Putting the Value Framework to Work in Surgery

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BACKGROUND: Health policy experts have proposed a framework defining value as outcomes achieved per dollar spent on health care. However, few institutions quantify their delivery of care along these dimensions. Our objective was to measure the value of our surgical services over time.

STUDY DESIGN: We reviewed the data of patients undergoing general and vascular surgery from 2002 through 2012 at a tertiary care university hospital as abstracted by the American College of Surgeons NSQIP. Morbidity and mortality data from the American College of Surgeons NSQIP database were risk adjusted to calculate observed-to-expected ratios, which were then inverted into a numerator as a surrogate for quality. Costs, the denominator of the value equation, were determined for each patient's hospitalization. The ratio was then transformed by a constant and analyzed with linear regression to analyze and compare values from 2002 through 2012.

RESULTS: A total of 25,453 patients met criteria for inclusion. Overall, the value of surgical services increased from 2002 through 2012. The observed increase in value was greater in general surgery than in vascular surgery, and value actually decreased in vascular procedures. Although there was a similar increase in outcomes in vascular surgery compared with general surgery, costs rose significantly higher ($474/year vs −$302/year; $p < 0.001$). These increased costs were mostly observed from 2006 through 2010 with the adoption of endovascular technology.

CONCLUSIONS: Despite the challenges posed by current information systems, calculating risk-adjusted value in surgical services represents a critical first step for providers seeking to improve outcomes, avoid ill-advised cost containment, and determine the costs of innovation. (J Am Coll Surg 2015;220:596−604. © 2015 by the American College of Surgeons)

The vexing problem of escalating American health care costs has challenged health policy experts for the past 4 decades. Reform efforts highlighting issues of access, safety, quality, and cost have failed to decrease health care cost because they fail to comprehend the dysfunctional cost shifting and conflicting incentives among payers, providers, insurers, and regulators.[1] In this context, a focus on increasing value, defined as the improvement in health outcomes achieved per dollar spent, emerged as a concept that can unite all stakeholders.[2]

However, the current health care system remains ill equipped to embrace the concept of value because the fee-for-service model rewards volume of service provided rather than the value of services.[3] Current pay-for-performance schemes seeking to mitigate volume growth primarily focus on process compliance or "best practices," that is, inputs and tactics rather than results.[4] Even obvious outcomes remain obscured in free text of electronic medical records.[2] Costing systems currently support clinician and hospital billing for reimbursement and neglect the measure of resource use.[5] For these reasons, value remains a theoretical rather than a practical goal.

Surgically treated diseases provide a logical opportunity to develop and implement the value framework. The availability of preoperative, intraoperative, and postoperative data permits risk-adjusted quantification of treatment outcomes. Taking advantage of such data, the Veterans Administration Health System, the Society of Thoracic Surgeons, and the American College of Surgeons (ACS) have each developed and maintained robust surgical quality-improvement programs ripe for developing systems to focus on value.[1]

First-step efforts to measure value must begin by relying on simple surrogate quality measures, then improving the methods with continued use and refinement. In this investigation, we developed measures of

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Abbreviations and Acronyms
ACS = American College of Surgeons
CDR = Clinical Data Repository
CMS = Center for Medicare and Medicaid Services
O/E = observed to expected
R^2 = coefficient of determination

value in surgical care using risk-adjusted surgical outcomes relative to cost and observed the value trends over time.

METHODS

Patients

The University of Virginia IRB approved the current study, including an institutional waiver for the need to obtain patient consent. The data from patients undergoing general and vascular surgery were entered prospectively into an institutional ACS NSQIP database. This database prospectively gathers data on 130 patient and operative variables, including patient demographics, preoperative risk factors, patient laboratory values, intraoperative variables, and postoperative 30-day morbidity and mortality. We retrospectively reviewed data of patients (aged older than 18 years) undergoing general and vascular surgery operations from January 1, 2002 to December 31, 2012. Patients were stratified into those undergoing general or vascular surgery operations based on each operation's CPT code.

Outcomes

The primary outcomes of interest were differences in value over time. For the purposes of this investigation, value was defined as quality divided by costs, as proposed by Porter and colleagues.[2,6] They define quality not as process compliance, but rather as patient outcomes with the inclusion of sufficient patient factors to allow for risk adjustment. They define costs not as individual surgical reimbursement, but rather the total costs of care, including shared resources across an entire health care organization, such as physicians, staff, facilities, and equipment. However, in this study we used only hospital costs.

Calculations and statistical analysis

To capture quality, we relied on previously described ACS NSQIP measures as a surrogate for quality.[7] We calculated the ratio of observed-to-expected (O/E) outcomes using logistic regression to predict the probability of both 30-day morbidity and mortality for each patient undergoing a given operation. Observed 30-day morbidity and mortality occurrences were then divided by the expected number to yield a risk-adjusted estimate of quality for all operations during a given year; an O/E ratio of 1.0 was "as expected," <1.0 was better than expected, and >1.0 was worse than expected. Because quality served as the numerator of the value equation, O/E ratios for each year were inverted (ie, 1 divided by the O/E ratio), such that an increase in the numerator would correlate with a higher number, so that increasing numbers represented increasing value.

Cost data for the analysis were obtained from patient hospitalization and physician administrative data abstracted from the University of Virginia Health System Clinical Data Repository (CDR).[8] The CDR is a secure comprehensive clinical database that captures all inpatient and outpatient clinical contacts within the University of Virginia Health System; the accuracy and validity of the University of Virginia CDR have been published elsewhere and shown to be comparable nationally.[9-13] Briefly, the CDR uses microcosting algorithms to capture extensive cost data in an actual use framework. Consequently, financial transactions are calculated not only as third-party charges, but also as estimated costs based on such algorithms, which were used as the basis for defining costs in the current study. To account for inflation, estimated costs are represented in adjusted-year 2002 US dollars, discounted by the annual Consumer Price Index.[14] Given the low frequency of incomplete cost observations (<2% of the database) and our belief that missing cost data were generated via a random mechanism, mean imputation was used for unobserved patient costs.

To calculate value, the annual inverted O/E ratio was divided by mean costs. To achieve a comprehensible value tangible to the public, this number was multiplied by a constant so that the value in year 2002 would be equal to 100.

All categorical variables are expressed as a percentage of the group of origin, and continuous variables are expressed as the mean ± SD. Trends in the O/E ratio, costs, and value over time were compared using linear regression. The slope of the linear regression was used to determine the trend, and the coefficient of determination (R^2) was used to assess the strength of the trend over time. Data analysis was performed using R statistical software (The R Foundation for Statistical Computing, available at: http://www.R-project.org).

RESULTS

A sample of 22,057 patients undergoing general surgery and 3,395 patients undergoing vascular operations at the University of Virginia from 2002 through 2012 met criteria for inclusion in our analyses. The combined