Improving Perioperative Temperature Management

Numerous randomized outcome trials have demonstrated that even mild hypothermia triples the risk of morbid myocardial outcomes,\(^1\) triples the risk of surgical wound infection,\(^2\) increases blood loss and transfusion requirement,\(^3\)–\(^5\) and prolongs recovery\(^6\) and duration of hospitalization\(^7\) in a wide variety of surgical procedures. This literature forms the basis for the practice guidelines in this area, including the recently updated American Heart Association-American College of Cardiology "2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery."\(^7\) This evidence-based guideline includes a Level 1 recommendation for maintenance of perioperative normothermia.

Quality-based payment systems have proliferated in the past decade. In 2005, more than 80% of Health Maintenance Organizations enrollees were in a plan featuring performance-based provider payment and more than two-thirds of employers required their health insurance carriers to incorporate such features in their contract.\(^8\) These efforts are strongly promoted by large collaborative of health care purchasers, such as the Leapfrog Group, Bridges to Excellence, and the Pacific Business Group on Health. Beginning with the Tax Relief and Healthcare Act of 2006, the federal government incorporated a precursor of performance-based physician payment into Medicare with its Physician Quality Reporting Initiative. The Center for Medicare and Medicaid Services has committed $1.35 billion to continue a 1.5% pay-for-reporting bonus in 2008.\(^9\) A Medicare demonstration of performance payments for hospitals distributed almost $9 million among 115 hospitals with encouraging improvement in 27 quality metrics. \(^4\)In 2006, Massachusetts Blue Cross Blue Shield earmarked almost $180 million for quality incentive payments\(^10\); and in the West, the California Integrated Healthcare Association\(^†\) distributed $55 million among 200 medical groups on the basis of medical quality, patient satisfaction and information technology deployment. In the United Kingdom, up to 20% of physician earnings are tied to performance measures.\(^11\) It is thus apparent that purchasers, whether we like it or not, now intend to pay for quality, not quantity. Anesthesiology, now more than ever, is faced with the choice of bringing quality measures to the table or watching the associated funding flow to other disciplines.

Redirection of physician payment funds to quality improvement efforts is motivated by the belief that medical care lags far behind established best practices. A widely cited study by the RAND Corporation, for example, documented that patients with a variety of common conditions received care consistent with well established, evidence-based standards less than half the time.\(^12\) The capacity of measurement and incentives to accelerate adoption of improved practices is also suggested by the impact of Joint Commission and National Committee for Quality Assurance attention to postmyocardial infarction \(β\) blocker administration.\(^13\) For example, \(β\)-blockers, conclusively demonstrated to improve postmyocardial infarction outcomes in 1982,\(^14\) were seldom prescribed even 15 yr after guideline

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Accepted for publication May 23, 2008.

Supported by NIH Grants GM 061655, DE 17706, and AG 029656 (Bethesda, MD) and the Joseph Drown Foundation (Los Angeles, CA). In recent years, Dr. Sessler’s department received research funding from numerous companies including Hospira, Nova Nordisk, Progenics, Arizant, Ogenix, MGI, Dynatherm, and Kimberly Clark. Dr. Sessler is a consultant for Cardinal Health Care, MGI, and Johnson & Johnson. Dr. Hannenberg does not have a personal financial interest in any company related to this editorial.

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DOI: 10.1213/ane.0b013e318181f6f2


Development of physician performance measures is highly transparent, evidence-based, and subject to the input of varied stakeholders, including physician groups, purchasers, health plans, government, industry, and others. These participants are organized into a large number of groups with the AQA (formerly the Ambulatory Quality Alliance) and the National Quality Forum playing prominent roles in endorsing and disseminating quality measures. Most of the emerging 140 physician-level quality measures were developed in the American Medical Association’s Physician Consortium for Performance Improvement. In this forum, specialty societies, such as the American Society of Anesthesiologists (ASA), propose physician performance measures derived from evidence-based practice guidelines.

The process starts with a meeting of multidisciplinary health care professionals and methodologists to assess the importance of the performance measure, the existing gap in care, the opportunity for improvement, physician accountability, and the data collection burden associated with the potential measure. We stress that proposed measures must have both an excellent scientific basis and a substantive gap between best practice and actual practice. For example, for this reason, the ASA could not now propose the use of pulse oximetry as a performance measure.

Proposed physician performance measures are released for public comment and revised as necessary before coming to vote by the full membership of the Physician Consortium and, subsequently, the other stakeholder groups. The ASA’s proposed thermal management measures were presented to the ASA Board of Directors and to the House of Delegates, and then posted for comment on the ASA website before consideration by the Consortium.

The proposed thermal management measure is constructed to allow flexibility and physician judgment, and to be suitable in varied practice settings. It applies to patients undergoing surgical or therapeutic procedures under general or neuraxial anesthesia exceeding 60 min in duration. The measure can be met either by use of active warming measures of proven efficacy or by achievement of a target temperature (36°C) measured in the operating room or postanesthesia care unit. The option of temperature measurement near the end of surgery was included because it is usually easier to accurately measure core temperature intraoperatively than postoperatively.

The proposed measure allows either a process measure or an outcome because it is occasionally challenging to maintain normothermia. Outcome measures typically rely on peer performance to establish thresholds for payment or recognition. The temperature outcome measure will thus never require 100% achievement of a target temperature, just as current diabetic care measures do not require 100% of hemoglobin A1c concentrations to be below 7%. Conversely, a measure based solely on use of active warming would have considerable potential to promote overuse of warming. It is also worth noting that the Medicare Physician Quality Reporting Initiative links its 1.5% supplemental Medicare payment only to reporting quality metrics; there is currently no connection between actual performance and eligibility for the additional payment, although one can reasonably be anticipated in future years.

