Impacts of Updated Transfusion Guidelines on a Small Hospital Blood Bank in a Chicago Suburb

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ABSTRACT

The purpose of this research was to identify effective means to utilize blood product resources within a hospital laboratory. A retrospective review of six years of blood utilization data (2010-2015) was analyzed from Rush Oak Park Hospital, Oak Park, IL, a small hospital blood bank in a suburb of Chicago. Time-frames included: before electronic medical record (EMR) use: after EMR implementation and computerized provider order entry (CPOE) use: and following targeted physician education. Updated transfusion indications were implemented in time-frame three in an effort to reduce unnecessary crossmatch and transfusion orders, and improve patient safety. The mean number of crossmatched and transfused units decreased significantly from time-frame two to three: from 236±44 units crossmatched to 166±29 units ($p < 0.001$) and 154±31 units to 99±18 units transfused ($p<0.001$). The blood type and antibody screen (T/S) samples increased significantly over the same period ($p<0.03$). Surgical and emergency room (ER) crossmatch to transfusion ratios (C:T) showed no significant change, while the other category (inpatient, outpatient, and Hematology/Oncology clinic) revealed a significant increase over time-frames two to three ($p<0.001$). The number of red blood cell (RBC) units transfused from 2013 to 2014 declined by 646 units, with an estimated cost savings of $129,200. Providing evidence-based guidelines with CPOE to reduce ordering and preparation of blood products is an area of opportunity to improve care and reduce costs.

ABBREVIATIONS: EMR - electronic medical record; CPOE = computerized provider order entry; MSBOS - maximum surgical blood order schedule; T/S - blood type and antibody screen; ER - emergency room; C:T - crossmatch to transfusion ratio; RBC - red blood cell; ANOVA - analysis of variance

INDEX TERMS: Blood grouping/crossmatching, erythrocyte transfusion/utilization, cost-savings

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INTRODUCTION

Blood product utilization is consistently under scrutiny and evaluation due to new technologies,[1-3] widely accepted lowered transfusion triggers,[4,5] and the possible adverse effects of blood transfusions.[3-7] For years, blood banks have been subjected to an outdated standard maximum surgical blood order schedule (MSBOS), as well as emergency room providers who chronically over-order blood products based on patients presenting complaint rather than clinical factors. Conveying new concepts, guidelines, and transfusion practices to providers is often overlooked, as is educating specific providers when ordering outside of established protocols.

When the possibility of requiring a blood transfusion is encountered by a patient, a blood type and antibody screen (T/S) are performed. If the situation or condition warrants, a requested number of red blood cell (RBC) units are crossmatched using the T/S sample and placed on hold for the patient. The number of units ordered and crossmatched compared to the number of units actually transfused is known as the crossmatch to transfusion ratio (C:T). This is a widely accepted method to monitor product use, a 2.0 benchmark is generally considered appropriate.[8,13,14] Apparent in a United Kingdom study, Mundy et al.[9] concluded that 77% of total hip and 62% of total knee surgeries requested units which were never used.

In 2014, with an effort to standardize utilization, the

American Association of Blood Banks (AABB) released the first edition of Standards for Patient Blood Management, with the goal of enhancing the quality of transfusion care.[10] Updated transfusion guidelines regarding utilization is thought to impact the excessive ordering and transfusing of blood products and provide further safety to patients by reducing exposure to transfusion risk.

Effective means to control blood utilization include:closely monitoring transfusions, providing education, and intervention of conventional hemoglobin level transfusion indications. Zuckerberg et al.[11] reported significant reductions in surgical blood use with simple education updates given to providers. While the typical MSBOS tends to be dated, Frank et al.[1,2] demonstrated significant reduction in crossmatch and transfusion orders by creating an institution-specific MSBOS to reduce preoperative blood ordering. In many cases, efforts to engage utilization have proven successful in reducing the number of crossmatched and transfused units.

The purpose of this research was to identify effective means to utilize blood product resources within a hospital laboratory. A retrospective review of six years of blood utilization data (2010-2015) was analyzed from a 150 bed hospital blood bank in a suburb of Chicago. This research was used to assess blood utilization, track change, and identify efficiency and compliance over the three separate periods of interest. The time-frames included: before electronic medical record (EMR) implementation (2010-11); after EMR ordering utilization (2011-14); and following targeted physician education (2014-15).

