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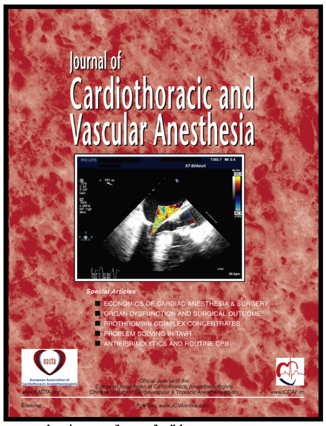

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Defining Value-Based Care in Cardiac and Vascular Anesthesiology: The Past, Present, and Future of Perioperative Cardiovascular Care

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PII: S1053-0770(17)30782-6
DOI: http://dx.doi.org/10.1053/j.jvca.2017.09.043
Reference: YJCAN4357

To appear in: *Journal of Cardiothoracic and Vascular Anesthesia*

Cite this article as: Lavinia M. Kolarczyk, Harendra Arora, Michael W. Manning, David A. Zvara and Robert S. Isaak, Defining Value-Based Care in Cardiac and Vascular Anesthesiology: The Past, Present, and Future of Perioperative Cardiovascular Care, *Journal of Cardiothoracic and Vascular Anesthesia,* http://dx.doi.org/10.1053/j.jvca.2017.09.043

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Title Page:

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Acknowledgements: none

Funding source: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Note: Dr. Robert Schonberger invited our group to submit this review article for consideration of publication in the Journal of Cardiovascular Anesthesiology.

Abstract:

Health care reimbursement models are transitioning from volume-based to value-based models. Value-based models focus on patient outcomes both during the hospital admission and post discharge. These models place emphasis on cost, quality of care, and coordination of multidisciplinary services. Perioperative physicians are challenged to evaluate traditional practices to ensure coordinated, cost effective, and evidence-based care. With the Centers for Medicare Services planned introduction of bundled payments for coronary artery bypass graft surgery, cardiovascular anesthesiologists are financially responsible for post-discharge outcomes. In order to meet these patient outcomes, multidisciplinary care pathways must be designed, implemented and sustained; a process that is challenging at best. This review will (i) provide a historical perspective of health care reimbursement, (ii) define value as it pertains to quality, service, and cost, (iii)

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review the history of value-based care for cardiac surgery, (iii) describe the drive towards optimization for vascular surgery patients, and (iv) discuss how programs like Enhanced Recovery After Surgery assist with the delivery of value-based care.

Keywords:

Value Based Care; Quality Improvement; Patient Outcomes; ERAS; Cardiac Surgery; Vascular Surgery

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Health Care Economics 101: The past, present and future of reimbursement

In 2015, the United States (US) spent $3.2 trillion on healthcare expenditures or 17.8% of its gross domestic product. It is projected that healthcare spending will rise to $4.6 trillion by 2020, nearly 20% of the gross domestic product. As a percentage of the total national health expenditure, Medicare, Medicaid and private health insurances contributed 20%, 17% and 33% respectively in 2015.[1] The US government provides health care coverage for 58 million people through Medicare and another 72 million through the Medicaid programs, making the government the single largest provider of healthcare in the US[2]. As a result of the rising healthcare expenditures, approximately 50% of government healthcare entitlement programs are now being funded with sources other than payroll

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taxes and premiums.[3] Some blame the traditional "fee-for-service" payment model for the escalating and excessive healthcare costs in the US. To attempt to control healthcare costs and improve the quality of patient care, payment models are transitioning from the traditional volume driven fee-for-service reimbursement to value-based payment systems.

The Past: Historical Perspective on Payment Models

Prior to the Great Depression, hospitals primarily relied on direct payment from patients. In an attempt to control declining revenues during the Great Depression, the American Hospital Association (AHA) developed the Blue Cross concept in 1929 (Figure 1).[4] Blue Cross plans primarily guaranteed payment for in-hospital costs, creating an economic disparity in access to non-covered out-of-hospital services, especially to low-income patients. In 1939, Blue Shield was developed by employers in the lumber and mining camps of the Pacific Northwest to provide out-of-hospital medical care through monthly fees to medical service bureaus. After World War II, the commercial health insurance industry rapidly expanded. This led to an increasing demand for health insurance as a standard benefit of employment. Despite the growth in the insurance sector, an increasing coverage gap emerged between those who had insurance and those who did not. To bridge this gap, Congress enacted the Medicare and Medicaid Act in 1965. Medicare and Medicaid, one of the largest public health reform initiatives in US history, provided a safety net for retirees and the underserved. The legislation extended health coverage to almost all Americans aged 65 and older and provided healthcare services to low-income children and the disabled. This expanded coverage linked with a fee-for-service reimbursement scheme soon led to cost overruns and a precipitous run-up in healthcare

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costs. In the 1980s and 1990s, innovative managed care models attempted to deliver service while containing rising health care costs. In the managed care model, providers receive a capitated or a "lump sum" payment per beneficiary for the healthcare services rendered. The capitation of payments placed the healthcare providers in the role of micro-healthcare insurers and incentivized them to restrict expensive, but sometimes necessary, health care services.

