
Cost Savings and Physician Responses to Global Bundled Payments for Medicare Heart Bypass Surgery

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In 1991, the Health Care Financing Administration (HCFA) began the Medicare Participating Heart Bypass Center Demonstration, in which hospitals and physicians are paid a single negotiated global price for all inpatient care for heart bypass patients. During the first 27 months of the demonstration, the Government and beneficiaries together saved more than \$17 million on bypass surgery in four participating institutions. Average total cost per case fell in three of the four hospitals during the 1990-93 period as the alignment of physician and hospital incentives resulted in physicians changing their practice patterns to shorten stays and reduce costs.

INTRODUCTION

In 1988 HCFA solicited proposals from more than 40 hospitals and physicians to participate in the Medicare Participating Heart Bypass Center Demonstration, which would pay a single negotiated global price for all inpatient care for heart bypass patients. The goals of the demonstration were to show the kinds of cost savings to the Government possible from negotiated bundled payments for Medicare heart patients, to encourage regionalization of the procedure in higher volume hospitals, and to align the incentives of physicians with those faced by hospitals under

prospective payment. In May of 1991, after extensive evaluation of the 27 final applicants, HCFA began paying four institutions in Boston, Atlanta, Ann Arbor, and Columbus, Ohio, a single global payment covering both Part A and Part B services provided any Medicare bypass patient classified in diagnosis-related groups (DRGs) 106 (with catheterization) and 107 (without catheterization). No separate inpatient billing was allowed. Two years later, the agency expanded the demonstration to include hospitals in Houston, Indianapolis, and Portland, Oregon.

By negotiating fixed discounts on average payments for DRGs 106 and 107, the Medicare program and its beneficiaries are assured of savings unless outpatient expenses associated with demonstration bypass patients rise faster than expected. Lower average payments, on the other hand, mean lower, or even negative, margins for the participating hospitals. Unless participants can reduce their costs of treating bypass patients, they may incur losses that may be unsustainable in the long run.

The key to determining profitability under the negotiated demonstration is whether hospital costs fall when physician incentives to reduce spending are aligned with hospital incentives under DRG prospective payment. Many physicians might argue that their inpatient practice patterns are unaffected by financial incentives: They give each patient needed care—especially very ill coronary artery disease patients requiring bypass surgery. Others, however, might argue that more

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cost-effective practice patterns can be implemented even for bypass surgery, as long as physicians are willing to cooperate with hospital administration.

The economic literature (Pauly and Redisch, 1973; Pauly, 1980; Harris, 1977) raises the hypothesis that physicians tend to treat the hospital as their workshop. To them, the inputs to patient care are practically free, including nurse time, radiological supplies, drugs, intensive care unit (ICU) telemetry, scanners, echocardiography, electrocardiograms (EKGs), and cardiac catheter devices. Surgeons and cardiologists pay nothing for this equipment and support in the inpatient setting; these costs are external to their own practices. Once physicians are under a single global rate, however, all of these costs are internalized. Realizing that more cost-effective practice patterns could save the hospital money, surgeons, in particular, may conserve on scarce resources in various ways. They might do so either out of a concern for the financial solvency of the hospital under the demonstration or in response to incentives to share in any cost savings by receiving a larger share of the global payment.

Key evaluation questions concerning Medicare program savings include:

- What were the total savings to the Medicare program and to beneficiaries from the demonstration?
- Was care shifted to a postdischarge setting, thereby reducing the savings from the bundled inpatient rates?

Whether Medicare and its beneficiaries can negotiate discounts and save money is only half of the overall policy question. If providers lose by failing to bring down costs, the discounts are not sustainable in the long run. Hence, equally important is how successful participants were in changing practice patterns to control costs.

Additional questions include:

- Did the bypass costs of demonstration hospitals rise more slowly under fixed global payment than they would have under DRG prospective payment?
- Did the average total and variable margins on bypass patients rise or fall under the demonstration?
- Did the costs of some departments rise or fall faster than others? If so, might this be indicative of changes in practice patterns or management efficiencies?

In the first part of this article, we describe how hospitals and physicians were paid under the demonstration. Second, we describe the data sources and results measuring Medicare and beneficiary program savings. Third, we discuss the hospital microcost data and hospital savings. We then conclude with implications for global bundled payments and future research. Focus of the analysis is on financial performance and behavioral response to a global payment. The impact of the demonstration on the quality of care, summarized in the conclusion, is analyzed in detail elsewhere (Cromwell et al., 1995).

HOW HOSPITALS AND PHYSICIANS ARE PAID

How hospitals and physicians are paid under the demonstration is key to changing physician patient care patterns. The negotiated global price between HCFA and the participants was based on separate estimates of Part A hospital and Part B physician allowable prices. Applicants then proposed separate discount rates on each component that resulted in an overall global payment rate per Medicare bypass discharge. Payment was made in all cases to the hospital in the form of two checks, one for Part A and another for Part B, minus any patient obligations. The hospital was

then responsible for paying for physician inpatient services covered under the demonstration, as well as covering any costs of related readmissions within 72 hours. Physicians were not allowed to receive any payment from their local Medicare carrier—only from the hospital out of the global payment. The Government was indifferent, however, regarding how the global payment was split. In particular, the hospital was not required to distribute payments to physicians in accord with the original Part A and B estimates, although they all did so as a starting point under the demonstration.

Under the original demonstration, except for St. Joseph's, Ann Arbor, not all physician services were covered under the single payment. St. Joseph's, Atlanta, covered pulmonology, pathology, infectious diseases, hematology, and neurology, in addition to the four capitated services (cardiac surgery, anesthesiology, cardiology, and radiology). Ohio State University (OSU) Hospital covered only infectious diseases and pathology in addition to the principal four specialties, and University Hospital in Boston covered only pathology in addition to the four capitated services. Under the expanded demonstration, all services of any kind are to be included in the global rate during the inpatient stay.