MATERIALS AND METHODS

Prior to collecting data, approval was obtained from the institutional review board (Rush University, Chicago, Illinois). A retrospective study was performed in our 150-bed hospital, with data collected from laboratory transfusion and quality records. The data consisted of six years of annual performance monitors, laboratory annual reports, and quality assurance data (January 2010 through March 2015). The data compiled included total monthly: T/S samples, crossmatched units, and transfused units. The C:T's for the emergency room (ER), surgical, and other (inpatient, outpatient, Hematology/Oncology clinic) categories were calculated. In addition to these metrics, an estimated cost-savings analysis was performed to realize potential savings, using total units transfused per year and approximate RBC unit cost.

Timeline

The data on red blood cell (RBC) utilization was separated into three time-frames before analysis. The first time-frame was a baseline measure, during which time the blood bank used a manual recording system, paper transfusion requisitions, and product requests (January 2010 to May 2011). The next time-frame noted (June 2011 to April 2014), followed implementation of an electronic medical record (EMR). The EMR, Epic (Epic Systems Corp., Verona, Wisconsin), included computerized provider order entry (CPOE). The third time-frame consisted of data collected following guideline updates to the CPOE (May 2014 to March 2015).

Updated guideline

Leading into period three, information was distributed to the providers within our healthcare system. This information included additional transfusion educational guidelines provided through electronic communication and EMR news updates. These revised indications were put in place by our healthcare system as a guide for appropriate utilization of RBC transfusions, and were not intended to replace the clinical judgment of the ordering provider. Crossmatch orders require providers to select at least one transfusion indicator. The available updated indications included:

1. Hemoglobin less than 7g/dL – One unit transfusions are recommended
2. Active bleeding with hemoglobin less than 8g/dL – GI/post-operative/probable cardiac ischemia
3. Active bleeding with hemodynamic instability – Pre-operative/pre-procedure
4. Hemoglobin less than 10g/dL – Acute cerebral ischemia/septic shock, or red blood cell exchange.

The projected impact of the order revisions included reducing unnecessary RBC utilization, improving patient outcomes and safety, and optimizing resources.

Statistical Analysis

The statistical analysis was performed with Excel, v. 15.0.4719 (Microsoft Inc., Redmond, Washington).

The mean values were calculated from the data collected, and changes over time-frames were reported using the mean monthly values during each period. Comparisons between time-frames were made by analysis of variance (ANOVA). Data are shown as mean ±SD, with a p-value less than 0.05 considered significant.

RESULTS

The review of blood product utilization was measured using the following information: T/S samples, crossmatches, transfusions, and C:T's (Table 1). The number of T/S samples showed a significant increase of 22 samples from time-frame two to time-frame three ($p = 0.03$). The number of crossmatched units and transfused units decreased significantly from time-frame two to time-frame three ($p<0.001$). This decrease coincided with the implementation of the updated CPOE guidelines within time-frame three.

Table.1. Historical Blood Utilization – ANOVA*

	Time-Frame 1 January 2010-May 2011	Time-Frame 2 June 2011-April 2014	Time-Frame 3 May 2014-March 2015	
	n=17	n=35	n=11	p value
Type and Screen	169±23	161±22	183±34	0.03
Crossmatch	257±46	236±44	166±29	<0.001
Transfused	171±33	154±31	99±18	<0.001
C:T[a] ER[b]	1.46±0.27	1.55±0.29	1.7±0.35	0.11
C:T Surgical	3.45±1.04	3.26±0.97	4.31±2.64	0.12
C:T Other[c]	1.19±0.07	1.21±0.10	1.45±.12	<0.001

* Data provided as monthly mean ±SD
[a] Crossmatch to transfusion ratio
[b] Emergency room
[c] Inpatient, outpatient, and Hematology/Oncology Clinic data included

The ER and other C:T remained relatively stable over the periods while the surgical C:T was consistently higher (Figure 1). The total number of units transfused from 2013 to 2014 decreased by 646 units (Figure 2). Crossmatched and transfused units showed their lowest totals in 2014 and the first quarter of 2015 (Figure 3).

To calculate hospital estimated purchase cost-savings, the acquisition cost (approximately $200 per unit) and total units transfused were used. By comparison, the number of units transfused from 2013 to 2014 resulted in an estimated cost savings of $129,200 (646 units). The projected purchase cost-savings comparing 2012 to 2014 data resulted in an estimated $164,200 (821 units).