The Present: Transition from Fee-for-Service to Value-Based Payment Models

Although there are several factors that are thought to be contributing to the rising health-care costs, the fee-for-service model and exorbitant administrative costs have been targeted as major areas of reform.[5] Administrative costs are estimated to be as high as 20-25% of the national health expenditures.[6] Additionally, it is estimated that 3 to 10% of total healthcare spending is attributable to fraudulent billing by public and private programs.[7] To address these issues, the National Commission on Physician Payment Reform was convened in 2012.[8] On March 4, 2013, the Commission issued a report detailing a series of recommendations aimed at controlling health care spending and improving the quality of care (Table 1). The key recommendations eliminate fee-for-service payment systems for medical services and replace them with payment systems based on value through mechanisms such as bundled payment, capitation, and increased financial risk sharing.

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The Future: Alternative Payment Models

Alternative payment models such as accountable care organizations (ACOs), bundle payment models, and patient-centered medical homes (PCMH) reimburse providers for the value of care delivered. An ACO is an integrated network of health care practitioners accountable for the quality, cost, and overall care delivered to the enrolled beneficiaries.[9] In the ACO model the financial risk is largely shared between the physicians and their respective organizations, incentivizing optimal use of high-value services while cutting unnecessary waste. Unlike managed care payment models, in the ACO model health care organizations payment is dependent on meeting pre-defined quality metrics. Although a majority of core quality measures are focused around the primary care setting, major subspecialties have measures that are specialty-specific. Failure to meet these standards results in financial penalty. Thus far, there have been only modest reductions in Medicare spending amongst the organizations that entered the Pioneer ACO program, with no significant changes in the quality of healthcare.[10] Currently, there is minimal data to show that value-based payment systems lead to superior outcomes compared to fee-for-service payment models. Also, it is unclear if capitation of payments in the value-based system will force providers to restrict necessary care from their patients.

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Bundled payment, a form of episodic payment model (EPM), represents a novel payment model where a fixed amount is paid by the insurer for all acute and post-acute care associated with a hospitalization or an event, inclusive of the professional fees. This is somewhat similar to the existing diagnosis-related group (DRG) model, used predominantly for inpatient care, where hospitals receive a single payment for specific

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healthcare events but are exclusive of the professional fees. The Comprehensive Care for Joint Replacement (CJR) for hip and knee replacement surgery was the first bundled care payment model rolled out by the Centers for Medicare & Medicaid Services in January 2016. Under the CJR model, hospitals are responsible for the entire episode of care beginning with admission after the procedure and ending 90 days after discharge. Depending on the quality and cost of performance, the hospital either repays a portion of the cost to Medicare or earns a financial reward based on the actual cost of the episode. The hospitals therefore have a financial incentive to provide high-quality, value-based care for their patients from the initial surgery to 90 days after they are discharged.

To maximize participation in the above alternative payment models, Congress enacted the Medicare Access and Children's Health Insurance Plan Reauthorization Act (MACRA) in 2015.[11] MACRA, a replacement of the long-standing Sustainable Growth Rate (SGR) formula, integrates existing Medicare components such as Meaningful Use, Physician Quality Reporting System (PQRS) and the Value Modifier Program into a single program, the Quality Payment Program (QPP)[12]. Under MACRA, Medicare allows physicians choice between two payment tracks – Merit-Based Incentive Payment System (MIPS) or an Advanced Alternative Payment Model (APM). Under MIPS, physicians continue to get reimbursed primarily via fee-for-service but there are in-built bonuses or penalties based on four components: quality of care, resource use, meaningful use of electronic health records, and clinical practice improvement (CPI). Each of the four components are scored creating a composite final score determining reimbursement rates starting in 2019. The bonuses and penalty payment amounts increase incrementally over

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time, from a maximum of 4 percent in 2019 to 9 percent in 2022. The second payment track includes physicians with significant participation in certain alternative payment models (APMs). Providers participating in qualified APMs must measure both cost and quality to receive an annual 5% bonus from 2019 to 2025. In order to be exempt from MIPS, clinicians must be deemed as Qualified Participants of an Advanced APM by meeting the minimum threshold for either the percentage of patients or payments. APMs require providers to shoulder “more than nominal financial risk,” and meet certain quality metrics. Beyond 2026, APM reimbursements will increase at 0.75% per year, while MIPS reimbursement will increase only at 0.25% per year, thus favoring APM participation over MIPS. It is important to note that changes to payment models are not just restricted to Medicare and Medicaid. Commercial payers are also pursuing pay-for-performance and bundled or episode-based contracts with physicians.

