

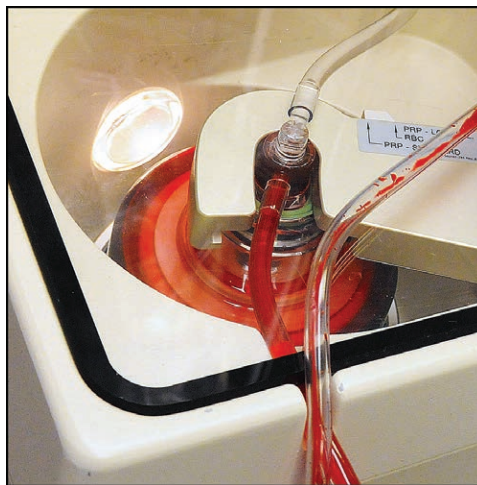
Promoting Safety, Quality, and Value through Patient Blood Management

Jonathan H. Waters, M.D.

IN this issue of *ANESTHESIOLOGY* is a report on the next evolution of a patient blood management program.¹ This report explores what was done at the Johns Hopkins Health System to take a successful program at their main hospital with a strong physician champion and disseminate the program to four other hospitals in their health system. To do so, they heavily leveraged the capabilities of their electronic health record, including a computerized physician order entry system and evidence-based decision support tools. These methods, which were complemented by widespread education, comprise the next steps in the evolution of patient blood management.

The domain of patient blood management started as bloodless medicine and surgery in the mid-1990s. In the bloodless model, a bloodless coordinator at each hospital was tasked with safeguarding the lives of patients who refused blood. From caring for bloodless patients, tools were developed that allowed major invasive procedures to occur without transfusion. Surprisingly, the outcomes for these patients were frequently better than for those who were transfused. The bloodless coordinators became advocates, sometimes to the point of zealotry, that “bloodless” was beneficial to all patients. Unfortunately, many physicians had issue with the term “bloodless” and its associated religious connotation. Thus, a move to relabel the field as “blood conservation” was undertaken. This label did not stick because there was significant fear of undertransfusion and withholding potential life-saving therapy. So another name change was made, with “blood management” being chosen.

The blood-banking community did not pay much attention because they felt that they practiced “blood management” every day as they managed their inventory of blood. So, a need to differentiate “inventory” blood management from what was done to benefit patients was required. A further change to the name was suggested, and “patient



“...this report highlights the role that an anesthesiologist can play in leading patient blood management.”

addressed. Sufficient erythrocytes could not be salvaged if patients were anemic before surgery. In conjunction with blood salvage, platelet and plasma utilization could be optimized with quantitative information that comes from point-of-care testing in the operating room or intensive care units.

As hospital mergers take place across the country, mechanisms to spread successful patient blood management programs to newly assimilated hospitals within health systems are needed. In this report, Frank *et al.*¹ explore what was done to disseminate their patient blood management program across a five-hospital health system. To do so, they chose to move away from the model of having a bloodless coordinator at each hospital and to leverage information technology. They focused on two components of blood management: getting clinicians to abide by evidence-based guidelines and promoting single-unit erythrocyte transfusions rather than the classic two units. Focusing on these two areas, they created standardized order sets and best practice advisories. Through use of these tools, they recognized a 400% return on their fiscal investment to run the patient blood management program.

Image: J. P. Rathmell.

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Building these tools requires extensive resources. In this report, the electronic health record Epic (USA) was used to create best practice alerts that notify a clinician in real time when they are deviating from the institutional recommendations. In conjunction with the alerts, they developed benchmarking reports comparing clinicians in each department as to their blood use and guideline compliance rates. For stand-alone or small hospitals with few resources, the ability to develop a patient blood management program as outlined by Frank *et al.*¹ might be impossible. This may be one of the reasons that patient blood management programs have been slow to develop across the United States.

When writing a business plan to develop a blood management program, one needs to keep in mind that the opportunity for savings is related to the baseline amount of overuse. If your hospital is lost in an era of a hemoglobin transfusion trigger of 10 g/dl for erythrocytes and you always give blood by double-unit orders, then your savings could be great. If your facility is ordering one unit at a time, with frequent evaluation of the effectiveness of the transfusion, and carefully giving the blood when signs of inadequate oxygen delivery are occurring, then your opportunity might be small. Most experts in the field believe there is substantial blood- and cost-savings opportunity for the vast majority of hospitals where a patient blood management effort does not exist.

In addition to understanding one's baseline practice, it is also important to assess how one will measure success. To illustrate, Goodnough *et al.*⁵ reported upon the success of a clinical decision support system implemented in 2010. If you look at their interval from 2011 to 2015, they had an increase in blood use of approximately 4%, but a 7% increase in patient volume, and a 20% increase in patient days at risk. This illustrates the need to volume adjust any changes in blood use. After volume adjustment (erythrocytes transfused/100 patient days), Goodnough saw a 14% reduction from 2011 to 2015 and an overall 42% reduction over a 7-yr period, indicating that their program was indeed a success.

Another aspect of this report highlights the role that an anesthesiologist can play in leading patient blood management. In general, hospitals purchase blood from blood providers. The only oversight of blood purchases and blood use has been through the "transfusion review committee." In many hospitals, this committee is chaired by a blood bank physician. Given that blood is sold to the hospital by a blood center, which typically employs the blood bank physician, a natural conflict of interest occurs. Ideally the patient blood management team has representative clinicians from multiple disciplines, each with a unique perspective and contribution on how to promote best practices. However, many successful patient blood management programs with which I am familiar are run by anesthesiologists.

