

MEDICARE'S HOSPITAL VALUE-BASED PURCHASING

PROGRAM OVERVALUES QUALITY

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Abstract

Medicare's Hospital Value-Based Purchasing Program (HVBP) is the first national pay-for-performance program to combine measures of quality of care with a measure of episode spending. We estimated the implicit tradeoffs between mortality reduction and spending reduction. To earn points in HVBP, a hospital can either lower mortality or reduce spending, creating a tradeoff between the two measures. We analyzed the quality performance and earned points of 2,814 hospitals using publicly available data. We then quantified the tradeoffs between spending and mortality in terms of QALYs. If incentives in the program were balanced, then the tradeoff between spending and QALYs should be comparable to those of high-value health interventions, roughly \$50,000 to \$200,000 per QALY. Instead, the tradeoff in HVBP was about \$1.2 million per QALY. HVBP overvalues improvements in quality of care relative to spending reductions. We propose two possible policy adjustments that could improve incentives for hospitals to deliver high-value care.

Key Words: Pay-for-performance, value-based payment programs, value of life, Medicare, QALY, episode spending

Introduction

The United States spends more than \$3 trillion annually on health care and is facing renewed concerns about continued growth.¹ Compounding the concern are well-documented differences in the quality of health care delivered across the country, suggesting suboptimal resource use.² To incentivize more efficient production of health care, the Centers for Medicare & Medicaid Services (CMS) has introduced an array of value-based purchasing programs, including the Hospital Value-Based Purchasing Program (HVBP) for hospitals, the Merit-based Incentive Payment System for physicians, and the Skilled Nursing Facility Value-Based Purchasing Program for nursing homes. These programs are widespread, addressing both inpatient and outpatient components of health care delivery for older Americans. The engine for these programs is a set of financial incentives that rewards providers for delivering high-quality and low-cost care.

However, balancing the incentives between quality improvements and spending reductions in these programs presents a major challenge to policymakers. For example, if hospitals received the same incentive payment for a small reduction in mortality as for a large reduction in spending, then the incentives would encourage hospitals to pursue minor improvements in mortality over spending reductions. The program would overvalue quality. Alternatively, if a large reduction in mortality yielded the same incentive payment as a small reduction in spending, then the program undervalues quality. To reflect societal values of these central aspects of health care improvement, programs should try to balance the incentives for quality improvement and spending reductions in value-based payment programs.

Despite its importance, we know little about the extent to which incentives in current value-based payment programs reflect accepted societal values for tradeoffs between quality of

care and spending. Using national data, we estimate the tradeoff in the HVBP between reducing mortality and lowering episode spending in terms of QALYs.

INCENTIVES UNDER HOSPITAL VALUE-BASED PURCHASING

CMS created several value-based payment programs to try to address low quality care in spite of high spending.³ HVBP is the most comprehensive of the current programs. Its design also serves as the blueprint for recent programs for home health agencies and skilled nursing facilities. Under HVBP, approximately 3,000 hospitals are subject to bonuses and penalties of up to 2 percent of their annual Medicare reimbursements based on performance on measures such as condition-specific mortality and total episode spending, where an episode is defined as the period from 3 days prior to a hospital admission through 30 days after discharge. In fiscal year 2017, HVBP rewarded hospitals on a weighted average of 22 measures across the main domains of patient experience, clinical process, mortality outcomes, patient safety, and episode spending. On each measure, a hospital's performance is converted into points, based on its performance against other hospitals in the nation and against its own baseline. Low performing hospitals earn zero points. Points are then linearly converted into a percent bonus, up to 2 percent, that affects all Medicare reimbursement the following year. Hospital leaders must decide how to invest finite resources to improve on the various measures because there are multiple ways to earn points.

