

The Impact of Education and Computerized Provider Order Entry (CPOE) on Standardization and Reduction of Blood transfusions in a Community Hospital

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Background knowledge: There has been a significant change in blood management guidelines. Although blood transfusions have a key role in specific settings, the potential harmful effects have led to changes in recommendations. It is difficult to change physician behavior patterns and it often takes years for knowledge transfer to occur from literature to the bedside. Strategies and mechanisms to drive these changes can be enhanced through the use of Electronic Medical Records, CPOE, and data mining. The impact of clinical decision support (CDS) and CPOE has been previously studied. Rothschild, et al showed a reduction of inappropriate non-emergent transfusion orders following implementation of clinical decision support as part of a previously implemented CPOE system. Of the inappropriate orders flagged by CDS, 14% were changed. Interestingly, this resulted in an increased transfusion dose in 73% of cases, a decrease in only 27% and a net increase in the number of red cell units transfused. Perez, et al also evaluated the impact of the addition of CDS into an existing CPOE process for ordering red blood cell transfusion in the ICU. He demonstrated a reduction in the mean number of red cell transfusions per patient from 1.5 to 1.3 units and a decrease in the percentage of patients transfused from 53% to 48%.

Local problem: At Eastern Maine Medical Center, a 411 bed primary and tertiary community hospital, we identified that our transfusion rates and variability in transfusion practices were higher than desired. For instance, 37% of patients admitted for an elective hip or knee replacement received a transfusion. Although this was not significantly different than national benchmarks, it was too high based on evolving concepts in blood management and conservation. Also, our transfusion patterns for all inpatients were variable and transfusion rates higher than our goal.

Intended improvement : Effective implementation of new transfusion guidelines should result in a decrease in transfusions. Computerized physician order entry (CPOE) has been shown to decrease variation in physician ordering practices. As part of a hospital-wide implementation of CPOE, Eastern Maine Medical Center (EMMC) designed a mandatory CPOE process for all blood components following the new guidelines. Full implementation occurred in November 2007. This specific process was led by a dedicated pathologist managing the blood management program and the CPOE design team. The impact on percentage of inpatients transfused, average pre-transfusion hematocrit, variation in percentage of inpatients transfused, red blood cells transfused per thousand patient days, and percentage of total red blood cells ordered as single units were evaluated.

Planning the intervention and HIT Dimensions Utilized: Prior to implementation of CPOE, EMMC began development of a comprehensive blood management program. The development phase took place between November, 2006 and February, 2007, with implementation of many key strategies between March and June, 2007. This included implementation of more restrictive transfusion guidelines through the use of mandatory transfusion order sets (Figure 1), medical staff and nurse education (on-line CME/CEU newsletter bi-monthly), a pre-operative anemia management program, and expanded use of peri-operative blood collection and re-administration. Implementation of CPOE took place over several weeks in November, 2007. By the end of November all inpatient transfusion orders, with the exception of emergency release and transfusion orders from the emergency department or operating room, were entered by the ordering physician using CPOE. When a transfusion was ordered by a physician who was outside the hospital and did not have access to the hospital information system, the physician's verbal order was entered by a nurse using the CPOE system. Five discrete transfusion orders were created in the hospital information system (*Cerner Corporation, Kansas City, MO*) as follows: red blood cells actively bleeding; red blood cells, not actively bleeding; platelets; plasma; cryoprecipitate (Figure 2). Each order is linked to a different and related set of indications for transfusion consistent with hospital established transfusion guidelines (Figure 3). A transfusion order cannot be completed until a clinical reason for transfusion is chosen on the linked form. The system is designed so that when "red blood cells, not actively bleeding" is selected as the red cell order, only a single unit of red blood cells can be

