A Novel Approach to Preoperative Blood Orders

WORLD-WIDE, several hundred million operations are performed each year. A substantial fraction require blood transfusion, often with little forewarning. Because crossmatching and antibody screening takes time, it is conventional to either type-and-screen or crossmatch blood for patients likely to require transfusion. The clinical challenge is to predict who will require transfusion—and how many units. This is where the Maximum Surgical Blood Order Schedule can be helpful. Frank *et al.*,[1] in this issue of the Journal, present a novel and largely objective method for determining operation- and institution-specific maximum blood order guidelines; that is, recommendations for type-and-screen or the crossmatching of units for particular procedure classes.

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The authors used their institution's electronic anesthesia records and blood bank database to compare type-and-screen and crossmatch orders with intraoperative transfusions. (Postoperative transfusions are of less concern because they are rarely emergent; crossmatching can thus, be done at the time blood is ordered.) The results, unsurprisingly, showed that far more patients get type-and-screens or units crossmatched than actually get transfused. The investigators used their data to develop a statistical algorithm for generating operation-specific maximum blood order guidelines.

Friedman *et al.*[2] created a Maximum Surgical Blood Order Schedule in 1976, which recommended how many units of blood should be crossmatched or type-and-screened preoperatively for common elective surgical operations. The goal of creating a maximum surgical blood order schedule is to reduce unnecessary laboratory work and to reduce the time that a unit is reserved (*i.e.*, crossmatched) for a single patient. The creation of the maximum surgical blood order schedule at most facilities is primarily based on consensus.[3,4] In other words, the blood bank director solicits a group of surgeons for their thoughts as to the expected blood loss for a particular procedure. How this solicitation takes place is institution-specific, as is how often the maximum surgical blood order schedule is revised. Although consensus-based guidelines are an improvement over individual judgment, they lack the rigor of quantitative recommendations based on objective institutional data.

The authors evaluated intraoperative erythrocyte transfusion needs in 1,632 adult procedures that were grouped into 135 internally similar categories, based on surgical specialty and anatomic location. Patients undergoing ophthalmologic surgery were excluded. The general approach was to assign each surgical category to one of five recommendations for pretransfusion testing based on the fraction of patients requiring transfusion, median blood loss, transfusion index (ratio of transfused units to patients), *a priori* risk of major bleeding (as determined by consensus with surgeons), and whether the operation was major vascular or transplant. The algorithm is novel in being largely objective. In this regard, it differs from previous maximum blood order proposals which were primarily consensus based.[5,6]

A difficulty in comparing maximum blood orders among hospitals is that institutions differ not only in the types of operations they perform, but also in the skill and technique of the surgeons who perform them, the variation in application of blood conservation strategies, and tolerance for anemia. Consequently, maximum blood order guidelines for one institution may generalize poorly to others. Similarly, national guidelines—even if objective—would strive to represent typical rather than specific institutions.

A second novel aspect of the algorithm proposed by the authors is that it can be applied to the transfusion data from other institutions. (The specific methods are presented in

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an electronic appendix to their article). Individual institutions can, therefore, use this methodology to develop specific guidelines based on their own transfusion practices. Presumably, objective institution-specific maximum blood orders will provide better direction than guidelines adopted from other institutions or even national guidelines.

Among the patients, in whom the algorithm of Frank *et al.*[1] suggested pretransfusion testing and crossmatching as unnecessary, about a third had preoperative type-and-screens performed and 10% had erythrocytes crossmatched for them. Among those whom the algorithm suggested only a type-and-screen was necessary before the surgery, a third had erythrocytes crossmatched in the blood bank. The authors report that these unnecessary tests cost their institution $43,135 annually.[7] Although this amount seems small, it represents an opportunity for reducing the cost associated with surgery. Reduction of waste can be a component of a hospital's blood management program. Other opportunities for reducing waste include the reduction or elimination of preoperative autologous donation and reducing the number of blood products that are wasted, such as platelet units that are returned from the operating room on ice. These various forms of transfusion-related waste, when combined, represent substantial avoidable cost.

As with many medical expenses, individual costs of blood typing and crossmatching are hard to estimate and depend heavily on cost allocations to fixed *versus* variable expenses. But independent of the exact cost, type-and-screens and crossmatching clearly burdens institutional budgets. Most transfusion services monitor the crossmatch-to-transfusion ratio specifically for this purpose. The transfusion community's benchmark crossmatch-to-transfusion ratio is 2:1 or less; that is, no more than 2 units crossmatched for every unit transfused.

Finally, the advent of electronic crossmatching should help to reduce the number of erythrocyte units that are electively crossmatched for surgical patients.[8] Electronic crossmatching is performed by most of the large medical centers and allows red cells to be crossmatched in just minutes as long as unusual antibodies are not present (such as anti-D, anti-Kell); however, only 5 to 10% of patients have these antibodies. By substituting electronic for conventional physical crossmatching, crossmatched units remain potentially available for various patients. This might allow the crossmatch-to-transfusion ratio to approach 1:1, further reducing cost and waste.

A limitation of the current analysis is that it has yet to be clinically implemented. It thus remains possible—although, perhaps unlikely—that their guidelines increase the number of patients experiencing intraoperative blood availability emergencies. Similarly, cost savings will depend on current institutional practice and the extent to which objective maximum blood orders are actually implemented.

In summary, Frank *et al.*[1] present an algorithm for determining operation-specific maximum blood order guidelines from electronic anesthetic records. Their algorithm is novel in being largely objective. How effective it is in clinical practice remains to be described. We hope these investigators will later report how difficult it was to implement their system, how well it worked in practice, and the resulting cost savings.

Alparslan Turan, M.D.,* Jonathan H. Waters, M.D.,† Daniel I. Sessler, M.D.* *Department of Outcomes Research, Cleveland Clinic, Cleveland, Ohio. turana@ccf.org. †Department of Anesthesiology and Bioengineering, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania.

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