Two key features of value-based payment programs shape the implicit tradeoffs. The first feature is the number of patient encounters included in calculating performance for a specific measure. The measure's population scope serves to limit the aggregate societal effect of any changes on the measure. When a measure is based on care provided to few patients, then

any improvements in that measure benefit relatively few people. When a measure is based on care provided to many patients, then any improvement in that measure has greater societal benefit. For example, a one-percent improvement in overall mortality rate indicates more lives saved than a one-percent improvement in the mortality rate for a rare disease.

The second key feature is the weighting of measures in computing financial incentives. A higher weight places more importance on that measure. For example, between 2013–2016, CMS reduced the weight on clinical process measures from 70 percent to only 10 percent of a hospital’s total score in the HVBP, thereby rapidly reducing the incentive to improve on clinical process of care relative to the other domains. The inclusion of multiple measures in a value-based payment program creates implicit tradeoffs.

KEY CONCEPTS AND FRAMEWORK

Because the HVBP program has multiple ways to earn points, there are implicit tradeoffs between measures of quality and episode spending. The lack of explicit discussion of these tradeoffs in the large value-based purchasing literature suggests that this seemingly obvious point is not widely appreciated. These implicit tradeoffs are especially salient when the measures involve mortality and spending. While our empirical example is for HVBP, this insight applies more broadly to other value-based purchasing programs.

These implicit tradeoffs create incentives that may have unintended consequences. The HVBP program was designed to provide financial incentives to both improve quality of care and to lower episode spending.⁴ The relative incentive size is as important as the total incentive size when hospitals make decisions regarding which quality improvement efforts to pursue. It is also possible that mortality reduction and episode spending reduction are correlated, so that improved

processes could both improve outcomes and save money. Unless the relative incentives reflect optimal societal levels, hospitals may misallocate resources and exacerbate inefficient resource use.

We show how to calculate the tradeoffs between any two measures in the HVBP program, and more generally in any value-based purchasing program. The Total Performance Score is a weighted average of the 22 HVBP measures. Implicitly, for a hospital to maintain its Total Performance Score, it can improve some unit of quality and spend more (perform worse), or, it can perform worse on some unit of quality in exchange for spending less (perform better). Running a regression of the Total Performance Score on each of the measures produces coefficients that can measure how an increase in one measure generates points, which can then, with only a few additional assumptions, be converted to dollars per quality-adjusted life year (QALY). Dollars per QALY is a commonly used standardized measure for comparing the value of various medical interventions.⁵ Therefore, we not only calculate the tradeoff between two ways to earn points, but then make this number policy relevant by quantifying it in a way that can be compared to standard threshold values.

Furthermore, the incentives in HVBP can be re-aligned to support appropriate incentives for mortality improvement and spending reductions. Each measure has two key features that can be adjusted by policymakers — the number of patients who are measured and the weight of that measure relative to other measures in the calculation of the Total Performance Score. We show how those might be adjusted in HVBP to better balance incentives.

METHODS TO ESTIMATE TRADEOFFS IN HOSPITAL VALUE-BASED PURCHASING

Data

We analyzed publicly available data on the HVBP from Hospital Compare and the fiscal year 2017 CMS Impact File. We excluded 141 out of 2,955 hospitals with missing information on mortality rates or on price-standardized 30-day episode spending.

Methods for Estimating Whether Tradeoffs Are Balanced

Our method for assessing whether incentives are balanced builds on the cost-effectiveness literature. If incentives in the HVBP program are balanced, then spending per quality improvement should be comparable to other high-value interventions. In the cost-effectiveness literature, quality is often measured in quality-adjusted life years (QALYs), where a QALY is a measure of the quality and quantity of life lived, with 1.0 QALY being one full year of life in perfect health. The accepted range for medical interventions is roughly \$50,000 to \$200,000 per QALY^{6,7}.

In this approach, we express the tradeoff between two measures as total spending per QALY. That is, if hospitals achieved a one-percentage point decrease in the mortality rate, then how many lives would be saved, how long would those elderly people be expected to live, and at what average QALY? The answer is a population-level measure of QALYs saved. And if hospitals achieved the corresponding decrease in episode spending, what would the total savings be? The answer is a population-level measure of financial savings that is implicitly equal to the number of QALYs saved through mortality reduction. The ratio of those two answers, expressed as dollars per QALY, can be compared to the accepted range.