In developing their prices, the applicants established fixed actuarial amounts per case for the thoracic surgeon, the anesthesiologist, the cardiologist, and the radiologist. These four specialists were assumed to be involved in every bypass case. At the beginning of the demonstration, each one of the specialists was paid their proposed amount per case after discount. All the other consulting physicians, including pulmonologists, nephrologists, internists, and neurologists, were paid Medicare allowable fees by the hospital out of a set-aside consultant pool—roughly 5 percent of the

global amount. The four capitated specialists were put at risk for this pool by the hospital. If the capitated specialists used fewer consulting physician services, the specialists split the underrun. If they used more, their payment amounts in the next period were reduced. Being put at risk for consulting services, plus any extra services they might also deliver, encouraged the key decisionmakers to conserve on Part B physician services.

Hospitals were already at risk for most Part A costs under the existing DRG prospective payment system (PPS). The bundled rate did not allow for any extra outlier payments, however, shifting the risk of long-stay and/or high-cost patients to the institution. Usually, the hospital was willing to give a larger discount than the physicians, in part to align the key decisionmakers' incentives with their own. Management hoped that physicians would not only begin to conserve on their own services but also take an active interest in conserving on hospital services as well.

Over time, three changes were made to the payment rates. The first involved small technical corrections by the hospital in figuring physician payments. Some specialties overestimated their average Medicare payments, and the hospital ratcheted down their allotted amount of the global payment. Also, cardiologists not performing the cardiac catheterization were subsequently paid a much smaller average amount.

The second change involved annual adjustments for congressionally mandated Medicare Fee Schedule and PPS changes. Applicants were at risk for all changes in gross practice cost indexes, DRG weights, and other update factors. Surgeons and cardiologists were particularly vulnerable to resource-based relative value scale (RBRVS) rollbacks in their allowable fees. All the hospitals maintained the split of Part B payments by specialty, however,

effectively sheltering physicians from reductions in the Medicare Fee Schedule.

The third factor involved physician bonuses for cost-effective care. In the two academic medical centers where surgeons and cardiologists are salaried, no cost-sharing was adopted, but in the two other institutions, the hospital shared some of its savings from more efficient patient care with the physicians. In Ann Arbor, the hospital took over the salaries of the surgeons' physician assistants and gave the practice more operating room time. In Atlanta, a very formal cost-sharing formula was devised. For eligible surgeons meeting the quality-of-care performance standards, a bonus payment of 25 percent was made based on the estimated cost savings to the hospital each year. Hospital cost savings were defined as the difference between the surgeon's average hospital variable cost per bypass (based on microcost data), minus the expected cost using normal inflation and intensity parameters. Surgeons under this system could earn more than their original discounted bid prices if the one-quarter savings on hospital variable costs exceeded any reductions to the revised Medicare Fee Schedule amount. For some Atlanta surgeons, the additional bonus amounted to \$900 per case, which, after accounting for RBRVS fee reductions, came to more than \$400 per case more than they were receiving from Medicare prior to the demonstration—this during a time when practically all thoracic surgeons in the country were experiencing large reductions in Medicare payments.

To summarize, given the payment incentives, physicians, particularly in Atlanta and Ann Arbor, had strong incentives to conserve on both physician consulting and hospital services. Surgeons and cardiologists also expressed the feeling that they needed to be more cost-

effective, recognizing that their hospital had proposed a significant discount. Exactly how they accomplished this is demonstrated in this article on a department-by-department basis.

MEASURING PROGRAM SAVINGS

HCFA's Office of Research and Demonstrations provided the negotiated demonstration payment rates for each hospital for the first 3 years, 1991-93. Under the demonstration, Medicare paid each of the hospitals a single global rate for every discharge in DRGs 106 and 107. This rate included all inpatient hospital and physician services. The standard Medicare payments for capital and direct medical education were also bundled into the rate on a prorated basis. Any related readmissions were also included in the rate. Pre- and postdischarge physician services were largely excluded, except for the standard inclusions in the surgeon's global fee. All four participants agreed to forgo any outlier payments for particularly expensive cases, although a prorated amount for expected outliers was bundled into the negotiated rate.

The original negotiated discounts for 1991 are presented in Table 1. (Only the 1991 rates are presented for simplicity. Annual updates of the negotiated rates generally followed Medicare PPS and Physician Fee Schedule rules.) The smallest discount was negotiated with St. Joseph's Hospital in Atlanta, i.e., 9.9-11.2 percent. Its negotiated payment also was lowest of the four sites, as a result, in part, of being a non-teaching hospital located in the South. The largest discounts, exceeding 20 percent for both DRGs, were offered by the two academic medical centers in the demonstration, University Hospital in Boston and OSU Hospital. Both hospitals receive sizable capital and

Table 1
Negotiated 1991 Discount Rates on Medicare Part A and Part B Services Under the Medicare Heart Bypass Demonstration, by Diagnosis-Related Group (DRG) Number and Hospital

Hospital	DRG Number	
	106	107
	Percent	
St. Joseph's Hospital - Atlanta	9.9	11.2
University Hospital Boston	24.1	21.6
Ohio State University Hospital	27.8	36.7
St. Joseph Mercy-Ann Arbor	9.7	19.5

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations.

indirect medical payments under the regular PPS. OSU agreed to waive both of these add-ons to the basic DRG amounts, which explains their large discounts.

