Use of anesthesia information management systems (AIMS): economic benefit value-based purchasing represents annually increasing percentage of Medicare receipts; treatment metrics being added on regular basis; represents attempt to reform health care system in United States such that physicians and hospitals paid for quality; outcome measures obtained from Surgical Care Improvement Project (SCIP) and Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) satisfaction survey (includes pain questions and infection data); SCIP compliance with antibiotic timeliness, selection, and dosing associated with 15% decrease in rate of infection (important effect; compliance not difficult)

Example from Mt. Sinai: “button” added to screen of anesthesia record as reminder for administration of prophylactic antibiotics (ie, workflow altered by altering templates); acknowledgment of antibiotic button required before “surgery start” button appears; system identifies “problem” providers and improves compliance

Example from Michigan: audit of AIMS and (positive or negative) feedback to providers via email after procedures improved compliance from 69% to 92% over 1 yr β-blockade: also in SCIP program (cardiac measure); template designed to provide checklist and outline contraindications to aid decision making

Pain management: patients reporting severe pain give lower satisfaction scores; automated record requires entry of pain score with each dose of pain medication and thus facilitates tracking of patient pain; information obtained from electronic data older patients report less pain; women report more severe pain than men; longer hospital stays associated with increased pain; black and Hispanic patients more likely to have pain than white patients, and Asian patients less likely; patients taking any central nervous system (CNS) drugs preoperatively more likely to experience severe pain; orthopedic and transplantation surgery patients reported highest pain levels, while those undergoing cardiothoracic surgery much lower on list (attributed to increased intervention in these patients)

Use of data: allowed direction of pain management resources toward problem areas; example — for 20 yr, nurses monitored respiratory rates hourly for 24 hr in obstetric patients who received neuraxial opiates; speaker requested that protocol be applied to orthopedic patients, with resulting dramatic increase in number of patients reporting maximum score of 0 or mild pain after major orthopedic surgery; web tool created to help predict patients who might experience severe pain, and thereby encourage nursing staff to contact pain service

Administrative uses: large amount of quality reporting required in United States (much from operating room [OR]); speaker advocates anesthesia group taking ownership of data, because control of flow and interpretation of data help provide group with additional political power; reporting requirements include rates of returns to OR and anastomotic leaks, general surgical operations log, postanesthesia care unit satisfaction, 48 hr postanesthesia mortality reports, and postoperative complications; infection rates and prevention compliance, education reports, and general OR utilization also tracked; AIMS rich source of data for voucher (summary of activities that can be transferred to government or private payers); missing information — obtained with requests to providers via texts, emails, or calls from secretary; with improved gathering of information, time required for payer to receive anesthesia bill decreased from ≥2 wk to 5 to 6 days after procedure at speaker’s institution

Productivity-based model: points generated for each provider for type of cases; speaker implemented policy for deduction of 10% of case points (which drive compensation) if postoperative note not entered in electronic medical record (EMR) within 48 hr, which prompted 98% compliance; irrational fear of small penalty caused important change in behavior (completely derived from EMR); three-quarters of microeconomy of department that drives individual compensation relates to clinical activity, with data gathered directly from EMR; because main job of anesthesiologists delivery of clinical care, EMR excellent source of information, and facilitates changing clinical behavior; productivity improves 30% with introduction of EMR system; average monthly American Society of Anesthesiologists (ASA) units produced from full-time equivalent employee in OR increased from 600 to almost 800 units, and consistent in all areas (eg, pain management, intensive care unit [ICU]); speaker found placing providers at risk for productivity and giving constant feedback (with salaries altered accordingly) highly effective; another major effect noted in junior vs senior faculty (productivity incentives resulted in greater increases in salary for instructors and associate professors, compared with senior professors [contrary to previous method of basing increases on “social support system”])

Administrative reports: Accreditation Council for Graduate Medical Education reports required for programs with resident training; passing information from OR to EMR difficult but...
possible in current system; most hospitals lack sufficient tracking in OR; AIMS easily used as nexus of information that drives entire OR system (eg, control desk, waiting room, preoperative assessment area, bed assignment); speaker recommends having programmer append EMR to include event notification and scheduling system

**Surgical mortality:** ≈1.3% of patients admitted for surgery die; surgical mortality public health problem; anesthesiologists only concerned with “clean kills” (ie, clearly caused by anesthesiologist) and avoid blame for other perioperative events; on this basis, only 0.03% of surgical mortality attributable to anesthesia; **contribution of intraoperative hemodynamics** — time spent with mean arterial pressure <50 mm Hg significantly affects mortality; unstable blood pressure lability predicts survival; information available in EMR; hemodynamics contribute additional ≥2% to mortality (potentially modifiable); however, association does not prove causation; increased mortality seen with “double-low” and “triple-low” (ie, low bispectral index, low blood pressure, and low minimum alveolar concentration) situations may relate to acute organ injury, or may represent intraoperative anesthesia stress test; anesthesia often administered with little deviation from standard “recipe”; relatively standard doses may cause exaggerated response in more debilitated patients