Empirical Calculation of Tradeoff

We examined the HVBP program design in fiscal year 2017 to assess whether a reduction in condition-specific mortality measured in the HVBP Program is over-valued, appropriately valued, or undervalued.

To calculate the tradeoff between lowering mortality rates and lowering episode spending at the hospital-level, we estimated a hospital-level linear regression model to predict the Total Performance Score (*TPS*) as a function of the three 30-day, risk-adjusted mortality rates and the 30-day, price-standardized episode spending amount. The Total Performance Score is the overall score hospitals receive based on their performance across all measures, and determines rewards and penalties in HVBP. We also controlled for hospital performance on all 18 other HVBP measures and volume of patients for each of the three mortality measures. We modeled Total Performance Score as a function of mortality rates for the three mortality conditions (acute myocardial infarction *AMI*, heart failure *HF*, and pneumonia *PN*), episode spending, and other hospital-level measures.

We are primarily interested in the regression coefficients on the three mortality rates and on episode spending. These coefficients estimate the average change in the Total Performance Score associated with a change in measure performance, and should all be negative. The magnitude of the episode spending reduction needed to achieve the same Total Performance Score improvement as a one-percentage point condition-specific mortality reduction is the ratio of the mortality coefficients to the spending coefficient. For example, the ratio of the coefficient on *AMI* to the coefficient on episode spending is the average amount of episode spending reduction needed to earn the same number of additional Total Performance Score points as a one-percentage point reduction in *AMI* mortality rate, holding constant all other measures.

To calculate the population-level total episode spending equal to a one-percentage point reduction in mortality, we multiplied the ratio of the coefficients from the regression model to predict Total Performance Score by the total number of Medicare inpatient episodes per year (5,420,633). This number is the numerator of the spending per QALY ratio. We did this separately for each of the three mortality measures.

Next, we calculated the population-level total number of QALYs gained from a one-percentage point reduction in mortality for patients hospitalized with heart attacks, heart failure, or pneumonia. We not only estimated the additional number of Medicare patients who would live, but also how long and at what health level. On average, a typical elderly person who lives one year has a QALY less than one. For each mortality condition, we took one percent of the total number of Medicare patients with that condition each year and assumed that they lived the median length of time for an individual with that condition. Data on the median length of life for patients hospitalized for these diagnoses were calculated using Medicare patients living in Michigan in 2010. We applied the QALY weight for each condition⁸ and a discount rate of 3 percent for future years of life (see Panel B of Exhibit 2). The resulting number is our best estimate of the number of QALYs that would be gained if the mortality rate fell by one-percentage point.

As a robustness check, we conducted the same analysis for fiscal years 2015 and 2016 to determine whether our estimates were consistent across multiple years.

RESULTS

Among the 2,814 hospitals in our sample, average heart attack, heart failure, and pneumonia mortality rates were 13.8 percent, 11.9 percent, and 11.2 percent, respectively

(Exhibit 1). Annual prevalence of heart attack episodes was the lowest, at 153,847 episodes, followed by 295,945 episodes for heart failure, and 409,297 episodes for pneumonia (Exhibit 2).

Across all hospital admissions, the average price-standardized, 30-day episode spending was \$19,209 (Exhibit 1) for 5,420,633 episodes (Exhibit 2). Note that while episode spending is measured for all Medicare patients who have a hospitalization, mortality is only measured for patients with one of three specific conditions, collectively comprising less than 16 percent of all Medicare inpatients.

The average mortality rates and episode spending in fiscal year 2015 and 2016 were similar to 2017, albeit with slightly lower average episode spending and slightly higher average mortality rates (results available upon request) than in fiscal year 2017.