Thermal management was an attractive topic for a performance measure because the literature is strong, the practice gaps substantial, and effective management is inexpensive and easy to implement. Maintaining normothermia is usually easy, with hospital cost typically being less than $10; furthermore, the most commonly used warming systems are remarkably safe. There are few, if any, anesthetic interventions that have been proven to so markedly improve the outcome of surgery with so little effort, risk, and cost, making this a nearly ideal area for performance measurement and improvement.

If adopted by Medicare, a normothermia measure would thus join an existing measure of timely surgical antibiotic prophylaxis administration as reportable by operating room anesthesiologists. Critical care physicians may have measures related to prevention of ventilator-associated pneumonia by head-of-bed elevation and prevention of catheter-related bloodstream infections by aseptic protocol. It is notable that all of the ASA sponsored measures relate to prevention of nosocomial infections, reflecting an evolving appreciation of the ability of the anesthesiologist to influence a broader range of outcomes than evident just a few years ago. Recognition of the importance of the care we give in a larger context serves the specialty and our patients well.

In an article in this issue of the journal, Modell et al. report changes in infrared aural canal temperatures before and after 101 general anesthetics for electroconvulsive therapy lasting about 15 min each. Preanesthesia temperatures averaged 36.2°C and were <36°C in one-third of the patients. On average, patient temperature increased by 0.2°C, whereas in one-third of patients it decreased, and in two-thirds it increased.

Modell et al. suggest that a possible etiology for the observed decreases in core temperature was ventilation with a Mapleson D system. Simple thermodynamic calculations show that only a trivial fraction of the basal metabolic rate is lost through the respiratory system. Clinical experience confirms these calculations: even active airway heating and humidification has a tiny effect on core temperature. Instead, the most important cause of core hypothermia after induction of general or neuraxial anesthesia is core-to-peripheral redistribution of heat. Subsequently, hypothermia results when heat loss to the environment exceeds metabolic heat production.
The authors’ also postulate that core temperature might have increased in some patients as a result of succinylcholine-induced fasciculations. The assertion is supported by a 1968 reference to a study in which convulsive therapy patients were not paralyzed. This is an important distinction because the reported small temperature increase presumably resulted from the induced seizure rather than fasciculations. In contrast, Modell et al.’s patients were presumably given succinylcholine and therefore paralyzed except for one arm; they would thus be unable to generate heat from muscular activity. A more likely explanation is temperature measurement error.

The authors recognize that the use of infrared aural canal thermometry is incompatible with valid performance measurement under the proposed normothermia measure. The inadequacy of this method has been demonstrated repeatedly. For example, Modell et al. reported in 1998 that “the variability and inaccuracy of temperatures measured by the infrared tympanic thermometers were sufficiently large to suggest that the use of these devices for routine thermometry may be potentially hazardous.” Inaccuracy of infrared aural canal thermometers may explain why one-third of the patients’ temperatures were implausibly low even before anesthesia, and after anesthesia some values increased whereas others decreased. The “take home” message of Modell et al.’s study is that reliance on the nearly ubiquitous, but inaccurate, infrared aural canal thermometers has important patient care implications and may soon have financial consequences as well. Anesthesiologists and hospitals need to make certain that postoperative temperature is accurately measured. This means using a reliable device, and ensuring that it is used correctly.

Four monitoring sites reliably provide core temperature: the pulmonary artery, distal esophagus, nasopharynx, and tympanic membrane (measured with a properly positioned thermocouple). These sites can be used interchangeably except during extreme thermal fluxes associated with cooling and rewarming phases of cardiopulmonary bypass. In intubated patients, the distal esophagus is usually the best temperature monitoring site as it is easy to use, minimally invasive, and resistant to artifact. The difficulty comes in patients in whom none of the true core sites is available. Core temperature can be estimated with reasonable accuracy using oral, axillary, and bladder temperatures except during extreme thermal perturbations. Axillary temperatures are reasonably accurate but work best when the probe is positioned over the axillary artery and the arm is kept at the patient’s side. Temporal artery thermometers are insufficiently accurate for clinical use. Rectal temperature also normally correlates well with core temperature but fails to increase appropriately during malignant hyperthermia crises and under other documented situations of rapid temperature flux, including heat stroke.

As Modell et al. note, the 15-min procedures they studied are unrelated to the temperature management performance measure developed by the American Medical Association’s Physician Consortium on Performance Improvement, a measure that applies only to cases lasting at least an hour. Nonetheless, their results highlight the importance of using accurate temperature monitoring systems and site.

In summary, considerable Level 1 evidence shows that thermal management improves outcomes in a variety of surgical patients. Core temperature should thus be measured in most surgical patients, and clinicians should make serious efforts to maintain normothermia in operations lasting more than an hour. This emerging standard-of-care is likely soon to be associated with financial incentives; thus, use of reliable methods and sites for temperature monitoring is of paramount importance.

REFERENCES

9. Medicare program; proposed revisions to payment policies under the physician fee schedule, other Part B payment policies, and establishment of the clinical psychologist fee schedule for calendar year 1998, correction–HCFA. Correction of proposed rule. Fed Regist 1997;62:43963–4