Improving Clinical Efficiency in a Hospital Blood Bank

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Introduction

The health care marketplace continues to demand improved quality at reduced cost. We sought to improve the efficiency and effectiveness of blood transfusion practices at an urban hospital with a particularly active cardiology and cardiac surgery practice. In this article, we describe the clinical efficiency improvements implemented at the hospital and discuss how active enforcement of transfusion guidelines and thoughtful review of surgical transfusion practices can reduce costs while maintaining a high standard of care.

Background

The Presbyterian Medical Center (PMC), a member of the University of Pennsylvania Health System (UPHS), is a community hospital located in West Philadelphia. An average of 48.9 cardiac procedures are performed each month, the vast majority of which are coronary artery bypass (CAB) or valve replacement (VR) procedures. In providing transfusion support to the hospital, the blood bank issues approximately 450 units of packed red blood cells (PRBC) and 135 units of fresh frozen plasma (FFP) each month. The blood bank staff includes a supervisor, four full-time blood bank technologists, and several part-time technologists.

In November 1997, the hospital pathologists and blood bank staff began a project to improve the blood bank’s operating efficiency and to reduce the risk of transfusion-related complications while maintaining a high standard of care. Transfusion records for cardiac surgery for the time period studied were analyzed for crossmatch-to-transfusion (C/T) ratios and average number of units transfused per procedure. Using the analysis results and established transfusion guidelines, including the guidelines of the American Association of Blood Banks (AABB) [1], the pathologists and staff revised three of the policies governing blood product requests from the hospital.

Policy Change 1: Prospective Review of Blood Product Requests

Prior to PMC’s incorporation into the UPHS, the blood bank’s policy was to provide physicians whatever transfusion support they requested, regardless of medical propriety. All requests were reviewed retrospectively on a monthly basis by the medical director of the blood bank. If a request was deemed inappropriate, a letter was sent to the ordering physician asking for an explanation, but no further action was taken. Retrospective review failed to alter physician transfusion practices and did not prevent blood products from being transfused to patients who did not need them.

After PMC joined UPHS, all transfusion requests for PRBC or FFP that did not adhere to institutional transfusion guidelines (Table 1) were prospectively reviewed. A memo was sent to physicians notifying them of the policy change.

The blood bank technologists were responsible for monitoring blood product orders for inappropriate requests and received instruction on the institutional and AABB transfusion guidelines, particularly regarding hemoglobin levels for PRBC and coagulation values for FFP. Requests for PRBC were flagged when a patient’s hemoglobin exceeded 8 g/dL, and requests for FFP were flagged when prothrombin (PT) or partial thromboplastin times (PTT) were not significantly elevated. Requests for FFP also were flagged if PTT was significantly elevated without a similar increase in PT. Platelet requests were reviewed initially, but the number of requests, much less inappropriate requests, were so few that platelet review was discontinued after 2 months.

When a potentially inappropriate request was identified, the technologist notified the clinical pathologist on call and relayed the pertinent clinical and laboratory information. To facilitate this process, the blood bank had the pager numbers of both pathologists at all times, and a call schedule was arranged and posted in the blood bank. Technologists could page or telephone the pathologists on a 24-hour basis. Once notified, the pathologist contacted the ordering physician and inquired about the patient’s clinical history and condition. Depending on the clinical information exchanged, the pathologist would approve, modify, or deny the request. All requests from the operating room or emergency department were filled without challenge.
Challenged requests that subsequently were approved often had an incomplete clinical history. In such cases, the physician was able to provide the necessary clinical information to gain approval of the request. When transfusion requests were deemed inappropriate, the pathologists would educate the ordering physician regarding the proper use of blood products. Some physicians were unaware that institutional guidelines existed, whereas others were unfamiliar with recent studies indicating that patients typically can tolerate lower hemoglobin levels than previously thought [2]. Transfusion requests associated with the following practices were most likely to be challenged, and frequently were denied or modified:

- Reflexively ordering two units of PRBC when only one unit is needed
- Ordering a transfusion or a type and crossmatch when a patient actually needs blood typed and screened
- Using FFP to treat a patient with a heparin overdose or lupus-like antibody
- Increasing a patient’s hemoglobin level to improve renal perfusion
- Using PRBC as an oncotic protein