Data Sources

Claims data came from two sources: HCFA's MEDPAR and National Claims History (NCH) data files. All inpatient, skilled nursing facility, outpatient department, home health care, and physician/supplier claims were assembled for patients undergoing coronary bypass surgery in DRG 106 or DRG 107, in the demonstration hospitals and their local competitors, who were identified by each of the participants. Patients included those discharged from January 1990, through September 1993. Because the demonstration began in mid-1991, the 1990 data provide more than a full year of baseline utilization and costs. The September 1993 cutoff ensured that 90 days of postdischarge utilization data would be available for all patients over the first 2 years of the demonstration.

METHODS

This study uses a quasi-experimental design with four demonstration hospitals matched to four control groups of competitor hospitals. Some of the research questions can be answered using only data from the demonstration sites (e.g., did postdischarge expenditures per patient increase in the demonstration hospitals?). However, absolute changes by themselves are not particularly meaningful, given the secular trends in bypass surgery. At a minimum, the trend for the demonstration sites should be compared with the national trend.

Many other research questions demand additional information from non-demonstration sites, calling for a quasi-experimental design. For example, the question "Did market shares change for the demonstration hospitals?" cannot be addressed without information on competitor volumes. Thus, the competitor hospitals naturally form the "control" group for addressing this question. Use of these controls adjusts for growth or shrinkage in local bypass markets that may differ from the national trend toward higher volumes. The comparison groups control for idiosyncratic local factors that may account for changes in Medicare bypass volumes independent of participation in the demonstration.

Construction of markets for the four demonstration hospitals was a two-step process. First, all hospitals located within the demonstration site's metropolitan statistical area (MSA) were identified. Second, demonstration sites were asked who outside their immediate metropolitan area they viewed as competitors. Some hospitals added no competitors outside their MSAs, but several, particularly those in smaller metropolitan areas, listed additional competitors. Although this method of constructing markets introduces an element of discretion, it results in a more meaningful set of competitors than a simple geographic definition.

Measuring the savings to the Medicare program and its beneficiaries is done by decomposing savings into three compo-

nents: (1) inpatient costs; (2) postdischarge costs; and (3) increases in volume as a result of shifts in market shares. For inpatient savings, the demonstration hospital is its own control, in the sense that its expected payment in lieu of the demonstration is based on established Part A DRG payment rates. For outpatient savings, national trends in postdischarge bypass payments are used to benchmark trends in actual demonstration payments. Finally, because regionalization of volume to participating hospitals is a goal of the demonstration, we also measure any shifts in volume in local markets and the payment implications, if any.

Estimation of inpatient savings requires comparison of hospital and physician/supplier payments made under the demonstration with payments that would have been made for Medicare bypass surgery in lieu of the demonstration. Demonstration payments per case were constructed using the rates negotiated with HCFA, weighted by the proportion of cases in each DRG and updated annually by HCFA. Beneficiary liability was calculated as 20 percent of the portion of the bundled payment apportioned to the Part B trust fund under the demonstration, plus the inpatient deductible (if owed) from the MEDPAR files.

Projected inpatient program outlays per discharge in lieu of the demonstration are defined as the sum of: (1) DRG 106 or 107 prospective payment rates in lieu of the bundled payment; (2) average bypass outlier payments; (3) Part A capital and teaching pass-throughs; plus (4) physician allowable fees for each inpatient service weighted by the baseline 1990 quantity of inpatient physician services per bypass discharge. Hospital Part A charges for the inpatient stay constitute roughly 70 percent of the cost of the bypass episode (inpatient stay plus 90 days postdischarge). Estimation of Medicare PPS expenditures

per case in lieu of the demonstration is straightforward because hospitals receive a fixed prospective amount per DRG that does not vary with changes in length of stay, type of treatment, or costs. Thus, this amount is insensitive to changes in physician practice patterns that might result from the demonstration, allowing us to treat the hospital as its own control.

Although using the actual numbers of discharges to weight the Part A discounts (and savings) to the Medicare program seems appropriate, using the actual bills submitted by physicians may underestimate what would have been paid in lieu of the demonstration if physicians conserved on inpatient services under the bundled payment. (Physicians continued to submit claims documents to HCFA in order to maintain the RBRVS fee-setting system, even though their payment came out of the single global payment.) An alternative method for estimating Medicare outlays on physicians and suppliers in lieu of the demonstration is to calculate what would have been paid for a standard "package" of inpatient services. First, a list of standard services received by bypass patients was developed (e.g., surgery, anesthesia, EKG monitoring, radiologic studies) based on claims. Then RBRVS payment amounts, adjusted to reflect for changes in practice costs over time and across geographic areas, were multiplied by the fixed bundle of physician services.

The drawback of this approach is that it assumes all patients would have received a standard set of services and does not allow care to vary based on patient severity, physician practice styles, or changes in practice over time. For example, if demonstration hospitals' patients were sicker on average than patients receiving the standard services, the estimate of physician/supplier spending in lieu of the demonstration will be biased downward,

although trend comparisons will be less sensitive to the assumption. This approach was deemed preferable to using actual physician/supplier bills that partially reflect cost-saving behaviors. It was also considered preferable to updating the baseline hospital-specific physician inpatient charges by a national update factor. Given the introduction of RBRVS during this period, physician payment updates in any given locality may differ dramatically from the national update amounts.

Beneficiary inpatient liability per case in lieu of the demonstration is calculated as the sum of the inpatient deductible plus 20 percent of physician/supplier allowed charges for the inpatient stay. The inpatient deductible is a separate variable on the MEDPAR file; the physician/supplier copayment was calculated directly as a percentage of estimated Part B liability.