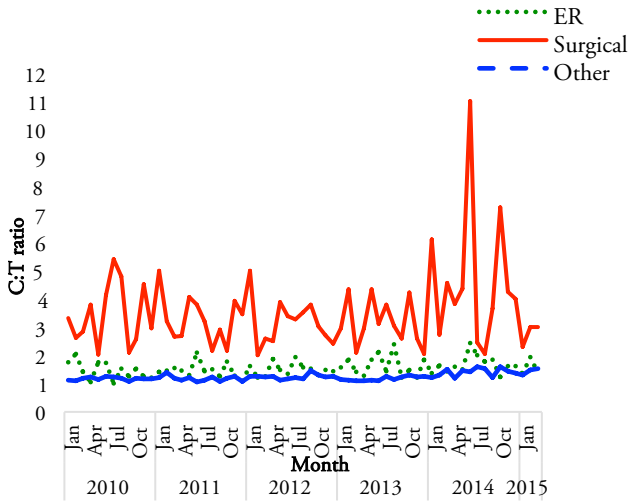

Figure 1. Monthly crossmatch to transfusion ratios per recorded category including: emergency room (ER), surgical, and other (including inpatient, outpatient, and Hematology/Oncology Clinic) data. The electronic medical record (EMR) implementation beginning in 2nd quarter 2011 and computerized provider order entry (CPOE) use beginning 2nd quarter 2014 are shown.

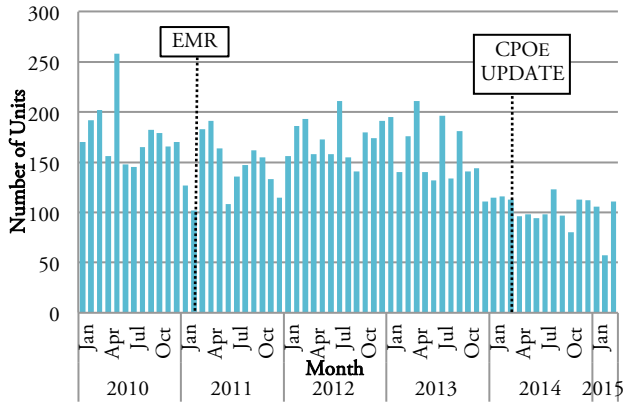

Figure 2. The electronic medical record (EMR) implementation indicated in the 2nd quarter 2011. A decline in the red blood cell transfusion trend following updated computerized provider order entry (CPOE) transfusion indications in the second quarter of 2014 is noted.

DISCUSSION

Historically, approaches to blood utilization have been antiquated. The progression within healthcare has included a recent trend by more organizations to encourage increased investigation into unnecessary blood transfusions. More providers are being evaluated

