INSTITUTE FOR HEALTHCARE IMPROVEMENT

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SUMMARY REPORT: 90-DAY PROJECT

Appropriate use of Blood Products

July 31 2010

Executive Summary:
Blood and blood products are precious resources that are given freely by donors to help others. In the US there is significant opportunity to improve on the use of this valuable resource. 10% to 35% of blood and other blood products could be saved if a few simple process were followed: improve the hemodynamic condition of patients preoperatively, conserve as much as possible during surgery, and in hemodynamically stable populations tolerate lower levels; when patients do need blood, don't assume they automatically need x units. Give individual units and then follow their clinical condition.

Many organizations have worked on this around the world and by using these ideas and engaging doctors with multiple methodology, clinical variation has been decreased with improved outcomes and lower use of blood. There are many passionate faculty around the world who would appreciate IHI taking a role in improving the use of blood products

I. Research and Development Team:

- Leader: John Whittington

II. Intent:

This project is designed to outline the issues and best practices on appropriate use of blood products.

III. Background:

In the US 5 million people a year receive red blood cells, platelets or plasma. Medline plus U.S National Library of Medicine

The following comes from the 2007 National Blood Collection and Utilization survey report:
Number of Transfusions:

- "The total number of WB/RBCs transfused in 2006 equaled 14,650,000 units"
- "The total number of platelet units provided to patients in 2006 was 10,388,000" (page 2)

Adverse Events:
"An estimated total of 72,000 transfusion-related adverse reactions occurred in 2006. These were defined as events that required any diagnostic or therapeutic intervention. This represents an

adverse reaction rate of approximately 0.32% (72,000/22,466,000), a rate on the lower end of the rates reported through other national hemovigilance reporting systems (0.3%-0.7%)" (pg 35).

THE 2007 NATIONAL BLOOD COLLECTION AND UTILIZATION SURVEY REPORT

Table 8-2. Transfusion-Related Adverse Reactions Reported to the Transfusion Service

Adverse Transfusion Reactions	Number of Occurences	Rate (All Components) from Reporting Facilities n=22,466,000*
Total number of occurrences that required any diagnostic or therapeutic intervention	72,000	1:312
Severe allergic reactions	4,944	1:4,540
Delayed hemolysis	1,770	1:12,681
Transfusion-related acute lung injury (TRALI)	1,522	1:14,748
Transfusion-associated circulatory overload (TACO)	1,110	1:20,222
Posttransfusion sepsis	240	1:93,525
Reactions that were life-threatening, requiring major medical intervention following the transfusion, eg, Vasopressors, blood pressure support, intubation, or transfer to the ICU	236	1:95,110
Acute hemolysis	141	1:159,191
ABO incompatibility	64	1:350,719

*Apheresis platelets counted as doses (*not* as concentrate equivalents).

There has been significant work on appropriate use of blood products in Scotland; Northern Ireland; England and New South Wales, Australia.

In the state of Maryland they have engaged all of the blood banks to work on wastage of blood products. Approximately 4 to 5% of blood products are wasted. There is a statewide collaborative to reduce this wastage to closer to 2%.

At IHI we believe there is an opportunity to improve the use of blood products.