Defining Value

With the changing landscape of reimbursement to MIPS and APMs, it is imperative for hospitals to initiate and sustain quality improvement efforts, evaluate performance outcomes, and employ evidence-based practices to improve the quality of care and decrease complications. It is a time in which all perioperative clinicians must define and demonstrate the value they bring to the patient in order to claim reimbursement for clinical services. However, defining value is much harder than first appears. The simplest definition of value is often described as:

$$\textbf{Value} = \frac{\textbf{Quality}}{\textbf{Cost}}$$

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This equation captures the essence of value and can be broadly applied in any circumstance in so much as the definitions of quality and cost are broadly encompassing. Maybe a better definition that captures both monetary and nonmonetary components of value is shown as:

$$\textbf{Value} = \frac{\textbf{Satisfaction of needs (benefits, monetary and nonmonetary)}}{\textbf{Use of resources (money, people, time, energy and materials)}}$$

In this definition value can rise and fall dependent on the dominance of one or more variables. For example, if a service of commodity is free, then the monetary or nonmonetary needs might be negligible, and there is still value. Another way of phrasing this in healthcare might be:

$$\textbf{Value} = \frac{\textbf{(Clinical Outcomes + Patient Experience)}}{\textbf{Total Cost per Capita}}$$

In 2007 the Institute of Medicine prepared a statement outlining the six requirements for effective healthcare (Table 2).[13] Combining the value definition above with the IOM's requirements for quality healthcare, one can construct the following new value equation for healthcare:

$$\textbf{Value} = \left\{\frac{\textbf{Safe*Effective*Patient Centered}}{\textbf{Untimely* Inefficient* Cost}}\right\} \textbf{* Equitable}$$

Using this equation, value is now defined as something that is safe, effective, patient-centered, timely and efficient. Applying the equity multiplier explicitly introduces

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population health as an integral component. If rendered care is not equitable, or accessible to all, then this care fails to provide value for the population.

The Voice of the Customer (the Patient) in the Value Equation

In April 2015, the Centers for Medicare and Medicaid Services (CMS) administered one of the first comprehensive patient experience surveys called the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). The HCAHPS evaluates the in-hospital experience of medical, surgical and obstetrical patients. Patients provide feedback of their experiences, specifically focusing on physician care and communication, in addition to hospital cleanliness and noise levels. Since 2015, CMS ranks hospitals based on their HCAHPS scores. Although well intentioned, there remains a disconnect between HCAHPS score and other surgical outcomes.[14-16] Specifically, HCAHPS scores do not report on, nor predict, patient outcomes.

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In an attempt to correct this, a collaborative effort between the American Society of Anesthesiologists and the American College of Surgeons produced the Consumer Assessment of Healthcare Providers and Systems Surgical Care Survey (S-CAHPS). This intended analog to HCAHPS for the preoperative experience carried the support of both organizations as the patient experience metric for the Value Based Payment modifier for surgical procedures. This tool also provides information for the public report on the Physician Compare website.[1]

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[1] www.medicare.gov/physiciancompare/

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Although there are numerous validated instruments to assess patient satisfaction with anesthesia care [17, 18] there is increasing emphasis placed on S-CAHPS due in large part because it is administered by the Agency for Healthcare Research and Quality and endorsed by the National Quality Forum. The current version of S-CAHPS contains 47 questions, of which only 8 pertain to anesthesiology.[19] Of these 8 anesthesiology questions, 3 questions are actionable and centered solely on the pre-anesthesia visit; the remaining questions completely overlook the intra-operative and/or postoperative care provided by anesthesiologists. Unfortunately, this survey fails to recognize the majority of an anesthesiologist's perioperative contribution.

How Do Anesthesiologists Fit into the Value Equation?

Anesthesiology services were historically viewed as consultant-based episodes of care. With the trend towards value-based, bundled care initiatives through both Medicare and private insurance companies, anesthesiologists must now demonstrate the value they bring to perioperative experience.

Value in anesthesiology is no longer just delivery of a safe anesthetic; it is currently being redefined to include application of evidence-based practice, improvement in global patient outcomes, and sustainment of quality improvement. This push for value is not only rooted in reimbursement; it is now a requirement by the American Board of Anesthesiology (ABA) in the Maintenance of Certification in Anesthesiology (MOCA) program[2] and by the Accreditation Council for Graduate Medical Education (ACGME) in

[2] http://www.theaba.org/MOCA/MOCA-2-0-Part-4

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anesthesiology residency training programs[3]. Major national organizations have developed programs to assist anesthesiologists with the transition to value-based care and to encourage multidisciplinary collaboration. Examples include the American Society of Anesthesiologists Perioperative Surgical Home Model, the Anesthesia Patient Safety Foundation's initiatives on medication safety and long-term patient outcomes, and the Anesthesia Quality Institute's National Anesthesia Clinical Outcomes Registry (NACOR). The NACOR program serves as a qualified clinical data registry (QCDR) for anesthesiology practices participating in MACRA.