A broader definition of net Medicare savings includes postdischarge outpatient costs as well. Hospitals, and particularly physicians, will have greater incentives to discharge demonstration patients earlier with attendant followup care at home or in another facility, with additional bills submitted outside the demonstration. Hence, a broader measure of savings is defined as the difference between postdischarge expenditures under the demonstration and those that would have occurred in lieu of the demonstration. A 90-day postdischarge cutoff is used, which, although relatively short, should capture most of the care that might be shifted from the inpatient stay to a postdischarge setting. A shorter postdischarge window also helps filter out care for conditions unrelated to the bypass.

Actual expenditures in the postdischarge period were calculated using Medicare claims covering (1) patients rehospitalized anywhere after discharge from the demonstration hospital; (2) Part A outpatient and skilled nursing facility ser-

vices; (3) outpatient Part B physician services; (4) durable medical equipment outlays; and (5) home health care payments.

Projected postdischarge program outlays in lieu of the demonstration were calculated using 1990 baseline outpatient data for each demonstration hospital, creating a mean expenditure per patient by DRG. To estimate the trend in outpatient expenditures in lieu of the demonstration, we used the percentage change in per patient postdischarge expenditures between the base period and each of the demonstration years, derived from national Medicare claims. Base-period postdischarge expenditures on demonstration hospital patients were then adjusted upward by these inflation factors to estimate what expenditures would have been over the demonstration period without the demonstration. The cumulative 90-day postdischarge growth rates were 9.2 percent from 1990 to 1991, 20.9 percent from 1990 to 1992, and 24.9 percent from 1990 to 1993. Cumulative growth rates calculated for the four sets of competitor hospitals were much higher than these national values. Our estimates of postdischarge savings based on national trends provide lower, and likely more conservative, estimates of overall program savings.

This approach to calculating outpatient savings implicitly assumes that differences in actual versus estimated spending in lieu of the demonstration are caused by the demonstration. Another source of variation in actual spending, already mentioned, is random variation in patient postdischarge needs from year to year, particularly given the relatively small number of patients in a couple of the demonstration hospitals. Statistical tests were conducted on pooled 1991-93 data to determine whether actual postdischarge expenditures were significantly different from the projected expenditures by site. The mean and variance for

actual expenditures were calculated directly, and the mean and variance of projected expenditures were calculated based on the 1990 actual spending, updated to account for national trends.

Demonstration hospitals might also have been more aggressive in shortening stays and shifting care to the outpatient setting even without the demonstration. Any organizational differences of this sort are unmeasurable and speak to the limited generalizability of a demonstration with just four hospitals.

The broadest measure of net program savings includes the first two measures plus any additional savings or losses that result from changes in the locus of surgery between demonstration and other competitor hospitals. It is calculated as the difference between the negotiated bundled price and the average Medicare outlay for treatment in a competitor hospital in the market, multiplied by the change in demonstration hospital market share, then weighted by demonstration hospital bypass volume in the base period. For a savings to exist, a demonstration hospital must have experienced a gain in market share and not just an increase in Medicare bypass volume. This guards against over- or understating the savings to regionalization in markets with growing or shrinking numbers of patients.

Actual market shares were determined based on the demonstration hospital's fraction of total Medicare bypass cases in the market, as identified using the MEDPAR files. The demonstration hospital's market share in 1990 was assumed to be the market share it would have had in 1991-93 in lieu of the demonstration. Again, this is a strong assumption, in that all the demonstration hospitals indicated (by applying for the demonstration and during case study interviews) that they were interested in actively trying to increase their volumes

and market shares. They may have accomplished this goal (at least partially) without being chosen as a demonstration hospital, but we have no way of evaluating how successful they might have been. Market shares also were tested, statistically, to determine whether they varied across the 1990-93 period.

The extent of market share savings to Medicare depends, as well, on the outlay differential between the demonstration hospital and local competitors. Net inpatient bypass outlays per discharge in competitor hospitals were estimated based on MEDPAR and NCH claims files. These net outlays were then subtracted from the global payment and the difference applied to any shift in market share.

FINDINGS

Table 2 presents Medicare program and beneficiary savings by each of the three components. Total Medicare program savings at the four original demonstration hospitals, from the inception of the demonstration in June 1991 through September 1993, were \$15.31 million. This corresponds to a 14-percent discount on the projected expenditures of \$110.8 million in lieu of the demonstration (not shown). Medicare beneficiaries (and their supplemental insurers) are estimated to have saved another \$1.84 million, for a total savings of \$17.2 million. Total program savings for the 7 months of 1991 during which the demonstration was in operation totaled \$4.0 million, rising to \$6.8 million for all of 1992. Savings for January through September 1993 totaled another \$4.5 million, corresponding to an annual estimate of \$6.0 million.

Inpatient savings constituted 85-93 percent of total savings, depending on site. Postdischarge savings added another 6-11 percent each year. This was unanticipated. Aligning physician with hospital DRG per

Table 2

Total Medicare and Beneficiary Savings Under the Medicare Heart Bypass Demonstration, by Source of Savings: 1991-93

Source of Savings	Jun-Dec 1991	Jan-Dec 1992	Jan-Sept 1993	Total
Medicare Program Savings				
Inpatient Savings	\$3,556,472	\$6,317,988	\$3,844,225	\$13,718,685
Postdischarge Savings	409,905	387,449	407,911	1,205,265
Market Share Shift Savings	19,418	106,021	259,397	384,836
Total Savings	3,985,795	6,811,458	4,511,533	15,308,786
Beneficiary Savings				
Inpatient Savings	512,737	905,949	817,433	1,723,382
Postdischarge Savings	6,041	42,384	14,714	57,098
Market Share Shift Savings	4,216	15,802	43,366	59,168
Total Savings	522,994	964,135	875,513	1,839,648

NOTES: Includes all heart bypass operations in DRG 106 or 107. The demonstration began in May-June 1991 at the four original demonstration sites. The 1991 data include only cases covered under the demonstration. 1993 values are based on discharges through September 30th.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: MEDPAR and National Claims History files and negotiated payment rates, 1991-93.

case incentives should encourage more, not less, postdischarge care primarily through earlier discharges. The only component to grow as a proportion of total savings across the 3 years is the savings attributable to market share shifts. This was anticipated. Albeit small, the shift in bypass surgery to the demonstration hospitals and away from local competitors grew from less than 1 percent of total savings in 1991, to 2 percent in 1992, and to 6 percent in 1993.

