk adjustment beyond DRG and transfer status could further help alleviate these concerns, but could still prove inadequate.¹³ Furthermore, such efforts require greater coordination between CMS administrators and clinical researchers than has been currently demonstrated. The relative success of the Geisinger plan may be related to their integrated

structure but also to the alignment of incentives with pay-for-performance and clear guidelines. The implementation of best practices to improve quality of care addresses both quality and cost, because the majority of cost variation appears to be the result of postoperative complications.¹⁴⁻¹⁶

Study Limitations

This analysis has several limitations related to data availability. Namely, this analysis only uses hospital-related costs as physician reimbursement, and postacute care costs were not available. However, we would expect some collinearity of the costs to mitigate this impact, which is supported by the modest decrease in postacute care cost seen with the Medicare Participating Heart Bypass Center Demonstration.^{8,9} Further limiting this impact, the CMS has estimated that the initial hospitalization will account for 75% of costs.¹⁰ In addition, the limited information in the proposal precludes adjusting the discount by the quality of hospital care. Finally, transfer status is expected to be incorporated in the pilot program, but is not tracked in detail in our dataset. These limitations highlight the need for improved access to Medicare financial data and increased coordination between CMS and regional collaboratives to improve future payment models. Access to these data also is critical for hospitals to increase care coordination and identify methods for cost containment. Finally, the political uncertainty with a new CMS administration may affect whether bundled payment systems are implemented. Nevertheless, increasing financial pressures and the growing number of private sector bundled payment schemes inevitably highlight the relevance of this analysis. This financial liability will likely motivate hospitals to contain costs that will limit downside risk, and thus these numbers likely overestimate the impact in the later years of the pilot program.

CONCLUSIONS

Cardiac surgery has been a target for bundled payments for decades with incremental expansion culminating in the current bundled payment proposal for isolated CABG. The proposal can be expected to shift financial risk and place the burden of postacute care coordination on hospitals. As a result, most hospitals can expect to owe CMS reconciliation payments at the end of the year that increase as regional pricing is phased into the model. Protections for quality and access to care are not built into the proposal, but improved risk-models and pay-for-performance with best-practice implementation have shown previous promise. Additional considerations for risk pooling, risk corridors, and stop-loss protection could further help bundled payments to be financially viable. The current health care policy climate is shifting rapidly, but bundled payments are likely to persist. Cardiac surgeons and clinical researchers should be ready to help improve such systems with the goal of improving patient care.

Conflict of Interest Statement

A.S. is a consultant on the Medtronic Cardiac Surgery Advisory Board. G.A. is a consultant for Abbott, Edwards, and Medtronic, and a speaker for AtriCure in the last 3 years but not within the last year. All other authors have nothing to disclose with regard to commercial support.

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