IV. Description of Work to Date:
The following are the deliverables and status for this project:

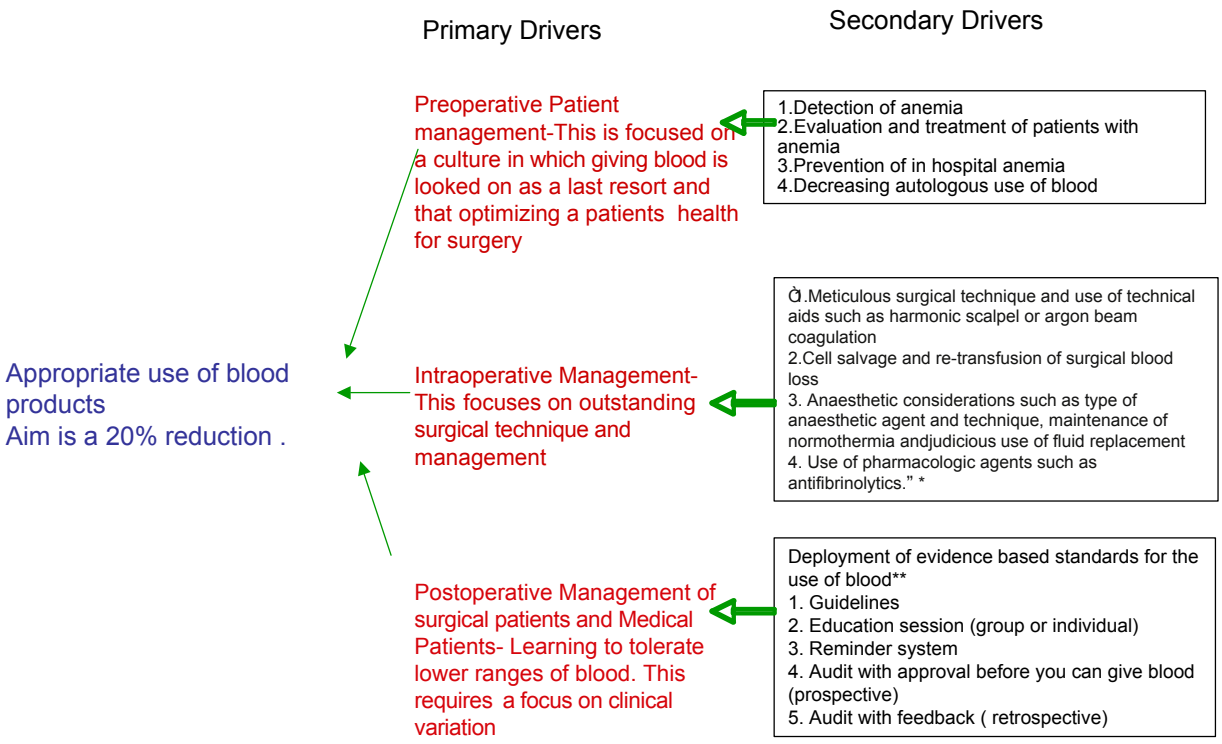
1. Identify faculty working on this problem. This is done.
2. Generate change ideas. This is done.

3. Determine possible measurement techniques. This is done.

V. Results of the 90-Day Scan:

Many organizations have worked on decreasing blood product usage with a primary focus on red blood cell usage. They have typically developed a set of guidelines that they work from. These guidelines are applied to a segment of the population such as hemodynamically stable patients. The guidelines generally state that a hemodynamically stable patient with a hemoglobin of seven or lower gets blood. Patients with a hemoglobin greater than 10 don't generally get blood and patients between seven and ten may get blood if they meet some other criteria. An example of this comes from the computerized order entry guidelines at the Mayo Clinic. In their ICU they recommended that asymptomatic, normovolemic patients with a hemoglobin greater than seven do not need blood transfusion unless they have one of the following: hemorrhagic shock, early septic shock, symptomatic anemia (confusion, angina, tachacardia, or tachypnea) or they were at risk (elderly patients with coronary, cerbrovascual or periperharal vascular disease). Evidence-based red cell transfusion in the critically ill: Quality improvement using computerized physician order entry * Rana et al Crical Care Medicine 2006:34:1892-7. Overall transfusions decreased in the ICU by 20% which amounted to 200 units.

A basic approach to blood product usage is to prevent people from getting transfusions in the first place and if a transfusion is needed, try to decrease the amount used. This driver diagram outlines an overall approach to this problem



**Patient Blood Management - a new paradigm for transfusion medicine?
Thomson A, Farmer S, Hofmann A, Isbister J, Shander A. ISBT Science Series 2009;4:423-35.

**Reducing the Amount of Blood Transfused A Systematic Review of Behavioral Interventions to Change PhysiciansÕTransfusion PracticesAlan Tinmouth, et
ARCH INTERN MED/VOL 165, APR 25, 2005

The driver diagram shows three areas of focus: preoperative, intrapoperative, postoperative and medical patients. These areas provide an ample opportunity to make significant improvement. By focusing on these areas of blood use, a decrease of up to 35% has been achieved. There are more areas that could be focused on including blood bank wastage and specialized patient types such as trauma patients.

Preoperative patient management begins with an attitude that we want to avoid the use of blood whenever feasible. Detection and management of anemia is important for this work. Jehovah's Witness patients have been helpful in this regard. This patient group has helped hospitals rethink how to better prepare patients for surgery. Healthcare has been rethinking the use of autologolus blood. As the graph below shows, its use has been falling off. This makes sense because there is opportunity for error in giving blood, the quality of the blood is not improved by being out of the patient and the patient is set up to come in more anemic and require more blood.