Beneficiary savings are summarized in the bottom panel of Table 2. Ninety-five percent of the \$1.8 million in estimated savings results from the lower negotiated payment for the bypass hospitalization. Savings to beneficiaries from reductions in postdischarge utilization are quite small. Patients save slightly from lower Part B liability resulting from the lower level of utilization. (Most would not owe the Part A deductible for a postdischarge rehospitalization, having already paid the deductible during the benefit period.) The reduced inpatient demonstration liability also generates small savings as market shares increase for the demonstration sites.

Table 3 shows cumulative savings for discharges through September 30, 1993, at each of the four sites. St. Joseph's of Atlanta had the largest cumulative sav-

ings across the 3 years. In fact, it had the largest cumulative savings for each of the three components: inpatient, postdischarge, and market share. The large inpatient savings and savings from growth in market share were not surprising, given St. Joseph's high proportion of demonstration cases and their increase in market share. The level of postdischarge savings is surprising, given that shifts in postdischarge care were expected to offset program savings to some extent. The savings per case were not, however, statistically different from zero.

On a per case basis, the Medicare program saved an estimated \$3,048 per case in St. Joseph's, Atlanta, the lowest of the four hospitals. This is directly attributable to the lower discount offered off PPS and Medicare physician allowable fees. Nevertheless, this savings of more than \$3,000 per patient is already based on one of the lowest Medicare DRG 106 and 107 payment rates in the country.

St. Joseph Mercy in Ann Arbor is similar to St. Joseph's in Atlanta in its positive postdischarge savings and savings resulting from market share increases. These two were, in fact, the two hospitals found to have significant growth in market shares across 1990-93 (Cromwell et al., 1995).

Table 3
**Medicare Program Savings Under the Medicare Heart Bypass Demonstration,
by Hospital and Source of Savings: 1991-93**

Source of Savings	St. Joseph's Atlanta	University Hospital Boston	Ohio State University Hospital	St. Joseph's Mercy Ann Arbor
Medicare Bypass Discharges	1,805	562	343	941
Inpatient Savings	\$4,171,427	\$3,655,632	\$3,233,562	\$2,658,064
Post Discharge Savings	1,057,659	-179,799	2,296,870	624,275
Market Share Shift Savings	1272,018	-40,245	-8,608	1161,671
Total Savings	5,501,104	3,435,588	2,928,084	3,444,010
Total Savings Per Discharge	3,048	6,113	8,537	3,660

¹ Indicates the demonstration hospital market share varied significantly across 1990-93 ($p < 0.05$).

² Indicates postdischarge savings per case differed significantly from 0 ($p < 0.05$).

NOTES: Includes all heart bypass operations in DRG 106 or 107. The demonstration began in May-June 1991 at the four original demonstration sites. The 1991 data include only cases covered under the demonstration. 1993 values are based on discharges through September 30th. Savings estimates do not include beneficiary savings.

SOURCE: Health Care Financing Administration, Office of Research and Demonstrations: MEDPAR and National Claims History files and negotiated payment rates, 1991-93.

The two academic medical centers, University Hospital in Boston and OSU Hospital in Columbus, have similar savings patterns. Cumulative inpatient savings total more than \$3 million at both hospitals. Both also show the expected cumulative loss in the postdischarge period from shifts in services to other facilities or to ambulatory sites that bill outside the demonstration. OSU was the only site for which postdischarge spending differed significantly from the expected values. Both sites had small cumulative losses from declines in market shares, which were unlikely to be caused by participation in the demonstration. By contrast, the academic medical centers exhibited per case program savings of \$6,113 and \$8,537; again, because of their high inpatient discounts.

In summary, the bulk of program savings at all four hospitals is comprised of the inpatient savings. Estimates of postdischarge savings and savings arising from market share shifts may reflect some random variation not controlled for in the quasi-experimental design. However, given that these components comprise only 11 percent of the total savings estimates, the general conclusion should be relatively insensitive to these problems.

HOSPITAL COSTS AND PROFITS

Data Sources

In addition to Part A and Part B claims, each participating hospital submitted detailed cost information on every Medicare patient undergoing bypass surgery beginning in 1990, the year before the demonstration began, through 1993. The data pertained only to the facility and did not include any physician inputs or charges unless they were paid for directly by the hospital. Only OSU Hospital among the four institutions continued to use the traditional method of cost-to-charge ratios by department to determine patient costs. Both St. Joseph's Hospital in Atlanta and Boston University Hospital had implemented state-of-the-art microcosting systems before the demonstration began. St. Joseph Mercy Hospital in Ann Arbor converted to a very similar system late in the demonstration. In the process, their staff recalibrated their 1991-93 costs using the new system.

Data were submitted in unique computerized files by each of the participants covering the 1990-93 period. Each hospital was asked to submit a set of baseline files on Medicare bypass patients prior to the start of the demonstration, followed by annual submissions of microcost data. One file

contained background information on the patient, including age, sex, admission and discharge dates, revenues, and the like. Another file summarized each patient's cost information at the department level classified as direct variable, direct non-salary, indirect administration, etc. Finally, in the three hospitals using detailed microcost systems, an itemized procedure-service file was provided, listing all of the individual drugs, laboratory tests, operating room minutes and supplies, etc., each patient received.