Role of AIMS: may function as “big brother” (ie, monitor and warn of dangerous underlying conditions); speaker investigated use of pop-ups that appear on screen (eg, warning for presence of double-low condition), with opt-out patient consent process; no change in hospital mortality documented to date, but provider behavior changed (reduction of ≥1 episode of hypotensive-deep anesthesia combination per anesthesia hour since institution of pop-up warnings); change related to information only (no enforcement of behavioral change); behavior of control (without pop-ups) group improved over time, which indicates change in culture

**Other uses of AIMS data:** include ICU and surgeon efficiency to help identify problems; OR efficiency data show decay in afternoons (opportunity for scheduling of additional procedures)

**Summary:** operational aspects of facility, quality, Physician Quality Reporting System, and custom reports all have financial implications; management through use of data can improve quality and administrative processes and allow linking of quality with compensation; data useful for managing all missions of department

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**Reducing Transfusion Costs with Preoperative Management of Anemic Patients**

**Thomas R. Vetter, MD, MPH, Maurice S. Albin Professor, Vice Chair, and Director, Department of Anesthesiology, School of Medicine, and Professor, Department of Health Care Organization and Policy, School of Public Health, University of Alabama at Birmingham**

**History of blood transfusion:** until recently, blood considered “mother’s milk” and transfused liberally; blood transfusion common modality in both surgical and medical patients; ≈15 million U of packed red blood cells (PRBC) transfused annually in United States; transfusion practices vary widely and not without risk (especially in developing countries)

**Preoperative anemia:** reports of prevalence vary from 5% to 75%, depending on source and population; risk factors include age, sex, and comorbidities; 35% of patients undergoing elective orthopedic surgery documented with hemoglobin <13 g/dL; existing preoperative anemia (iron deficiency erythropoiesis or anemia of chronic disease) most common cause; data show elevated risk for mortality, even in patients with mild anemia; effect of intraoperative transfusion also not reassuring; primary goal to reduce need for intraoperative transfusion; analysis of large database — suggests that, for every 46 patients transfused intraoperatively, 1 will die within 30 days; other events (eg, pulmonary complications, sepsis, wound complications, thromboembolic complications) also significantly increased in patients transfused, compared with those not transfused; widespread transfusion practices increase risk to patients; often, risks not discussed when obtaining informed consent

**Patient blood management:** timely application of evidence-based medical and surgical concepts designed to maintain hemoglobin concentrations, optimize hemostasis, and minimize blood loss; key focus to improve patient outcomes; ASA moving from product-centered approach to patient-centered approach

**Patient-centered blood management:** medical golden rule — practice level of care you would want for yourself or family member; surgeons and anesthesiologists commonly accept preoperative anemia de facto (surgery performed without preemptive corrective action); ethical medicolegal requirements exist to inform anemic patients preoperatively of risk vs benefits about anesthesia and surgery and planned diagnostic and treatment measures; pattern of low threshold for transfusion not sustainable

**Overcoming challenges:** strategies for surgical blood management help reduce need for intraoperative or postoperative allogeneic blood (ie, optimizing patient’s preoperative erythrocyte mass; minimizing diagnostic, therapeutic, and intraoperative blood loss [during average stay in ICU, simple phlebotomy results in equivalent of 2-U blood loss])

Preoperative optimization: recommendations from Network for Advancement of Transfusion Alternatives (NATA) — based on current data; use erythropoiesis-stimulating agents (ESAs) for anemic patients; administer intravenous (IV) iron preparations; some approaches require 30 days for full effect (speaker questions feasibility of ongoing access to patients and resetting of surgical time clock); available ESAs — epoetin alfa (Procrit, EpoGen; EpoGen available only in 20,000-U vial, thus requiring 2 vials per treatment); darbepoetin alfa (Aranesp; not approved by Food and Drug Administration [FDA] for this indication; most expensive option); Risk Evaluation and Mitigation Strategy (REMS) for ESAs — agents associated with increased risk for thromboembolic events, particularly in patients with cancer; providers required to provide approved medication guide when dispensed; IV iron — oral iron preparations not well tolerated, so compliance poor (not realistic for preoperative use in most patients); IV preparations have low molecular weight and low allergenic potential; ferumoxytol (Feraheme) appears to be good option, but not approved by FDA for preoperative use; iron sucrose (Venofer) low cost and approved for use; reimbursed — payment strategies do exist and cover use of ESA; coverage requirements include workup indicating anemia of chronic disease (however, full anemia workup would include, eg, colonoscopy to rule out occult causes); insurance pays for 3 doses of ESAs (at 21 days, 14 days, and 7 days) before surgery and one dose on day of surgery