ordered as part of that ordering “conversation”. Additional units require a separate order and justification. In a hemodynamically unstable patient, more than one unit may be ordered as part of a single ordering conversation by choosing “red cells, actively bleeding”. Following completion by the ordering provider, the transfusion order prints at the “dispense bench” in the EMMC blood bank. This printed communication includes patient demographics, the name of the ordering and attending physicians, and the indication for transfusion selected by the ordering provider. The most recent laboratory results relevant to the product requested (e.g. hemoglobin and hematocrit for red cells, platelet count for platelets, etc.) also print and are available for review. The technologist in the blood bank identifies any circumstances where laboratory results are discordant with the indication for transfusion chosen by the provider, and selectively refers those orders to the transfusion service medical director for prospective transfusion review based on established prospective review criteria. Prospective review may result in cancellation or modification of a transfusion order, after consultation with the ordering provider. Release of the blood product to the patient care unit is triggered by an electronic “dispense request” by the nursing unit. Four measures were monitored to evaluate the effect of interventions aimed at reducing transfusions: percentage of inpatients (general surgical, orthopedic, and acute medical) transfused; red cells transfused per 1,000 patient days; pre-transfusion hematocrit; percentage of orders for red cells received as an order for one unit. Through data mining, physician “report cards” were created illustrating the relevant pre-transfusion laboratory value, date of transfusion and number of products administered. These reports were “unblinded” showing each Medical Service member’s data. The physicians could then see their performance compared to their peers.

Outcomes: Comparing the post-CPOE implementation period of December, 2007 through December, 2008 to the immediate pre-CPOE implementation period of April, 2007 through November, 2007, the average percentage of inpatients transfused in the EMMC general surgical, orthopedic surgical and acute medical patient population fell from 7.4 to 5.8 percent, 10.1 to 5.7 percent, and from 6.3 to 5.2 percent respectively (all p-values less than .008). Comparing the same periods, red cells transfused per 1,000 inpatient days fell from 47.3 to 35.5; average pretransfusion hematocrit fell from 22.6 to 21.9 percent; percentage of transfusions ordered as single units increased from 65.6 to 74.0%. See Figures 4, 5, 6, and 7.

Barriers Encountered and Challenges Faced: Changing physician practice is very challenging. Usually it takes more than a year from a published guideline until physicians adopt the new standard. Education alone did help change some practice patterns, but not enough. Continuous education did not improve adoption. Realizing the need to use CPOE with embedded guidelines led to a medical staff by-law change to mandate the use of CPOE and transfusion orders. It is a major challenge to convince the medical staff to make this mandatory. Data mining has also been a major challenge as most reports are inaccurate. However, once CPOE is implemented and individual physician tracking is possible, reports are accepted as “real” and physicians become very competitive to achieve the best results compared to their peers.

Summary : EMMC introduced the concept of an indication-driven transfusion ordering process through an interactive, intranet-based order set that, after completion, was printed as part of the paper medical record and faxed to the blood bank. This order set was implemented as part of the development phase of a comprehensive blood management and conservation program. The ordering provider was required to indicate the reason for transfusion to complete a transfusion order. The interactive order set provided possible indications for transfusion consistent with EMMC’s transfusion guidelines, and served as a decision support tool at the time blood was ordered. Limited prospective review of transfusion decisions by the transfusion service medical director provided an opportunity for one-to-one education and helped introduce the concept of more restrictive transfusion strategies. In November, 2007, EMMC converted all inpatient ordering to a CPOE system. CPOE for transfusion incorporated the essentials of the paper process: 1) the requirement that a reason for each transfusion be selected as part of the ordering process, 2) that a distinction be made when ordering packed red blood cells for patients who were actively bleeding versus those patients who were not actively bleeding. In addition, the CPOE process added a process that prevents ordering more than one unit as part of a single blood order computer “conversation” in patients who are not actively bleeding. This supports the concept that each red cell transfusion is an independent clinical decision, and has helped reduce the number of multi-unit transfusions in hemodynamically stable patients.