METHODS

Costing is done in the microcost systems from the bottom up. It is in each hospital's best interest to make the cost allocation as accurate as possible. None of the microcost systems are used to maximize reimbursement; only to inform managers of real costs by type of patient. First, department heads identify the procedures and services that comprise 80 percent of department charges. Then, applying management-engineering techniques, department heads identify the labor, supplies, and equipment inputs associated with each procedure. Next, a unit cost is determined for each input in each department, e.g., a technician's hourly wage. When unit costs are multiplied by the number of units of a service or procedure, a patient's total cost for a given procedure is generated. Summing across all the different procedure costs within a department gives total departmental costs incurred on behalf of the patient. Finally, summing across all departments gives an estimate of the patient's total cost. Overhead costs are allocated to procedures on a predetermined fixed or variable basis. Because of the vast number of procedures performed every day in the inpatient setting, cost-to-charge ratios are used to identify costs for the residual 20 percent of services.

Hospitals differ in their breakdown of departments. Thus, it was not possible to present a uniform set of departmental data for comparison purposes—although all important cost centers are available. More detrimental to interhospital comparisons was the lack of uniform definitions of indirect versus direct costs or variable versus fixed costs. Some hospitals, for example, allocated most of central supplies to ancillary services, but others treated supplies as a separate indirect overhead department. Some hospitals broke out the blood bank or rehabilitation cost centers from the laboratory and physical therapy, respectively, but others simply merged them. Hence, time-series comparisons within facilities are believed to be more meaningful than interhospital comparisons.

By classifying costs into fixed and variable, financial managers are able to calculate two variants of patient margins or profits. Net income is simply the difference between net revenue paid under the two negotiated rates for all Medicare patients in DRG 106 or 107 and estimated patient average total (including fixed) costs. For purposes of the analysis, the estimated Part B physician portion of the negotiated rate is excluded, as is any patient copayment, so as not to overstate the revenues available to the hospital to cover its own institutional costs. The variable margin is calculated as the difference between net revenue and total variable costs, excluding fixed capital and overhead costs. Positive variable margins imply that bypass patients are more than covering the extra costs that are incurred by the hospital during their admission. In the short run, financial managers should be willing to accept any patients that more than cover their own variable costs and help pay for some of the facility's fixed costs.

The cost data are always reported in current dollars. Although costs rise over time

because of rising wage rates, drug prices, more costly equipment, and changing practice patterns, no adjustments were made for general inflation in the hospital sector. This is not a problem in determining the profitability of demonstration cases because net revenues also have been updated, using HCFA payment methods under the demonstration. However, cost trends alone will overstate the trend in real resources, procedures, and services used to treat bypass patients, which is of interest in measuring changes in resource consumption once physicians are at risk for extra services. Given that somewhat over half the annual rise in hospital costs can be traced to input price inflation outside the industry's control (Cromwell and Butrica, 1994), the upward bias in real utilization based on costs amounts to roughly 5 percent a year over the 3 years of the demonstration. That is, one would have expected the costs of bypass patients to rise nearly 16 percent as a result of higher input prices alone, ignoring the trend toward more intensive care (Mitchell et al., 1993; Adamache et al., 1994). Thus, 16 percent is the benchmark growth rate in determining whether real utilization rose or fell.

FINDINGS

Table 4 presents a summary of trends in costs and profits for the four demonstration hospitals. In three of four hospitals, average total costs per case fell in absolute terms over the 1990-93 period. The range of decline was from -2 percent (in St. Joseph Mercy, for DRG 107) to -23.4 percent (again for St. Joseph Mercy, for DRG 106). Assuming at least 5-percent annual inflation in input prices, these reductions amount to even larger hospital savings on a real-resource basis, e.g., possibly as great as 39 percent (23 percent + 16 percent). OSU Hospital, although not actually achieving

cost reductions, was successful in holding cost inflation to less than 11 percent over a 3-year period for DRG 106. The hospital appeared to be less successful in DRG 107 and exceeded the expected 16-percent inflation benchmark by 8 percentage points.

Both non-academic medical centers were quite successful in improving net income per demonstration patient, especially in DRG 106. University Hospital of Boston was less successful, although net incomes in DRG 106 fell only slightly, in spite of over 20-percent discounts off DRG rates. OSU Hospital suffered significant losses, compared with the year before the demonstration. This was the result of a combination of very large discounts plus significant cost increases, especially for DRG 107.

Most important to hospital financial managers are variable margins, as they reflect short-run profits and the contribution of product areas to fixed costs. The four sites varied greatly in their estimates of variable costs and, hence, their variable margins. In 1990 University Hospital of Boston reported variable margins of \$22,000-23,000 per case, compared with only about \$5,000 per case in Atlanta. The Atlanta facility classified fully two-thirds of its bypass costs as variable, versus only one-third in Boston. It seems unrealistically low to assume that only one-third of all costs in treating bypass patients is variable. Most operating room, central supply, nursing, drug, catheter, laboratory, blood bank, and central supply costs are variable, as are many ICU and routine nursing hours.

Within-hospital trends in variable margins under the demonstration are mixed. The two non-academic facilities show very large increases (except for DRG 107 in Ann Arbor), implying highly successful financial outcomes. The two academic medical centers, by contrast, experienced declines in variable margins, albeit still positive. Some of this change may be the result of

reclassifications of fixed to variable costs, but still, the short-run profitability of Medicare bypass surgery declined in both places. Had volumes increased significantly, thereby spreading fixed costs across more cases, the lower variable margins would have been more tolerable. Alternatively, volumes may have fallen much more without the imprimatur of the demonstration, in which case, bypass profitability would have deteriorated even more than indicated in Table 4.