The **Evolution of Quality Improvement in Cardiac Surgery**

The Past: "Fast Track" Quality Improvement Efforts in Cardiac Surgery

The term "fast track" cardiac surgery was coined in the 1990's in response to efforts to decrease ICU length of stay by promoting early extubation in non-complicated cardiac surgical patients.[20, 21] Since that time, shortening ICU stay remained a focus, as rising healthcare costs and hospital resource utilization became a priority across many healthcare organizations.[22, 23] As such, value in cardiac surgery over the past 25 plus years was unintentionally defined as improving outcome metrics related to prevention of postoperative ventilator dependency and pulmonary complications. During this time, research on various intraoperative anesthetic techniques and postoperative sedation strategies geared toward promoting early extubation emerged.[24-27] Numerous studies

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3 https://www.acgme.org/Portals/0/PDFs/Milestones/AnesthesiologyMilestones.pdf

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demonstrated shortened postoperative time-to-extubation and shorter ICU lengths of stay, with subsequent reductions in cost.[28-31] A systematic review and meta-analysis 10 fast-track trials in cardiac surgery (n=1800 patients) demonstrated shortened postoperative mechanical ventilation times and ICU length of stay with no increase in morbidity and mortality.[32] The long-term effectiveness of fast-track pathways for cardiac surgery were subsequently evaluated in a recent Cochrane review.[33] This review of 25 fast-track for cardiac surgery trials (n=4,118 patients) demonstrated (i) no difference in one-year mortality in comparison to conventional care, (ii) no differences in the risk of postoperative complications associated with early-extubation (e.g. reintubation), and (iii) no change in total hospital length of stay.

Reasons why fast-track pathways fail to improve long term outcomes after cardiac surgery include both patient-specific and surgery-specific risk factors. A recent single center prospective study on the predictors of failure in a fast-track pathway for cardiac surgery (n=451 patients) identified reduced renal function, age, hypertension, cardiopulmonary bypass time, first lactate or base deficit after surgery, and cross-clamp time as predictive of failure.[34] Another recent single center study retrospectively reviewed 1741 consecutive patients managed with a fast-track cardiac pathway and found female gender, age, prolonged surgical time, and prolonged cross clamp time as independent risk factors for fast-track pathways failure.[35] These studies on methods to "fast-track" cardiac surgery illustrate that the factors impacting postoperative ventilator dependency and early extubation are numerous, complex, and have varying degrees of modifiability. Surgical techniques aimed to negate the risks associated with

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cardiopulmonary bypass and cross clamp time include utilization of minimally-invasive surgical techniques (when clinically applicable and available). Examples include minimally invasive coronary artery bypass grafting, minimally invasive mitral valve repair, and transcatheter aortic valve replacement. Other potentially modifiable factors include anesthesia-specific elements such as postoperative sedation and total intraoperative opioid dose. Design of an evidence based standardized extubation protocol represents an opportunity for anesthesiologists to participate in multidisciplinary quality improvement. Early extubation after CABG represents a key 2017 NACOR non-MIPS QCDR measure (TABLE 3).

The Present: Acute Kidney Injury as an Example of Ongoing Quality Improvement Efforts in Cardiac Surgery

Over the past several years, renal failure after cardiac surgery has emerged as focus area for improving quality after cardiac surgery. Acute kidney injury after cardiac surgery occurs in approximately 30% of patients, the etiology of which is believed to be multifactorial.[36, 37] A recent systematic review and meta-analysis of 46 studies evaluating acute kidney injury (AKI) after cardiac surgery (n=242,388 patients) found that cardiopulmonary bypass-associated acute kidney injury lead to a two-fold increase in early mortality.[38] Risk factors for the development of AKI after cardiac surgery included pre-existing renal insufficiency, preoperative anemia, female gender, reduced left ventricular ejection fraction, diabetes, peripheral vascular disease, emergency surgery, and prolonged bypass times.[39-41] Multiple interventions to prevent AKI have been studied including perioperative erythropoietin and sodium bicarbonate. A 2016 systemic review

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and meta-analysis of six studies including 473 patients on the role of erythropoietin for prevention of AKI in cardiac surgical patients found that erythropoietin did not prevent AKI.[42, 43] A recent randomized control trial of 75 patients with pre-existing reduced renal function presenting for CABG evaluated the potential protective effect of a single high dose of erythropoietin versus placebo on the development of AKI. In this small study, single high-dose erythropoietin did not have a renal protective effect.[44] A 2014 systemic review and meta-analysis of five studies including 1079 patients found no benefit of sodium bicarbonate in the prevention of AKI in cardiac surgical patients.[43] However, a recent single center prospective observational study found that sodium bicarbonate might be helpful in low-risk patients with normal preoperative renal function in the prevention of AKI after cardiac surgery.[45] Additionally, another prospective single center prospective cohort study of 262 patients undergoing cardiac surgery found that perioperative hemodynamic instability and fluid overload were independently associated with increased mortality and need for renal replacement therapy.[46] These studies in AKI after cardiac surgery illustrate the multifactorial nature of a single outcomes metric.

The Future: Quality Improvement Efforts in Cardiac and Vascular Surgery

What we have learned from the fast-track era, and are learning from the emerging literature in renal injury outcomes could be applied to a *comprehensive* clinical care pathway for cardiac surgery. While more research is needed to better understand the underlying mechanisms of acute kidney injury, many risk factors for poor outcomes are similar, inter-related and may be influenced by improved preoperative optimization and

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application of standardized evidence-based management throughout the perioperative experience.