Our main results should be compared to the commonly accepted benchmarks of \$50,000 to \$200,000 per QALY. Reducing the heart attack, heart failure, or pneumonia mortality rate by one percentage point produces the same average change in Total Performance Score for a given hospital, as reducing episode spending by \$1,397 for heart attack, \$980 for heart failure, and \$1,255 for pneumonia (see column 3 of Exhibit 1).

We build on these estimates to calculate condition-specific spending per QALY estimates for heart attack, heart failure, and pneumonia (see Exhibit 2). If hospitals reduced episode spending by the amount found in the previous paragraph, then total Medicare savings would be that amount times the number of Medicare patients (around 5.4 million). The decrease in total annual spending would be \$7.6 billion for heart attack, \$5.3 billion for heart failure, and \$6.8 billion for pneumonia (see Panel A of Exhibit 2).

Combined, our estimates of the total value of Medicare savings divided by the equivalent total QALYs gained imply that the value of mortality reduction in HVBP is \$1,542,837 per

QALY for heart attack, \$1,268,827 per QALY for heart failure, and \$835,129 per QALY for pneumonia (see Panel C of Exhibit 2). The average across all three conditions is \$1,215,598 per QALY. Our robustness check shows that the estimates are similar for the prior two years (results available upon request).

In the HVBP program, spending per QALY for mortality reduction exceeds the benchmarks considerably (see Exhibit 3). We conclude that, because the HVBP program greatly overvalues mortality reduction compared to episode spending reduction, its incentives are unbalanced.

POLICY RECOMMENDATIONS

To create more balanced incentives, we propose two policy changes. First, CMS could change the number of people for whom each measure applies. As described above, the spending measure applies to all Medicare patients (more than 5.4 million patients), while the mortality measures only apply to a small subset with those conditions (between 153,000 and 409,000). Therefore, the current system rewards mortality reductions for relatively few patients and spending reductions for all patients. A simple way to create more balanced incentives would be to measure episode spending for the same subset of patients for whom outcome measures such as mortality are also calculated.

Second, CMS could change the weights on the measure domains, as they have every year of the HVBP program up through 2018. In fiscal year 2017, the five domains were allocated weights of 5 percent for clinical process of care, 20 percent for mortality outcomes, 25 percent for spending, 20 percent for safety, and 25 percent for patient experience. For fiscal year 2018, for example, CMS increased the safety weight to 25 percent and removed all clinical process

measures from HVBP so that the weights were evenly distributed across all domains. Rather than weighting each domain equally, CMS could place more weight on episode spending relative to mortality outcomes when computing the Total Performance Score.

We illustrate the consequences of both policy options for heart failure mortality and episode spending measures. The current policy is represented by Point A in Exhibit 4 and corresponds to the height of the bar for heart failure in Exhibit 3. Under current policy, heart failure mortality reductions are valued at \$1.269 million per QALY, with unequal numbers of patients measured for the efficiency and mortality domains but with equal domain weights (25 percent each). The first policy change—limiting the number of patients measured for the efficiency domain to just heart failure patients, but keeping the domain weights constant—would dramatically reduce the value of mortality reduction towards point B. Point B lies directly below Point A because there is no change in weights (shown on the *x*-axis).

The second policy change — adjusting the domain weights but keeping the number of patients measured unchanged — could also dramatically reduce the value of mortality reduction. For example, if the spending domain weight increased and the mortality domain weights decreased then the result would move in the direction of point C in Exhibit 4. This change would move down and to the right in the graph, because the *x*-axis is the spending domain weight. Again, this policy change would result in a valuation within the balanced incentives zone.

CONCLUSIONS

We found that the implicit incentives in HVBP value reductions in mortality at about \$1.2 million per QALY, averaged across the three incentivized conditions. The value of a QALY in

HVBP is much higher than standard thresholds used to determine whether medical care is cost-effective, usually between \$50,000 and \$200,000 per QALY.