There are several other advantages to having an anesthesiologist oversee how blood is used. The anesthesiologist is the only provider that does not write an order for a transfusion. We transfuse it ourselves. With this clinical perspective, we have first-hand knowledge of logistical problems associated with transfusion, as well as associated waste related to the provision of blood not only in the operating rooms but also in the critical care units. Thus, anesthesiologists have insight into blood use that many other providers do not have.

Transfusion of allogeneic blood is the safest that it has ever been.⁶ Viral testing and electronic crossmatching have made complications associated with transfusion rare; however, complications still exist, such as the risk of circulatory overload, acute lung injury,⁷ or of new pathogens, like Zika,⁸ infecting the blood supply. Inherently, the safest transfusion is the one not given. Although the risks of transfusion can be debated, what cannot be argued is the cost. Acquisition cost of blood runs around \$211 per unit of erythrocytes.⁹ Fully loaded costs of transfusion have been estimated to range from \$500 to \$1,200 per unit of erythrocytes.¹⁰ For my hospital system, the 330,000 units of blood comprise the largest line item on the laboratory budget, which naturally draws attention. As healthcare reform takes hold, the low-hanging fruit of the "triple aim," *i.e.*, providing safer care, improving the health of populations, and reducing per capita costs of health care, is easily achieved through patient blood management.

Competing Interests

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Correspondence

Address correspondence to Dr. Waters: watejh@upmc.edu

References

1. Frank SM, Thakkar RN, Podlasek SJ, Ken Lee KH, Wintermeyer TL, Yang WW, Liu J, Rotello LC, Fleury TA, Wachter PA, Ishii LE, Demski R, Pronovost PJ, Ness PM: Implementing a health system-wide patient blood management program with a clinical community approach. *ANESTHESIOLOGY* 2017;127:754–64
2. Proceedings from the National Summit on Overuse, September 24, 2012, Organized by the Joint Commission and the American Medical Association. Convened Physician Consortium for Performance Improvement® (PCPI®). Available at: www.thepcpi.org/pcpi/media/documents/overuse-proceedings-paper.pdf. Accessed June 21, 2017
3. Gammon HM, Waters JH, Watt A, Loeb JM, Donini-Lenhoff A: Developing performance measures for patient blood management. *Transfusion* 2011; 51:2500–9
4. WHO Global Forum for Blood Safety: Patient blood management. Available at: http://www.who.int/bloodsafety/events/gfbs_01_pbm/en/. Accessed June 21, 2017
5. Goodnough LT, Baker SA, Shah N. How I use clinical decision support to improve red blood cell utilization. *Transfusion* 2016; 56:2406–11.

6. Alter HJ, Klein HG: The hazards of blood transfusion in historical perspective. *Blood* 2008; 112:2617–26
7. Gilliss BM, Looney MR, Gropper MA: Reducing noninfectious risks of blood transfusion. *ANESTHESIOLOGY* 2011; 115:635–49
8. Goodnough LT, Marques MB: Zika virus and patient blood management. *Anesth Analg* 2017; 124:282–9
9. Ellingson KD, Sapiano MRP, Haass KA, Savinkina AA, Baker ML, Chung KW, Henry RA, Berger JJ, Kuehnert MJ, Basavaraju SV: Continued decline in blood collection and transfusion in the United States-2015. *Transfusion* 2017; 57(suppl 2):1588–98
10. Shander A, Hofmann A, Ozawa S, Theusinger OM, Gombotz H, Spahn DR: Activity-based costs of blood transfusions in surgical patients at four hospitals. *Transfusion* 2010; 50:753–65

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Queen Victoria's Youngest Two Sons: Princes Arthur and Leopold



In June of 1860, English photographer John Jabez Edwin Mayall (1813 to 1901) captured photo-portraits of Queen Victoria's children. In this close-up from Mayall's albumen carte de visite (*above*), 10-yr-old Prince Arthur (1850 to 1942) rests his right hand on the right shoulder of 7-yr-old Prince Leopold (1853 to 1884). Both princes are dressed in the kilts and hose of Highland garb. As the seventh of the Queen's nine children and her third son, Prince Arthur would follow in the footsteps of the father he so closely resembled—into the military and into a host of “manly” pursuits. His birth had been anguishing enough to motivate the Queen to consent to chloroform administered by Dr. John Snow for the birth of her next child, Prince Leopold. Constrained by hemophilia and epilepsy to less physically rigorous pursuits, the Queen's youngest son, Prince Leopold, served as the Queen's personal secretary and championed both chess and the arts. Sadly, the intellectually brightest of Victoria's children, Prince Leopold, fell down a staircase in France and succumbed to a cerebral hemorrhage when he was 30 yr old. (Copyright © the American Society of Anesthesiologists' Wood Library-Museum of Anesthesiology.)

George S. Bause, M.D., M.P.H., *Honorary Curator and Laureate of the History of Anesthesia*, Wood Library-Museum of Anesthesiology, Schaumburg, Illinois, and *Clinical Associate Professor*, Case Western Reserve University, Cleveland, Ohio. UJYC@aol.com.