ERAS: An Example Program to Deliver Comprehensive Value-Based Care

ERAS standardizes perioperative care through the implementation of evidence-based, best-practice recommendations to improve the quality of care, which in turn decreases cost.[47] ERAS pathways have repeatedly demonstrated a wide variety of improvements in patient outcomes including decreased hospital length of stay, decreased surgical site infection, decreased readmissions, and decreased urinary tract infections across a spectrum of surgical disciplines.[47] These improvements in patient outcomes ultimately translate into improved patient satisfaction and decreased hospital expenditure. As a result, ERAS pathways represent real world examples of value in healthcare. ERAS pathways serve as a vehicle to deliver value-based care in the perioperative setting, and unify the quality initiatives set forth by individual medical specialties (e.g. surgery and anesthesiology) and multiple disciplines (e.g. nursing, pharmacy, nutrition, and physical therapy). ERAS pathways are not intended to replace rigorous randomized control trials; these pathways are intended to serve as a platform/method to incorporate the evidence from these robust trials. ERAS pathways for cardiac and vascular surgery are currently in their infancy.

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An ERAS pathway for cardiac surgery should include interventions *throughout* the preoperative and intraoperative phases of care to help improve postoperative outcomes such as early extubation, prevention of AKI, and prevention of central venous line

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infections. These outcomes metrics are consistent with the 2017 NACOR QCDR measures (Table 3). Examples of preoperative interventions in an ERAS pathway for cardiac surgery may include physical exercise programs, smoking cessation programs, and formal evaluation and optimization of perioperative nutritional status.[48] Intraoperative interventions may include the use of multimodal analgesia, with an emphasis on minimizing long-acting opioids, application of protective lung ventilation, and avoidance of excessive crystalloid administration. Postoperative interventions may include a formal ventilator weaning protocol, early post-extubation pulmonary toileting, and an early ambulation program. Postoperative pain control would ideally include multimodal analgesics with the adequacy of pain control assessed by using both objective measures (i.e., postoperative opioid consumption using morphine equivalents) and subjective measures (i.e., visual analog pain scores). While it's unclear which of these specific interventions will be most impactful on early extubation and patient satisfaction after cardiac surgery, it can be assumed that the cumulative effect of these interventions may promote and sustain the impact of early extubation (and other recovery metrics) in a larger, more meaningful way.

Vascular Surgery: An Evolution from Morbidity and Mortality to Prevention and Optimization

Historically, the value metrics in vascular surgery have focused on decreasing length of stay, improving 30-day survival, and decreasing perioperative myocardial infarction.[49-51] The metrics of success in vascular surgery centered upon immediate surgical outcome rather than on long-term patient recovery. The value focus for vascular surgery is

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transitioning to the sustainability of health, long-term effects of medical therapy and surgical intervention, and return to an acceptable level of physical function.

The Standardized Endpoints for Perioperative Medicine (StEP) working group was established to develop consistent outcomes definitions and standardization of outcomes reporting across all future trials, which currently limits the value of research in this area. The StEP has proposed patient comfort and patient-centered outcomes beyond hospital LOS and long-term survival/disease-free survival including: postoperative nausea/vomiting, perioperative pain measurement, quality of recovery scales, sleep quality/disturbance, perioperative anxiety /stress, return of bowel function/ileus, patient satisfaction, health-related quality of life, disability-free survival, return to work/normal functioning, and days alive and out of the hospital.[52] Application of standardized patient-centered outcomes metrics will enable hospitals, anesthesiologists, and surgeons to develop local programs to improve the quality of care, participate in national outcomes registries, and may assist with the transition to new value-based reimbursement models.

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Preoperative Evaluation: Tests and Timing

In order to meet these patient-centered value metrics, greater emphasis on preoperative planning and optimization is paramount, including application of evidence-based recommendations for preoperative testing for non-cardiac surgery.[53] Unnecessary preoperative testing ultimately leads to an increase in health care expense without any added value. The expense related to obtaining low-value unnecessary testing has been

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shown to cost Medicare approximately $310 per beneficiary, whereas application of evidence-based recommendations for preoperative testing reduces the cost to approximately $71 per beneficiary.[54]

The optimal timing for preoperative evaluation is dependent upon the invasiveness of the planned procedure, patient comorbidities, and local institution culture. [55] As such, there is no consensus on the optimal timing of the preoperative evaluation for vascular surgery patients. Silvay et. al. suggests that preoperative assessments for vascular surgical patients should occur 6-7 days prior to surgery.[56] However, specific factors that may influence timing of the preoperative evaluation include the current patient condition[57], planned surgical procedure, urgency of the surgery, and extent of achievable optimization before surgery. For patients who are medically complicated and whose planned vascular surgery is elective and extensive, the evaluation should dictate the timing of surgery.

Preoperative Screening: Functional Capacity and Frailty

The traditional preoperative evaluation for vascular surgery serves to (i) assess for the presence of active or unstable cardiac disease and (ii) determine the functional capacity as measured in metabolic equivalents (METs). In addition to being a prognostic predictor of outcomes,[53, 58-60] METs determination provides an objective assessment of cardiopulmonary fitness. Preoperative functional capacity before vascular surgery is a powerful prognostic tool for pre-surgical assessment. In a recent study of 1048 patients undergoing open thoracoabdominal aneurysm repair, functional status was the strongest independent predictor of perioperative death.[61] Other factors, including increasing age,

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BMI, and renal function, also contributed to perioperative death, with BMI being the only modifiable secondary predictor.