To better understand the degree to which HVBP overvalues lives saved at the expense of diverting resources away from other important areas of quality, it is helpful to put the \$1.2 million figure in context. A recent paper by Doyle and colleagues⁹ used random assignment of ambulance services to show that patients who went to higher spending hospitals had better outcomes, and that by paying more to send patients to better hospitals, Medicare spent about \$80,000 per one year of additional life saved. A review of 200 public health interventions in the England found that 89 percent had cost-effectiveness ratios less than £30,000 per QALY, or about \$42,000 per QALY.¹⁰ Another review found that estimates varied by method of calculation, but all were well below \$200,000 in 1997 dollars.⁶ We could find no descriptions in the published literature of interventions with cost-effectiveness ratios anywhere near \$1 million per QALY. To create more balanced incentives, CMS could change the number of people for whom each measure applies or reweight the measure domains.

Although our study does not estimate the cost of making improvements in quality or in spending reduction, those costs are not part of the tradeoff within the HVBP program. The implicit tradeoffs do not depend on the cost of improvement, which could be large or small, and may vary across hospitals. The improvement costs are important for hospitals deciding on what to invest in, but are not directly part of the cost per QALY calculation.

In addition, we acknowledge that there could be positive spillover effects — efforts in mortality reduction could improve morbidity as well. These improvements would also decrease the cost per QALY. To the extent that mortality reductions also improve morbidity in those

conditions or spillover to other conditions, our calculations overestimate the emphasis that the HVBP program places on quality of care over reductions in spending.

An alternative interpretation of our results is that the HVBP program reflects society's values by placing an extremely high value on mortality reduction relative to spending reduction. Ashenfelter and Greenstone¹¹ pointed out that when government agencies make decisions with costs and benefits borne by different groups of people, that cost-benefit estimates are likely to be quite heterogeneous. That is the case for HVBP, with the mortality and spending measures calculated for different groups of patients. However, we also found stark differences in the value for each of the three mortality measures, differences of up to 40%. This creates an inefficiency on its own.¹² It would be better if the value of mortality reduction were the same across the three mortality measures, so that hospitals would face an equal incentive to reduce all types of mortality. In summary, even if the HVBP program does not place too high a value on quality overall, the different values across the three mortality measures creates inefficient incentives.

Our study brings together these often parallel but separate areas of research, by being the first to describe how cost-effectiveness standards can be applied to value-based purchasing programs. From a societal perspective, if spending reductions can be efficiently reallocated toward more cost-effective care, these results suggest that HVBP rewards hospitals too much for mortality reductions relative to spending reductions. Addressing if and how to value quality will become increasingly important as value-based purchasing programs proliferate.

Although we apply this method to HVBP for three measures of mortality, our approach could be applied to other measures of quality in HVBP or to other value-based purchasing programs. Applying such an approach would better align value-based purchasing with societal goals to efficiently allocate public resources.

CONFLICTS OF INTEREST

No disclosures or conflicts of interest.

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Notes for Exhibits

EXHIBIT 1 (table)

Caption: Hospital Value-Based Purchasing Regression Results, Fiscal Year 2017

Source/Notes: SOURCE: Authors' calculations using data from fiscal year 2017 Hospital Compare, Michigan Medicare claims data, and Impact File. NOTES: The table reports data from a sample of 2,814 hospitals participating in fiscal year 2017 Hospital Value-Based Purchasing program without missing mortality or spending data. Column (1) presents baseline means. Column (2) models Total Performance Score as a function of 30-day risk adjusted mortality rates using ordinary least squares. This hospital-level model also controls for hospital performance on all other Hospital Value-Based Purchasing measures. Column (3) presents the spending and mortality reduction equivalency, calculated from the ratio of each unrounded mortality coefficient for 1 percentage point mortality reduction to 30-day episode spending coefficient from regression.