Interpretation: Focused education will improve outcomes but not “hardwire” the process such that the best practice is ensured. By providing all information needed at the time of order entry and making the correct option the easiest to do, physicians will learn to standardize their care. We were able to teach physicians to consider transfusion of each unit a separate event and to move their threshold for transfusions significantly. Providing physicians accurate and timely “report cards” also encouraged them to change their practices. Without these tools, practice changes would take much longer and never be “hardwired”.

Conclusions: CPOE is an effective tool to help standardize care and change physician practice. Appropriately structured, CPOE can provide decision support to the ordering physician at the time a clinical decision, in this case the decision to transfuse, is being made. The CPOE process for transfusion at EMMC requires that the ordering physician document the clinical indication for transfusion at the time a transfusion order is entered, facilitating real time consideration of transfusion guidelines. Since only a single unit of red blood cells may be ordered at a time in the hemodynamically stable, non-bleeding patient, the ordering process reinforces the concept that each unit is an independent clinical decision. After implementation of CPOE, EMMC’s already low transfusion rate decreased further. In addition, accurate, “unblinded” data mining results in physician participation and brings out their competitive nature to be the best. Through CPOE and data mining, there was a decrease in variation in monthly transfusion rates (measured as red cells per thousand patient days and percentage of inpatients transfused), suggesting greater standardization of transfusion practices.

Financial Considerations: During the year following CPOE implementation, there was a reduction in blood product acquisition costs of over \$517,000 from a total budget of just over \$2,000,000, a greater than 25% reduction in blood acquisition costs. Ongoing cost benefits are apparent across multiple venues including cardiac surgery, general surgery, and general medicine.

FIGURE 1:

CHOOSE AN INDICATION FOR TRANSFUSION:

ANEMIA – ACTIVELY BLEEDING:

- Acute loss of greater than 25% of blood volume unresponsive to fluid resuscitation.
- Acute loss of blood and Hb less than 9 gm/dL and documented moderate or severe ischemic heart disease.
- Fall in Hb of 2 gm/dL (Hct of 6%) within 24 hours AND Hb less than 8 gm/dL (Hct 24%) AND signs/symptoms of anemia.

ANEMIA – NOT ACTIVELY BLEEDING:

- Pre-operative Hb less than or equal to 7 gm/dL (Hct 21%) when alternative therapy is not available.
- Post-operative Hb less than 7 gm/dL and signs or symptoms of anemia.
- Hb less than or equal to 7 gm/dL (Hct 21%) without expected response to medical therapy AND signs/symptoms of anemia.
- Hb less than 8 gm/dL in patients receiving chemotherapy or radiotherapy.
- Diagnosis of acute MI or unstable angina with Hb less than 9 gm/dL and clinical evidence of ischemia.
- Chronic transfusion regimen for thalassemia, myelodysplasia, or other red cell disorder.

4. Type and Screen now, if needed.

5. **Premedications: (Consider for patients with previous reaction to transfusions)**

- None
- Acetaminophen (Tylenol) _____ mg PO/PR one dose prior to these transfusions.
Do not exceed 4 gm of Acetaminophen per 24 hours (Adults) or 90 mg/kg per 24 hours (Pediatrics).
- Diphenhydramine (Benadryl) _____ mg PO/IV one dose prior to these transfusions.

6. Repeat the Hemoglobin / Hematocrit _____ after transfusion.

FAX (973-7989) OR SEND COPY OF THIS ORDER SHEET TO THE BLOOD BANK.

Figure 1. Interactive, PC-based paper order set that introduced the concept of a mandatory, indication-driven transfusion ordering process. The yellow bars link to references.