Results

Over a 13-month period, 14.6% of all PRBC requests and 42.2% of all FFP requests were challenged. Of these challenged requests, 17.1% for PRBC and 8.2% for FFP were denied. Each month an average of 11.2 units of PRBC and 3.5 units of FFP were denied, saving the blood bank $1267 per month (Table 2). For any given month, 3 to 21 units of

### Table 1. Presbyterian Medical Center Transfusion Guidelines

<table>
<thead>
<tr>
<th>Appropriate Use</th>
<th>Inappropriate Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Red blood cells</strong></td>
<td><strong>Fresh frozen plasma</strong></td>
</tr>
<tr>
<td>Anemia with hypoxia</td>
<td>Volume expansion</td>
</tr>
<tr>
<td>Active bleeding with or without hypovolemic shock</td>
<td>Improve general well-being</td>
</tr>
<tr>
<td>Exchange transfusion</td>
<td>Enhancement of wound healing</td>
</tr>
<tr>
<td>Symptomatic chronic anemia unresponsive to conservative therapy</td>
<td>Elevation of hemoglobin value alone</td>
</tr>
<tr>
<td>Hemoglobin &lt; 8 g/dL</td>
<td><strong>PT</strong> = prothrombin time; <strong>PTT</strong> = partial thromboplastin time; <strong>TTP</strong> = thrombotic thrombocytopenic purpura.</td>
</tr>
<tr>
<td>Hemoglobin &lt; 10 g/dL in patients who have cardiac, pulmonary, or neurologic disease</td>
<td><strong>Clinical oxygenation problems at any hemoglobin level</strong></td>
</tr>
<tr>
<td>Clinical oxygenation problems at any hemoglobin level</td>
<td><strong>Multiple coagulation factor deficiencies in a patient who is at risk for bleeding</strong></td>
</tr>
<tr>
<td><strong>Therapy for TTP</strong></td>
<td><strong>Volume expansion</strong></td>
</tr>
<tr>
<td>Infusion during massive transfusion when the coagulation defect is evident</td>
<td><strong>Bleeding, or prolonged PTT without prolongation of PT</strong></td>
</tr>
<tr>
<td><strong>Correction of a specific coagulation factor deficiency</strong></td>
<td><strong>Standing orders</strong></td>
</tr>
<tr>
<td>Reversal of warfarin when vitamin K will not be sufficiently timely</td>
<td><strong>Emergent reversal of heparin</strong></td>
</tr>
</tbody>
</table>

NOTE. Guidelines are not absolute (eg, patients with a hemoglobin level of 7 g/dL have adequate oxygen carrying capacity when their intravascular volume is adequate for perfusion).
PRBC and 0 to 10 units of FFP were denied. By not cross-matching the denied units of blood, an additional $72 per unit of PRBC was saved through technologist time and reagent costs. This represents an additional savings of $809 per month, for an average monthly cost savings of $2076. The savings in technologist time from denying FFP were negligible.

Policy Change 2: Reducing PRBC Crossmatching for Cardiac Surgery

Over the past 20 years, thoracic surgeons have refined their surgical techniques and developed blood recycling technology to the point where it is common for a patient not to receive a single unit of PRBC during open heart surgery [3,4]. In response to these surgical advances, the PMC blood bank instituted a policy to reduce the number of units of blood crossmatched for cardiac surgery. The traditional practice was to crossmatch four units of blood and type and screen two additional units for each cardiac surgery procedure. An internal review of cardiac surgery patients revealed a C/T ratio of more than 2.24, representing a significant waste of blood and technologist time. To lower the C/T ratio for cardiac surgery, the blood bank began the following crossmatch policy, effective 16 January 1998:

- Two units of PRBC are crossmatched for first-time CAB procedures
- Three units of PRBC are crossmatched for repeat CAB and VR procedures
- No blood is screened for either of these procedures

Before the new policy was implemented, a memo indicating the blood bank’s intentions was sent to cardiac surgeons practicing at PMC.