EXHIBIT 2 (table)

Caption: Incentives in the Hospital Value Based Purchasing Program for three mortality conditions, measured as spending per quality adjusted life year (QALY)

Source/Notes: SOURCE: Authors' calculations for all except QALY weight, which is based on Nyman et al. (2007). NOTES: The table reports data from a sample of 2,814 hospitals participating in fiscal year 2017 Hospital Value-Based Purchasing program without missing mortality or spending data. Numbers in Panel (A) and Panel (B) computes the primary estimate of interest in Panel (C). In Panel (A), we obtain (A) total annual spending from (spending and mortality equivalency) \times (5,420,633 which is the annual volume of Medicare episodes for spending measure). In Panel (B), we obtain (B) QALYs saved from (episodes per year) \times (QALY weight) \times 1 percent, with 3 percent annual discount over median life expectancy if survive. In Panel (C), we obtain total annual spending per QALY saved from (total annual spending) \div (QALYs saved).

^a Spending and mortality reduction equivalency are taken from column (3) of Exhibit 1

^b Episodes per year are obtained from Hospital Compare.

^c QALY weights are based on weights for people 75 years or older and assuming weights are consistent with those with heart attack (0.696 for heart attack), with other heart disease (0.711 for heart failure), and with self-reported "good" health (0.762 for pneumonia). The QALY weights are based on Nyman et al.⁸

^d Median life expectancy if survive is estimated from Michigan Medicare beneficiaries admitted in 2010 for heart attack, heart failure, or pneumonia, who did not die within 30 days of hospital discharge.

EXHIBIT 3 (figure)

Caption: Schematic for incentives in the Hospital Value Based Purchasing Program for three mortality conditions, measured as spending per quality adjusted life year (QALY)

Source/Notes: SOURCE: The high and low benchmarks for spending per QALY are based on recommendations from Neumann, Cohen, and Weinstein⁷, all other numbers are authors' calculations using data from Hospital Compare, Michigan Medicare claims data, and Impact File. NOTES: The spending per QALY comes from the last row of Exhibit 2 under Panel (C), total annual spending per QALY saved. The average spending per QALY is a simple average over the three conditions.

EXHIBIT 4 (figure)

Caption: **Two policies to change unbalanced incentives to be more balanced, using heart failure as an example**

Source/Notes: SOURCE: The high and low benchmarks for spending per QALY are based on recommendations from Neumann, Cohen, and Weinstein⁷, all other numbers are authors' calculations using data from Hospital Compare, Michigan Medicare claims data, and Impact File. NOTES: Point A is calculated from fiscal year 2017 Hospital Value Based Purchasing data, using hospitals with scores in all measure domains (2,230 hospitals). Medicare Spending per Beneficiary (MSPB) episode volume is 18 times greater than heart failure episode volume.

EXHIBIT 1. Hospital Value-Based Purchasing Regression Results,
Fiscal Year 2017.

		Coefficient (Standard Error)	Spending and Mortality Reduction Equivalency in Dollars (Standard Error)
	Mean (1)	(2)	(3)
<i>Panel A. 30-day mortality</i>			
Heart attack	13.8 percent	-2.25 (0.15)	1,397 dollars (112)
Heart failure	11.9 percent	-1.58 (0.11)	980 dollars (76)
Pneumonia	11.2 percent	-2.02 (0.10)	1,255 dollars (81)
<i>Panel B. 30-day spending</i>			
Episode spending	19,209 dollars	-0.001609 (0.000064)	

EXHIBIT 2. Incentives in the Hospital Value Based Purchasing Program for three mortality conditions, measured as spending per quality adjusted life year (QALY)

	Heart Attack (1)	Heart Failure (2)	Pneumonia (3)
<i>Panel A. Spending per 1 percentage point mortality reduction</i>			
Spending and mortality equivalency (dollars) ^a	1,397	980	1,255
(A) Total annual spending (billion dollars)	7.573	5.312	6.803
<i>Panel B. QALYs per 1 percentage point mortality reduction</i>			
Episodes per year ^b	153,847	295,945	409,297
QALY weight ^c	0.696	0.711	0.762
Median life expectancy if survive (years) ^d	4.85	2.02	2.68
(B) QALYs saved	4,908	4,187	8,146
<i>Panel C. Spending per QALY</i>			
(A) ÷ (B) Total annual spending per QALY saved (dollars)	1,542,837	1,268,827	835,129