FIGURE 2:

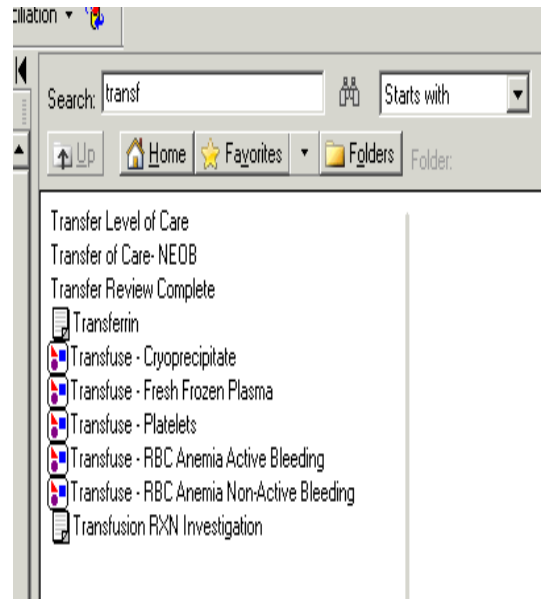


Figure 2. Screen shot of transfusion orderable showing five transfusion order options.

FIGURE 3:

Blood Product Transfusion Indications - Red Blood Cells (RBC) Active Bleeding

You are placing transfusion orders on the following patient:

Patient Name	DOB	Age
TESTING, HARC	08/12/1970	38 Years

Lab Results:

HCTIN - 21.2 (05/08/2009 07:50:54)
 HGBN - 6.7 (05/08/2009 07:50:54)

(e02z_bb_pt_verification_rbc)

Is this correct? Yes

ANEMIA - ACTIVELY BLEEDING:

(Note: Blood Volume is 70 mL/kg in adults)

Yes Acute loss of greater than 25% of blood volume unresponsive to fluid resuscitation.

Yes Acute loss of blood and Hb less than or equal to 8.5 gm/dL (Hct 25%) and documented moderate or severe ischemic heart disease.

Yes Fall in Hb of 2 gm/dL (Hct of 6%) within 24 hours AND Hb less than 8 gm/dL (Hct 24%) AND signs/symptoms of anemia or tissue hypoxia (Hemodynamic instability unresponsive to other measures)

Yes Other, specify:

Figure 3. Screen shot of indication form. Provider must verify patient identity and lab results and indicate the reason for transfusion.

FIGURE 4:

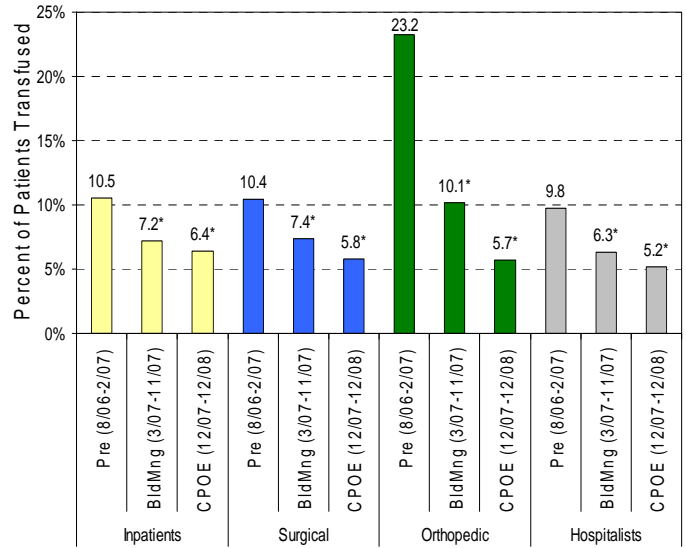


Figure 4. Bar graph showing percentage of patients transfused by period. An asterisk (*) indicates a significant difference (P < 0.01).