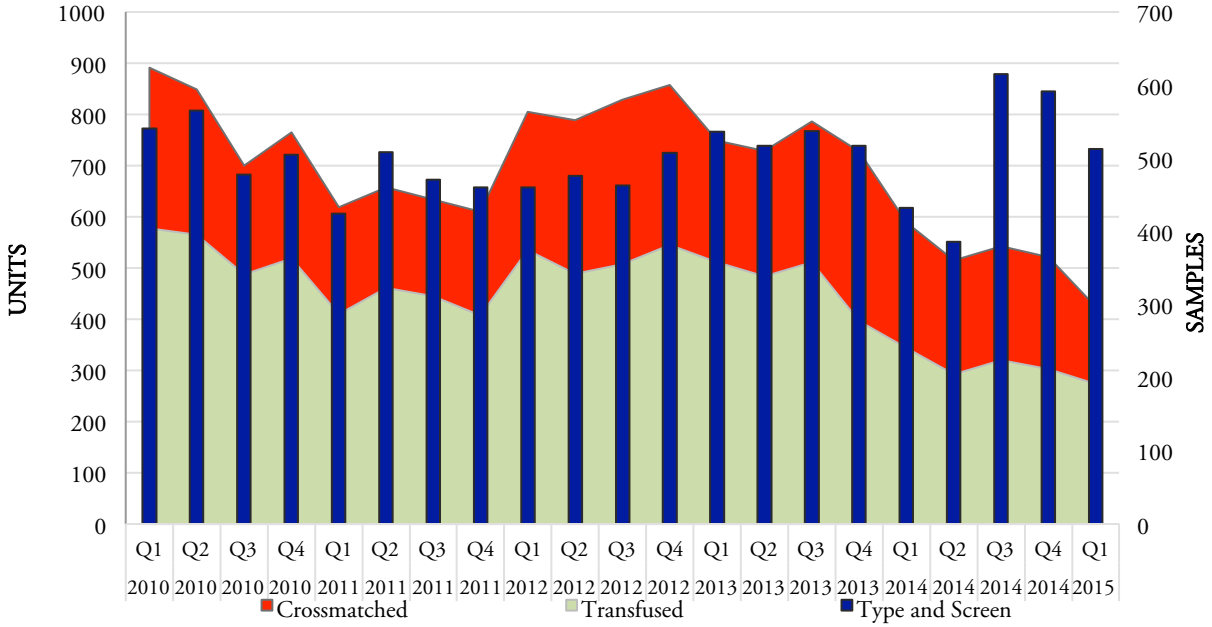

Figure 3. Electronic medical record implementation (EMR) in 2nd quarter 2011 and computerized provider order entry (CPOE) update in 2nd quarter of 2014 shown. The decrease in blood use is apparent following updated guidelines.

with institution-based approaches to patient blood management centered on EMR data.[1-3] However, an "unnecessary transfusion" has yet to be clearly defined.[4] This study was initiated to assess lowered transfusion indications and their impact on blood use.

The MSBOS has been used for decades to recommend standard practices for surgical blood ordering. This method places units on hold for a specific patient only taking into consideration the type of surgery being performed. This leads to increased waste, larger inventories, and increased departmental costs.[4,9,12,13] Other variables must be considered to effectively assess the need for crossmatching units to a patient and include: preoperative hemoglobin level, predicted blood loss, patient blood volume and likelihood of transfusion[5,6,9,12,13] These variables should all be used in conjunction to evaluate patient needs.

The current MSBOS used at our facility has resulted in a consistently high surgical C:T. In other studies, modifications to a standard MSBOS to monitor institution-specific trends and regulate blood utilization have shown positive results.[1,2,7,12] In similar research, Palmer et al.[6] used both patient and surgeon specific variables when reassessing crossmatch appropriateness with positive results. This specialization of the MSBOS focuses on the individual needs for varying organizations to gain positive results. An updated institution-specific MSBOS is a potential area for improvement within our hospital, given the current trends in blood utilization.

Throughout time-frame one, the laboratory blood bank used a manual recording and request method. The transfused units averaged the highest during this time-frame compared to all periods analyzed. In addition, the surgical C:T was above the benchmark for this period, due to lack of updated intervention and over-ordering of RBC's. The increased C:T ratio for surgical and the emergency room was not statistically significant (Table 1). In contrast, during time-frame three with both the EMR and updated CPOE transfusion indications in place, the blood bank recorded the lowest number of monthly transfusions. In addition, this time-frame had the highest number of T/S samples over the entire period studied.

The implementation of the updated CPOE guidelines for RBC orders initiated time-frame three. While the surgical C:T was erratic following the CPOE update, this was due in large part to traumatic surgical procedures where excessive products were ordered but not used. This is apparent in Figure 1, which shows a

greater than threefold spike in C:T in June and twofold spike in October 2014. The higher C:T in the surgical group may be related to the absence of a run-in period to allow providers to become familiar with the system. The emphasis on reduction in transfusions as opposed to blood orders, the historic use of higher hemoglobin triggers for patients undergoing surgery, and the smaller sample size and sampling period in time-frame three may also have contributed to the higher C:T in this group. Over the following quarters, the C:T seemed to stabilize. The increased awareness of new guidelines helped solidify compliance of providers. Requiring an indication for transfusion combined with lowered hemoglobin guidelines established a significant decrease in both the number of units crossmatched and units transfused, the result being that the C:T in period three was not reduced. Other research had similar findings, further indicating the effectiveness of this type of intervention within blood utilization.[3,5,10,14] Providing resources with evidence-based guidelines to reduce ordering and preparation of blood is an area of opportunity to reduce risk and costs.[4,7]

Limitations of this study include the sample size and institutional specifics. Due to the manual nature of much of the blood bank, the usage of CPOE is diminished as some orders are processed on paper requisitions. Aggregate data was collected and included T/S samples without intention to transfuse (prenatal, initial preoperative). In the hospital, surgical crossmatches are ordered in anticipation of need, while inpatients and hematology/oncology crossmatches are generally ordered as needed with intent to transfuse. These issues can affect the application of the systems in place, resulting in an unclear approach to blood utilization.

In conclusion, many areas of utilization in transfusion medicine can be improved upon if the resources are developed by organizations. Efforts towards improving blood utilization have shown that aspects centered on more efficient resources and tools can produce significant results. The impact of educational efforts regarding evidence-based research in this study is apparent. Requiring an indication for transfusion developed with updated guidelines can improve blood utilization. With increased momentum and guidance, blood product utilization will continue to improve.

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