Three of the four hospitals experienced declining average costs that were allegedly the result of changes in physician practice patterns and patient protocols. Table 5 decomposes the changes in direct costs by major cost center over the 1990-93 period. Overhead costs not directly associated with patient care are excluded because they do not reflect the impact of changes in physician practice that affect direct variable costs. Only the results for DRG 106 are shown, as results for the lower cost DRG 107 were quite similar.

Based on case-study interviews, all three hospitals introduced a new 24-hour protocol for postsurgery ICU stays and introduced shorter acting anesthetic agents to promote early extubation in the ICU. Both hospitals in Atlanta and Ann Arbor show a reduction in their ICU costs per patient of 25-34 percent as a result. University Hospital, by contrast, showed no net reduction in direct costs per case.

The two St. Joseph's hospitals also showed significant reductions in routine nursing costs, pharmacy costs, and radiology and laboratory costs. Again, case-study interviews with department directors explained these results. Once surgeons' incentives to control costs were aligned with those faced by hospitals under DRG payment, the surgeons became much more active in discharge planning, in reviewing drug protocols, and in eliminating unnecessary standard orders for routine testing. Nurses also reported that surgeons and cardiologists became more interested in discharge planning and not keeping patients in

Table 4
Cost and Profit Trends for Hospitals Participating in the Medicare Heart Bypass Demonstration, by Diagnosis-Related Group (DRG) Number and Hospital: 1990-93

Cost Measure and Hospital	DRG Number					
	106		Change 1990-93	107		Change 1990-93
	1990	1993		1990	1993	
Total Cost per Case						
St. Joseph's, Atlanta	\$22,118	\$20,206	-8.6	\$17,756	\$15,460	-12.9
St. Joseph Mercy, Ann Arbor	27,541	21,106	-23.4	18,235	17,865	-2.0
University Hospital, Boston	33,111	30,886	-6.7	21,471	20,621	-4.0
OSU Hospital, Columbus	25,384	28,157	+10.9	20,464	25,442	+24.2
Net Income per Case						
St. Joseph's, Atlanta	-1,482	2,126	+\$3,608	-891	3,513	+\$4,404
St. Joseph Mercy, Ann Arbor	230	8,866	+8,636	4,135	2,868	-1,267
University Hospital, Boston	1,406	1,090	-316	9,935	6,685	-3,250
OSU Hospital, Columbus	2,992	-4,185	-7,177	3,310	-6,725	-10,035
Variable Margin						
St. Joseph's, Atlanta	5,685	10,295	+81.1	4,610	9,741	+111.1
St. Joseph Mercy, Ann Arbor	12,546	20,328	+62.0	12,374	12,670	+2.4
University Hospital, Boston	21,818	19,254	-11.8	23,204	18,690	-19.5
OSU Hospital, Columbus	13,979	7,630	-45.4	12,145	3,863	-68.2

NOTE: OSU is Ohio State University.

SOURCE: Developed from micracost files on demonstration hospitals.

any longer than needed. They emphasized that physician support, especially by the thoracic surgeon, was instrumental in changing patient perceptions of the value of early discharge as well.

Attempts to change behaviors of orthopedic surgeons who were not under similar payment incentives, "fell on deaf ears." Generic substitutions in anesthetics, blood products, and contrast media for angiograms also were reported. Pharmacists, in particular, emphasized the role of the surgeon in convincing anesthesiologists and cardiologists to make cost-effective substitutions based on their special studies.

The results in Table 5 do not support cost savings in University Hospital. This is surprising, in that the hospital was one of the earliest to adopt clinical pathways for bypass patients to accelerate patient flow-through. The hospital did experience a 10-percent decline in routine nursing costs, but the 1990-93 difference was statistically insignificant. Possibly the absence of any appreciable volume gains, unlike the hospitals in Atlanta and Ann Arbor, also contributed to higher costs per procedure in some centers.

All four hospitals shortened their average length of stay during the demonstration. University Hospital's length of stay fell from 17.6 to 11.9 days; OSU's fell from 15.4 to 13.2 days; Ann Arbor's fell from 14.2 to 10.7 days; and Atlanta's fell from 12.3 to 9.0 days. Particularly striking among the four hospitals is the length of time in the hospital prior to surgery. For DRG 106 patients (who receive their catheterization during the surgical admission), the average time to surgery in the Atlanta and Ann Arbor sites was 2-3 days in 1992, compared with an average of 5-6 days at University Hospital of Boston and OSU Hospital, without any reduction in the gap during the demonstration. (The Atlanta and Ann Arbor sites also

Table 5
Percent Change in Direct Cost per Medicare Discharge in Diagnosis-Related Group 106, by Hospital and Department: 1990-93

Department	St. Joseph's Atlanta	University Boston	St. Joseph's Ann Arbor
Total	-13	+6	**-19
Nursing ICU	**-25	+1	**-34
Nursing General	**-32	-10	**-40
Pharmacy	**-32	+11	**-35
Operating Room ¹	**+19	+2	**-16
Catheter Lab	+2	**-29	+19
Respiratory Therapy	-10	-14	*-29
Radiology	-17	-12	**-25
Laboratory/Blood Bank	**-45	**+39	*-20
Other	—	—	—

* Significant at the 0.10 level.

** Significant at the 0.05 level.

¹ Includes recovery and anesthesia.

NOTE: ICU is intensive care unit.