Results

Twenty-five consecutive cardiac surgery patients prior to and the first 50 patients after the change were reviewed. Fifty-one patients (65%) underwent a first-time CAB, 13 patients (18%) underwent a VR, 6 patients (8%) had a combined CAB and VR, and 5 patients (7%) had a repeat CAB procedure. The number of units transfused during and within the first 48 hours of surgery was determined by a review of the patients’ transfusion records maintained in an electronic database. Prior to the policy change, 17 of 25 patients (68%) received two units of blood or less; the mean number of units transfused per patient was 2.1 (the median was 2.0 units). Following the policy change, 33 of 53 patients (62%) received two units of blood or less; the mean number of units transfused per patient was 2.2 (the median was 2.0 units). In essence, the transfusion practices of the cardiac surgeons did not change as a result of the new blood crossmatch policy. However, the C/T ratio for these cardiac procedures was lowered from 2.24 to 1.23 ($P < 0.05$), a substantial improvement in operating efficiency. No complaints were received from the cardiac surgeons regarding delays in blood transfusions for their patients since the policy change.

By reducing the number of units of blood crossmatched per procedure, the blood bank saved an average of $5912 per month in technologist time and reagent costs. This represents the difference in cost between crossmatching four units of PRBC (at $72 per unit) versus two or three units, multiplied by the monthly average of 49 cardiac procedures at PMC.

Policy Change 3: Eliminating Crossmatching for Selected General Surgical Procedures

The success in reducing crossmatching for cardiac surgery prompted a review of blood ordering practices in general surgery. Specifically, transfusion ordering and actual blood transfused was reviewed for the following procedures: amputation of a leg; debridement of an ulcer; colostomy; colectomy; myocutaneous flap procedures; exploratory laparotomy; and cholecystectomy. Three surgeons were noted to have a high C/T ratio for these procedures. Review of 26 consecutive procedures performed by the three surgeons showed that only one patient actually received a blood transfusion, yet two units of blood were crossmatched for each procedure.

Based on these data, the PMC pathologists directed the blood bank to automatically change any request for crossmatched blood to a request for a type and screen.
pathologists contacted the three surgeons in question by telephone and memo to inform them of the proposed changes and presented the data prompting the change. The surgeons did not realize that crossmatching blood was more expensive than screening a patient for blood ($72 versus $54, respectively) and that once a patient is screened, blood can be crossmatched in less than 10 minutes.

Results
Among these seven procedures, an average of 81.7 operations are performed per month at PMC. By not crossmatching blood for these patients, the blood bank saved $1470 per month in technologist time and reagent costs. There were no complaints from the surgeons regarding delays in transfusion support for their patients.

Impact of Project and Lessons Learned
Since its implementation 13 months ago, the clinical efficiency project has improved operating efficiency within the blood bank and has resulted in a number of positive outcomes. Its success is reflected in a lower overall C/T ratio—1.71, down from 2.24—and reduced operating costs, resulting in an average savings of $9458 per month (Table 3). The costs and time involved in developing the project were negligible as the data used were gathered as part of ongoing quality control operations.

Adherence to transfusion guidelines prevented patients from receiving blood they did not need and incurring unnecessary transfusion-related risks. One incident occurred in which a patient was refused blood and later died. The patient was critically ill and on review was thought not likely to have benefited from a blood transfusion. Aside from this, there have been no complaints from the medical staff regarding adverse patient outcomes from not having received blood. Throughout the project, the welfare of the patient took priority over financial considerations in all policy and individual transfusion decisions.

Individual enforcement decisions were made on a case-by-case basis and involved the ordering physicians and pathologists. Given the experiences of the transfusion medicine department at the Hospital of the University of Pennsylvania, which decreased its blood wastage in part through active involvement of hospital physicians [5], we believed active physician involvement would be the best way to achieve our goals. Communicating with the physicians has been the most challenging aspect of implementing the policy changes. In some cases, a diplomatic approach was necessary to achieve an acceptable and appropriate resolution to challenged requests; however, the physicians’ response generally has been positive.

The new policies have improved blood inventory control and reduced the workload of the blood bank staff. Because fewer units of crossmatched PRBC are being ordered, the blood bank has been able to decrease the number of units of blood stocked in house. The savings in technologist time is particularly significant since the blood bank is at a minimal staffing level. Further, the blood bank staff have become more involved in achieving and maintaining operational efficiency. The technologists are reviewing requests and contacting patient care units themselves when they receive grossly inappropriate or obviously incorrect requests, which saves time and blood products.

The ongoing education of the physicians, particularly resident physicians, regarding guidelines for blood product transfusion has lead to better transfusion decisions. In the past several months, the number of units of PRBC being denied has declined, indicating that physicians are making fewer inappropriate requests.

References