Most recently, the concept of frailty was introduced as a moniker for the decreased physiological reserve of elderly patients. Frailty reflects a decrease in both mental and physical functional ability across all organ systems. It is associated with increased morbidity and mortality beyond the traditional risk factors of age, ASA class, and other preexisting conditions.[62-64] Patients who were evaluated as frail were found to have a higher incidence of mortality when undergoing either endovascular repair of an abdominal aortic aneurysm (0.67% v 2.5%) or lower extremity bypass (0.34% v 2.4%). In addition, patients who were frailer experienced increased length of stay and increased number of complications.[64]

Preoperative frailty, as defined by the modified frailty index, derived from the CSHA frailty index[65, 66], was used to evaluate the discharge location (home vs. non-home) in patients undergoing elective vascular surgery. Non-home discharge (discharge to skilled-nursing facility, rehabilitation hospital, or long-term care facility) is of critical consideration to patients. In approximately 20% of patients who were discharged to locations other than back home, twice as many (32% v 15.7%) were deemed frail. The risk of non-home discharge was greatest in open AAA repairs, suprainguinal bypass and infrainguinal bypass.[66] Regardless of procedure type, it was found that frailty increased the risk of non-home discharge by 2-fold, demonstrating the critical impact that frailty (e.g. lack of physiological reserve) plays on outcomes.

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The anesthesiologist's role in the comprehensive preoperative evaluation would be to assess for frailty, optimize, and facilitate dialogue with the patient and surgical team regarding expectations for both short term and long-term recovery. The anesthesiologist serves as a perioperative physician in this capacity, who utilizes the preoperative phase of care to risk stratify patients, optimize current health of the patient, and develop plans for immediate and postoperative care. This comprehensive preoperative evaluation would serve to set patient and surgeon expectations regarding the recovery process.

Preoperative Optimization: A Focus on "Prehabilitation" and Nutrition

Optimization of the vascular surgical patient includes interventions aimed at improving physiological reserve and perioperative nutrition. Two noteworthy studies in patients with abdominal aortic aneurysms aimed at improving baseline function through the use of targeted prehabilitation by using moderate intensity cycling for 6-12 weeks.[67, 68] Both studies, although limited in patient numbers, demonstrated (i) feasibility of applying a prehabilitation program to patients without worsening their aneurysms or increasing risk and (ii) significant improvement in baseline physiological reserves. Certainly, more studies are needed to evaluate the effect of prehabilitation on outcomes in these patients. In addition to physiologic reserve, further evidence regarding preoperative nutritional deficiency has demonstrated this characteristic to be a prognostic indicator for negative outcomes in the perioperative period[69, 70]. Improvement in preoperative nutrition has beneficial effects across the perioperative spectrum. Where it was recognized over 50 years ago that weight loss before surgery worsened outcomes[71], newer evidence suggests

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that improved nutritional support (both preoperatively and postoperatively) decreases morbidity and mortality.[72, 73] Combining these optimization variables in a marginal gains approach, or ‘pre-habilitation package’, appears to have significant potential.

Optimization not only serves to add value to the patient, but it also increases value to the hospital by potentially reducing hospital length of stay, readmissions, and healthcare expenditure. Published risk factors for readmission after vascular surgery include surgery-specific and medical specific variables. Surgery-specific risk factors for readmission include re-operation during the index admission, wound infection, and loss of graft patency. Medical specific variables for readmission include preoperative co-morbidities, older age, and discharge to a rehabilitation facility or skilled nursing facility.[74-76] While the risk for readmission after vascular is often multifactorial, there are modifiable variables, such as close postoperative follow-up by telephone, that can reduce this risk.[77]

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Conclusion

With the transition to value-based reimbursement models and the increasing emphasis on quality improvement from national subspecialty organizations, licensing boards, and major health care organizations, it is imperative that cardiothoracic and vascular anesthesiologists demonstrate the value that they bring to the patient care experience. This need to demonstrate value is in the setting of evolving outcome metrics for cardiac and vascular surgery; metrics that are moving away from overall morbidity and mortality metrics to global patient-centered outcome metrics, such as long-term

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functional recovery and prevention of common postoperative complications. As a result, cardiovascular anesthesiologists must step outside traditional intraoperative roles and be involved with multidisciplinary decisions regarding preoperative and postoperative care. ERAS pathways are comprehensive patient care pathways that include evidence-based, best practice recommendations for preoperative optimization, prevention of postoperative complications, and promotion of early functional recovery. ERAS pathways serve as a vehicle to deliver value, and cardiovascular anesthesiologists are poised to be driving this vehicle. Participation in the design, implementation, and sustainability of an ERAS program is one example of how a cardiovascular anesthesiologist can demonstrate the value that they bring to the perioperative experience.