FIGURE 5:

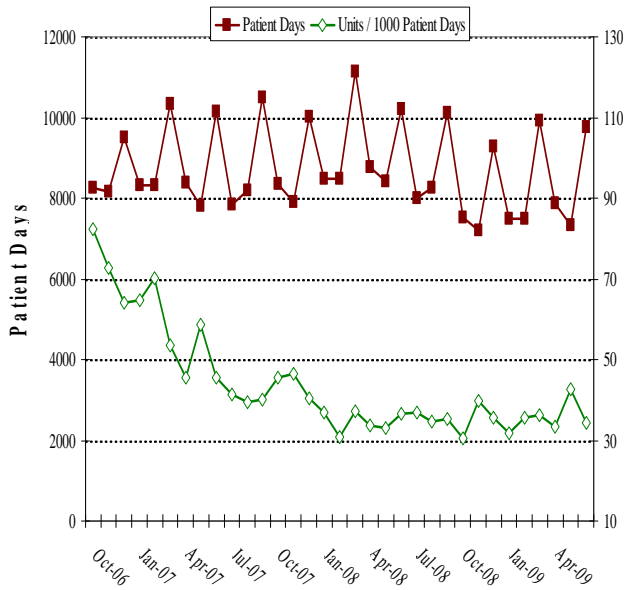


FIGURE 6:

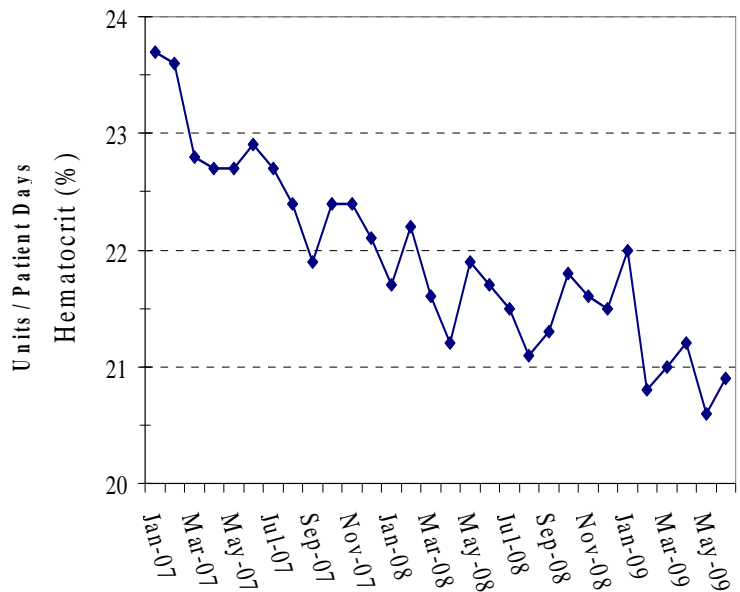


Figure 5. Graph showing red cell units transfused per thousand patient days (August, 2006 – June, 2009). Note: every third month in the fiscal year has 5 weeks.

Figure 6. Monthly average pre-transfusion hematocrit, for all inpatient transfusions (August, 2006 – June, 2009).

FIGURE 7:

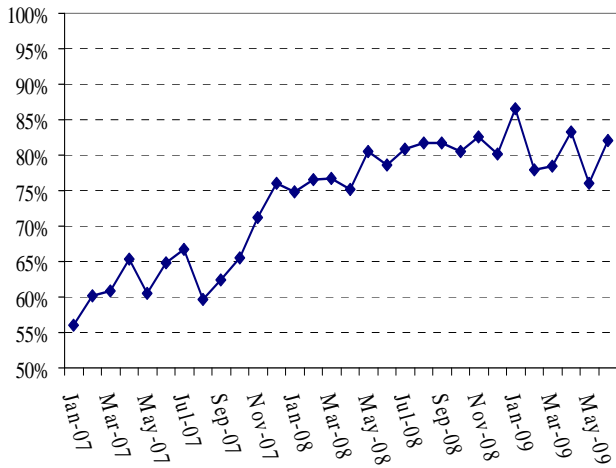


Figure 7. Percentage of all transfusion orders received as a request for a single unit (August, 2006 – June, 2009). Note: After clinical re-evaluation, patients may have had a second unit ordered within a 24 hour period.