**Preoperative protocol:** according to NATA guidelines, proposed patients should be seen in preoperative clinic as soon as possible, at minimum of 3 to 4 wk before planned surgery (virtually impossible); speaker proposes sending patients directly from visit with surgeon to appointment for preanesthesia evaluation (where necessary anemia workup performed and surgical date set); trial underway in which regimen compressed from 30 days to 12 to 16 days; institution-dependent dynamic exists between anesthesiology, hematology, and other primary care specialties about ownership of program; patients remote from hospital present challenge in ensuring follow-up for second dose of drugs; speaker suggests partnering with regional infusion and dialysis centers; simple preprinted order set allows pharmacist, nurse practitioner, or physician assistant to take ownership of treatment without presence of physician

**Fiscal concerns:** blood increasingly precious commodity (estimated acquisition cost of 1 U PRBC ≥$1000), with shortages resulting in cancellations of elective surgeries; morbidity of transfusions results in additional costs; cost of transfusion
(including labor and overhead) and adverse events bring cost to $2100/U of PRBC; data from single hospital for single procedure (total hip replacement) show annual cost reduction of $500,000 associated with treatment of preoperative anemia.

**Perioperative surgical home**: patient-centered, anesthesia-perioperative-lead interdisciplinary and team-based system of coordinated care to guide surgical patient through entire surgical continuum (takes ownership of transitional care planning); ultimate goal to increase value; adding scope to anesthesia practice necessary for maintaining vibrant specialty; speaker advocates continuing to perform traditional services, and expanding to include preoperative pain consultations, coordination of scheduling, performance and review of tests, and provision of therapeutic intervention (taking ownership of additional tasks in preparation for bundled payments); enhanced recovery after surgery (ERAS) — preoperative anemia included in category; key component of perioperative surgical home; ERAS guidelines intended to improve surgical outcomes.

**Maximum blood ordering schedule**: realistic blood ordering challenging due to high variability among surgeons and anesthesiologists in orders for type-and-cross or type-and-screen (not required for many procedures).

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**Suggested Reading**

- **Marques MB et al**: How we closed the gap between red blood cell utilization and whole blood collections in our institution. *Transfusion* 2012 Sep;52(9):1857-67.
- **Spahn DR et al**: More on transfusion and adverse outcome: it’s time to change. *Anesthesiology* 2011 Feb;114(2):234-6.

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**Estimated time to complete the educational process:**

- **Review Educational Objectives on page 1**: 5 minutes
- **Take pretest**: 10 minutes
- **Listen to audio program**: 60 minutes
- **Review written summary and suggested readings**: 35 minutes
- **Take posttest**: 10 minutes
1. Anesthesia information management systems (AIMS) offer economic benefit through all the following, except:
   (A) Documenting provider compliance with established protocols
   (B) Tracking outcome metrics
   (C) Reducing time spent recording and reviewing manual records
   (D) Identifying “problem” providers

2. Which patients are most likely to experience severe pain, based on data obtained from electronic medical records (EMR)?
   (A) Elderly patients
   (B) Asian patients
   (C) Male patients
   (D) Patients taking tricyclic antidepressants

3. Introduction of an EMR system has been shown to improve productivity of anesthesiologists by:
   (A) 5%  (B) 10%  (C) 20%  (D) 30%

4. Select the correct statement about surgical mortality.
   (A) 0.3% of patients admitted for surgery die
   (B) 3% of surgical mortality attributable to anesthesia
   (C) Anesthesiologists need not be concerned about surgical mortality that is not directly related to anesthesia
   (D) Amount of time spent with mean arterial pressure <50 mm Hg significantly affects mortality

5. Programming AIMS to give clinicians warnings about, eg, intraoperative hypotensive episodes has been ineffective in changing behaviors without enforcing the desired behaviors.
   (A) True  (B) False

6. Which of the following drugs for preoperative optimization of anemic patients are approved by the Food and Drug Administration?
   1. Epoetin alfa
   2. Darbepoetin alfa
   3. Ferumoxytol
   4. Iron sucrose
   (A) 2,3,4  (B) 1,2,3  (C) 1,4  (D) 1,3

7. Select the true statement about preoperative iron therapy.
   (A) Iron sucrose is a low allergenic intravenous source of iron
   (B) Oral iron supplementation is tolerated by most patients
   (C) Not recommended by the Network for Advancement of Transfusion Alternatives
   (D) Iron sucrose is the most expensive option

8. Insurance reimburses for doses of erythropoiesis-stimulating agents given:
   (A) On the day of surgery, and 7, 14, and 21 days before surgery
   (B) On the day of surgery only
   (C) 7 and 14 days before surgery
   (D) 14 and 21 days before surgery

9. When labor, overhead, and adverse events are considered in calculating the cost of 1 U of packed red blood cells, the total is estimated at approximately:
   (A) $1000  (B) $1400  (C) $2100  (D) $2800

10. The perioperative surgical home model refers to a program that increases in-home care pre- and postoperatively.
    (A) True  (B) False

Answers to Audio-Digest Anesthesiology Volume 56, Issue 11: 1-D, 2-A, 3-D, 4-A, 5-D, 6-A, 7-C, 8-C, 9-A, 10-C