Acknowledgements: none

Funding source: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Note: Dr. Robert Schonberger invited our group to submit this review article for consideration of publication in the Journal of Cardiovascular Anesthesiology.

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Table 1. Recommendations of the National Commission on Physician Payment Reform

1.	Payers to largely eliminate stand-alone fee-for-service payment to medical practices
2.	Test new models of care over a 5-year time period, with the goal of broad adoption by the end of the decade
3.	Recalibrate fee-for-service payments to improve quality and cost-effectiveness; penalize misuse or overuse of care
4.	Annual updates for evaluation and management codes, especially the ones currently undervalued; freeze updates for procedural diagnosis codes for 3 years, except for those that are currently undervalued
5.	Eliminate higher payment for facility-based services that can be performed in a lower-cost setting
6.	Incorporate quality metrics into the negotiated reimbursement rates for fee-for-service contracts
7.	Encourage smaller practices to form virtual relationships and share resources to achieve higher quality care
8.	Fixed payments for care of patients with chronic conditions and in-hospital procedures to reduce cost and improve quality
9.	Fixed payment models to include measures that assess high quality care, assess adequacy of risk-adjustment indicators, and promote strong physician commitment to patients
10.	Eliminate the Sustainable Growth Rate (SGR)
11.	Repeal of the SGR to be paid for with cost-savings from the Medicare program as a whole
12.	The Relative Value Scale Update Committee (RUC) to make decision-making transparent and include representation from the medical profession; CMS to develop alternative open, evidence-based processes to update relative values

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Table 2. 2007 Institute of Medicine Requirements for Effective Healthcare

1.	No Needless Deaths
2.	No Needless Pain or Suffering
3.	No Helplessness in Those Served or Serving
4.	No Unwanted Waiting
5.	No Waste
6.	No One Left Out

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Table 3: NACOR and MIPS Measures Specific to Cardiovascular Anesthesiology

Quality Measurement	Measure Description	Clinical Guidelines, Evidence-based recommendations, or Programs to help Anesthesiologists Achieve the Measure
NACOR Non-MIPS Measures Approved for QCDR Reporting in 2017*		
Adherence to Blood Conservation Guidelines for Cardiac Operations Using Cardiopulmonary Bypass (CPB)-Composite	Percentage of patients, aged 18 years and older, who undergo a cardiac operation using cardiopulmonary bypass for whom selected blood conservation strategies were used.	*Clinical Guideline*: The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists blood conservation guidelines (Ann Thorac Surg 2011;91:944–82)
Application of Lung-Protective Ventilation during General Anesthesia	Percentage of patients, aged 18 years and older, who undergo general anesthesia care that includes an endotracheal tube who had a median exhaled tidal volume less than or equal to 10 mL/kg of predicted-body- weight (PBW) during positive pressure ventilation (PPV).	*Evidence-based recommendation:* Lung protective ventilation for abdominal surgery improves outcomes (N Engl J Med. (2013). 369 428–37), but insufficient evidence for the role of protective lung ventilation in cardiac surgical patients (Heart Lung Vessel. 2015; 7(1): 5–6). There are two ongoing clinical trials currently evaluating lung protective ventilation in cardiac surgery (https://clinicaltrials.gov/ct2/show/NCT02090205, https://clinicaltrials.gov/ct2/show/NCT02866578)
Coronary Artery Bypass Graft (CABG): Post-Operative Renal Failure- INVERSE MEASURE	Percentage of patients aged 18 years and older undergoing isolated CABG surgery (without pre-existing renal failure) who develop postoperative renal failure or require dialysis	*Evidence-based recommendation*: Avoidance of fluid overload and maintenance of hemodynamic stability may prevent AKI (Blood purification. 43:298-308, 2017). No evidence for erythropoietin in the prevention of AKI (Heart, lung & circulation. 25:1067-1076, 2016). Weak and limited evidence for sodium bicarbonate

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		(Crit Care. 18:517, 2014)
Coronary Artery Bypass Graft (CABG): Prolonged Intubation- INVERSE MEASURE	Percentage of patients aged 18 years and older undergoing isolated CABG surgery who require postoperative intubation > 24 hours	*Evidence-based recommendation*: Assist with development of evidence-based extubation protocols (Cochrane Database Syst Rev. 2016 Sep 12;9:CD003587)
Coronary Artery Bypass Graft (CABG): Stroke- INVERSE MEASURE	Percentage of patients aged 18 years and older undergoing isolated CABG surgery who have a postoperative stroke that did not resolve within 24 hours	*Evidence-based recommendation*: Many risk factors are patient dependent (i.e., advanced age, peripheral vascular disease) or surgical dependent (prolonged CPB time) J Neurol Sci. 2015 Oct 15;357(1-2):1-7. However, impact of MAP while on CPB on development of neurologic injury currently being investigated Trials. 2016 May 17;17(1):247
NACOR Non-MIPS Measures Pending CMS Approval for QCDR Reporting in 2017*		
Perioperative Cardiac Arrest - INVERSE MEASURE	Percentage of patients, regardless of age, who undergo a procedure under anesthesia and who experience a cardiac arrest under the care of a qualified anesthesia provider prior to anesthesia end time	*Program:* Participation in a multidisciplinary outcomes reporting program such as the SCA/STS database collaboration. This will assist teams with tracking their individual perioperative cardiac arrest rates and identify areas for quality improvement.
Perioperative Mortality Rate- INVERSE MEASURE	Percentage of patients, regardless of age, who undergo a procedure under anesthesia and who experience mortality under the care of an anesthesia provider prior to anesthesia end time.	*Program:* Participation in a multidisciplinary outcomes reporting program such as the SCA/STS database collaboration. This will assist teams with tracking their individual mortality rates and identify areas for quality improvement.