EXHIBIT 3. SCHEMATIC FOR INCENTIVES IN THE HOSPITAL VALUE BASED PURCHASING PROGRAM FOR THREE MORTALITY CONDITIONS, MEASURED AS SPENDING PER QUALITY ADJUSTED LIFE YEAR (QALY)

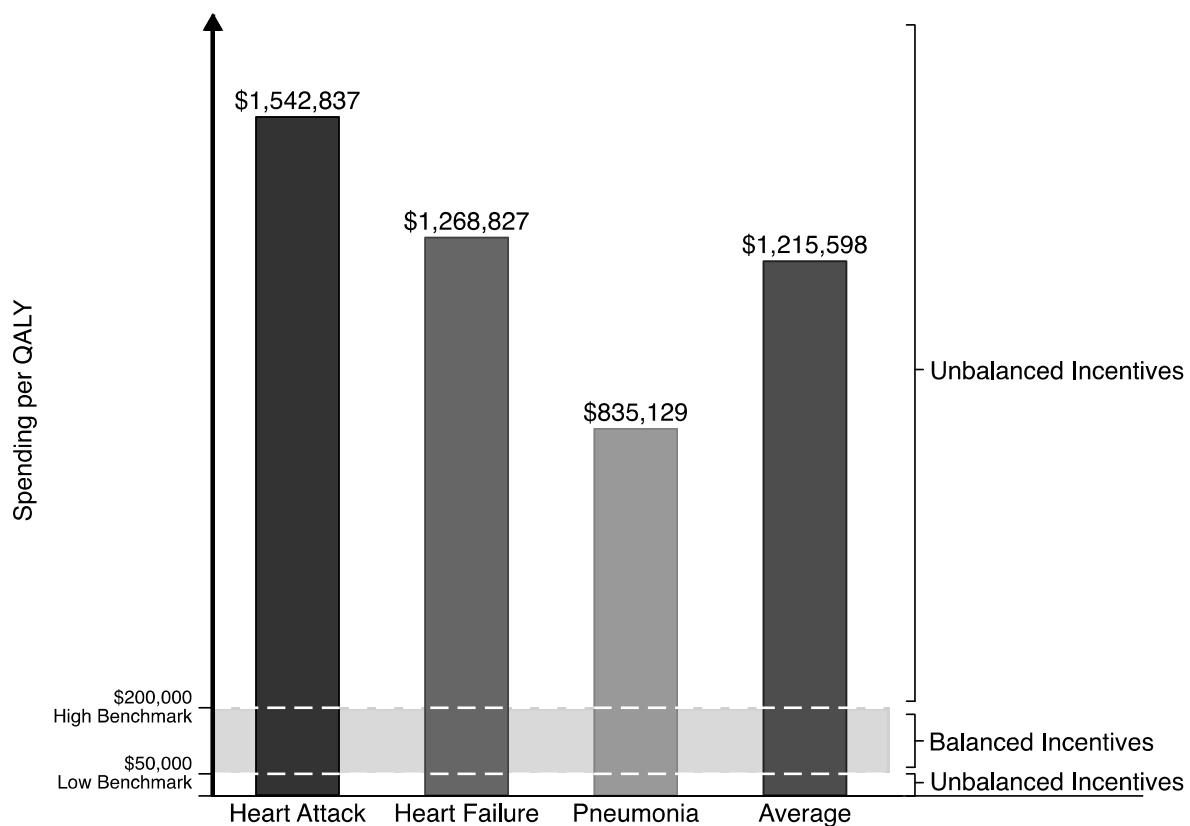


EXHIBIT 4. TWO POLICIES TO CHANGE UNBALANCED INCENTIVES TO BE MORE BALANCED,
USING HEART FAILURE AS AN EXAMPLE