SOURCE: Developed from microcost files on demonstration hospitals.

had slightly shorter presurgical stays for DRG 107.) The shorter presurgical stays were attributed to the ability to coordinate the handoff from cardiologist to surgeon and willingness to expand the operating room schedule (for example, having Saturday surgery for non-emergency patients) to reduce time to surgery.

Ideally, we would have had similar cost and profit data for competitor hospitals, which would have helped attribute changes related to the implementation of the demonstration as opposed to secular changes in bypass practice. Despite the absence of a comparison group, these data answer the central question of whether a hospital can reduce costs through changes in patient care management to maintain profitability in the face of reduced payment. We also feel that many of the changes in practice patterns were likely to have resulted from the bundled payment mechanism. Lengths of stay in the demonstration hospitals decreased over time, at least as much or significantly more than in competitor hospitals (Cromwell et al., 1995). Moreover, the reduction of postdischarge expenditures below their expected levels in two of the sites implies some change in practice styles or patient management beyond what was

implemented nationally. Our more recent work on heart bypass surgery has also indicated that many hospitals have not yet implemented changes, such as those in contrast media, that were found in the demonstration hospitals.

CONCLUSION

Negotiated prices for bundled hospital and physician services have spread rapidly nationwide under private managed care systems, encouraged in part by the HCFA bypass demonstration. Based on the results from the early years of the demonstration, the program has been successful in achieving significant discounts from regular DRG and RBRVS prices. In 2½ years, the Government and beneficiaries together saved more than \$17 million on bypass surgery in four participating institutions, averaging \$4,700 per case. Concerns that savings from inpatient discounts would be seriously eroded by shifts to outpatient care were unfounded. If anything, postdischarge costs declined slightly as well, although the results vary by institution.

In three of four participants, institutional costs per bypass case actually fell between 1990 and 1993. One would have expected at least a 16-percent increase because of rising input prices alone, ignoring any secular increase in intensity. And the fourth hospital kept cost increases 5 percentage points below the expected growth in prices for DRG 106 patients. Cost reductions came primarily in ICU and routine nursing, and in the laboratory and pharmacy, as surgeons took more responsibility for managing patient flow-through. Clinical nurse specialists were dedicated to managing heart patients from before admission to following them up after discharge. Twenty-four hour protocols were introduced in the ICU for uncomplicated cases. Same-day bypass surgery, unheard of prior to the

demonstration, became common practice among DRG 107 patients who had their catheterization done elsewhere. Generic drugs were substituted for brand-name narcotics. Surgeons and cardiologists consolidated their equipment and supply purchases in order to negotiate greater bulk discounts.

All of these changes have been achieved with no diminution in quality. Mortality rates among participants were more than one-half a percentage point below the national average, even adjusting for their less serious DRG case mix. Further, controlling for numerous surgical risk factors (e.g., previous bypass, left ventricular ejection fraction), no time trend in mortality was found in three institutions, and a significant improvement in inpatient and 1-year mortality was found in the fourth hospital (Cromwell et al., 1995).

Cost containment resulted in higher profit rates for the two non-academic medical centers. Hospital savings more than offset Medicare Part A discounts of 10 percent or more in these institutions. The two academic centers saw their average margins fall under the demonstration. This was the result, in one case, of offering discounts of 21-24 percent, while achieving absolute cost reductions of just 4-6 percent—still a notable achievement. The other academic center offered the largest discounts, exceeding 27 percent, but failed to reduce costs. Its average margins went from approximately \$3,000 in the black to \$4,000-6,000 in the red. All participants continued to experience substantial variable margins, which is the most appropriate measure of short-run performance.

Greater volumes generated from the demonstration's imprimatur coincided with the reductions in costs achieved by the non-academic centers. Had the academic centers been more successful in gaining market share, they may have been able

to spread fixed costs across more cases and been able to recoup the large discounts they offered the program.

Several conclusions can be drawn from the experience of just four participants. As might be expected, not all hospitals and physicians will perform equally under bundled payment. Some will achieve greater cost savings from patient care changes, and some will be more successful in marketing the program to patients, referring physicians, and to local managed care plans. Without question, though, significant efficiencies are achievable, even in such an expensive, complicated, and risky a field as heart surgery.

It is also clear that academic medical centers will have special challenges in the managed care arena. University salary limits, constraints on operating room time, closed staffs, expensive surgical residents, teaching-oriented physicians, high administrative and capital overhead, an impersonal community image, even a "they will come" philosophy in some places—all present barriers to successful competitive bidding. Academic centers are struggling with these barriers, and the two in the demonstration have made dramatic changes in patient care management and marketing more recently. Nevertheless, now that bypass surgery is performed in more than 900 hospitals, teaching hospitals no longer have a monopoly on this service and must convince deans and staff of the necessity of becoming more cost-conscious and flexible in a rapidly changing market.

The current demonstration was expanded to include three new participants in Indianapolis, Houston, and Portland, Oregon. Although the demonstration officially ended in mid-1996, bundled payments were continued for all the hospitals except Portland, in anticipation of their participation in the next demonstration.

Finally, given the successful performance of the original four participants in this demonstration, HCFA is planning to implement a new bundled payment demonstration expanding the concept to a group of cardiovascular and orthopedic procedures. Major surgical procedures have the advantage of little possibility of substitution of outpatient care for in-hospital services. However, as the bundled payment concept is broadened from heart bypass to bypass and angioplasty, possibly to ischemic heart disease, the potential for shifts to ambulatory care become greater. Over the next 2 years, more quantitative and qualitative research will be conducted to document and explain cost-containment efforts and outcomes. The early results are encouraging and demonstrate the critical importance of aligning physician and hospital incentives for efficient patient care management.

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