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Treatment of Hyperglycemia with Insulin	The percentage of patients, aged 18 years and older, who undergo elective inpatient surgery and who have a blood glucose level of > 200 mg/dL and who receive insulin prior to anesthesia end time.	*Clinical Guideline*: The Society of Thoracic Surgeons Clinical Practice Guidelines on Arterial Conduits for Coronary Artery Bypass Grafting (Ann Thorac Surg. 2016 Feb;101(2):801-9) includes comments on glycemic control.
MIPS measures reportable via the ASA QR and QDCR**		
Perioperative Cardiac Arrest - INVERSE MEASURE	Percentage of patients, regardless of age, who undergo a procedure under anesthesia and who experience a cardiac arrest under the care of a qualified anesthesia provider prior to anesthesia end time	*Program:* Participation in a multidisciplinary outcomes reporting program such as the SCA/STS database collaboration. This will assist teams with tracking their individual perioperative cardiac arrest rates and identify areas for quality improvement.
Perioperative Mortality Rate- INVERSE MEASURE	Percentage of patients, regardless of age, who undergo a procedure under anesthesia and who experience mortality under the care of an anesthesia provider prior to anesthesia end time.	*Program:* Participation in a multidisciplinary outcomes reporting program such as the SCA/STS database collaboration. This will assist teams with tracking their individual mortality rates and identify areas for quality improvement.
Treatment of Hyperglycemia with Insulin	The percentage of patients, aged 18 years and older, who undergo elective inpatient surgery and who have a blood glucose level of > 200 mg/dL and who receive insulin prior to anesthesia end time.	*Clinical Guideline*: The Society of Thoracic Surgeons Clinical Practice Guidelines on Arterial Conduits for Coronary Artery Bypass Grafting (Ann Thorac Surg. 2016 Feb;101(2):801-9) includes comments on glycemic control.

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NACOR = National Anesthesia Clinical Outcomes Registry
MIPS = Merit-based Incentive Payment System
QR = Qualified Registry
QCDR = Qualified Clinical Data Registry
ASA = American Society of Anesthesiologists
*https://www.aqihq.org/files/2017%20V1%20Approved%20Measures.pdf
**https://www.aqihq.org/files/2017%20MIPS/MIPS%20at%20a%20Glance%202017.pdf

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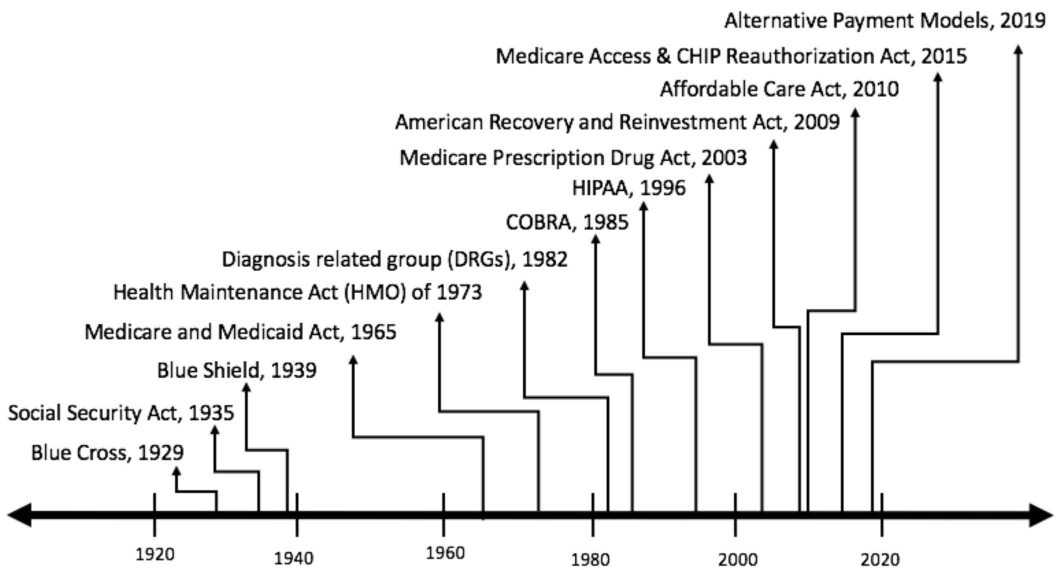
Figure 1: An Overview of the History of Healthcare Reimbursement



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