2007 National Blood Collection and Utilization Survey Report

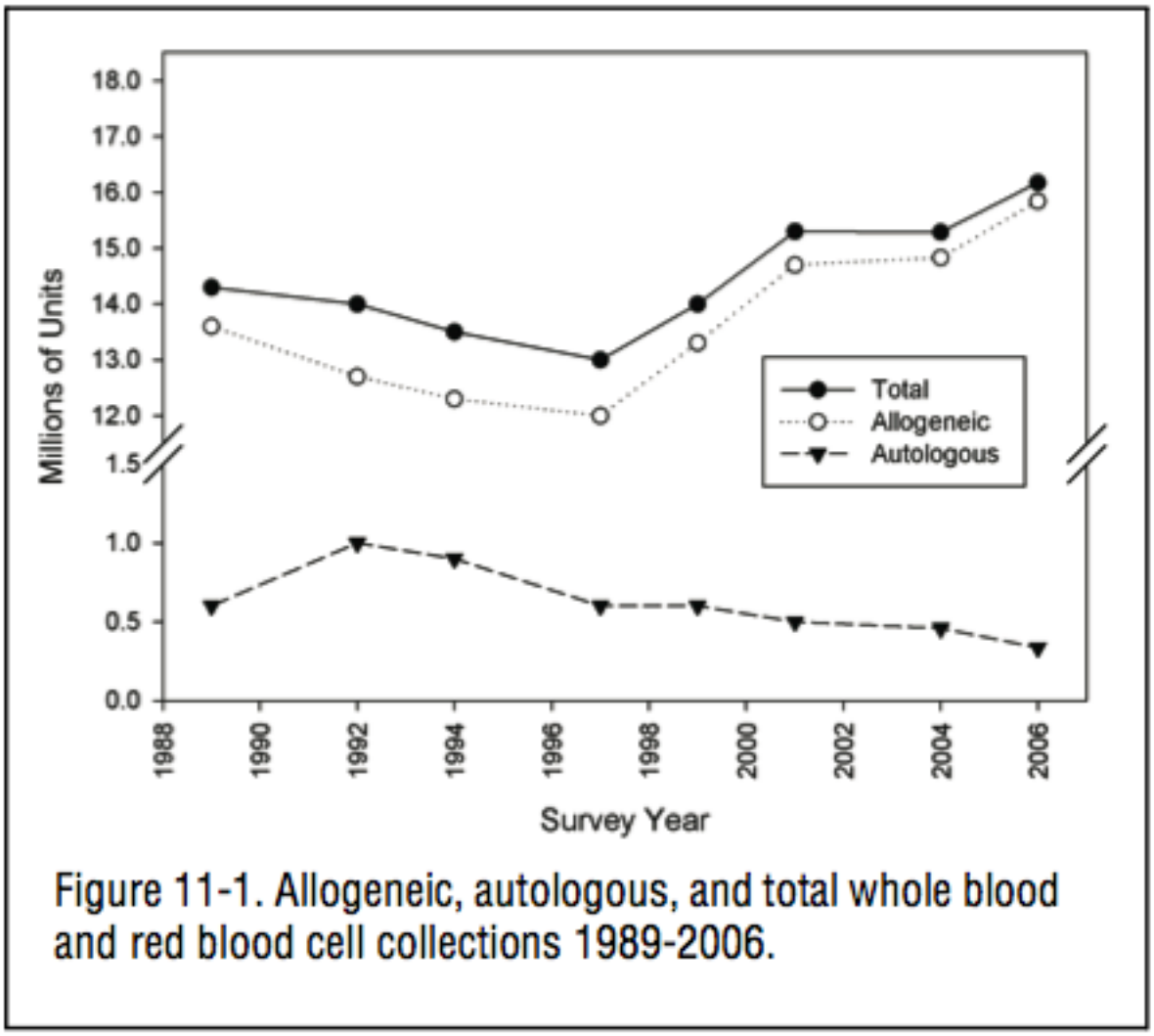


Figure 11-1. Allogeneic, autologous, and total whole blood and red blood cell collections 1989-2006.

Intraoperative improvement opportunities exist. The mainstays for this work are good surgical technique, using cell savers as a means to auto transfuse patients. These are important along with good anesthesia support including fluid management and good management of coagulation.

Postoperative patients and non-emergency medical patients can all benefit from more restrictive use of blood. Basically, patients should be transfused if they are less than seven, not transfused if they are greater than 10 and should only be transfused between seven and ten when there are other significant factors that put patients at risk if they are not transfused. The authors of a Canadian ICU study concluded, "A restrictive strategy of red-cell transfusion is at least as effective as and possibly superior to a liberal transfusion strategy in critically ill patients, with the possible exception of patients with acute myocardial infarction and unstable angina" Hebert PC, Wells G, Blajchman MA, et al, for the Transfusion Requirements in Critical Care Investigators, Canadian Critical Care Trials Group. A multicenter, randomized, controlled clinical trial of transfusion requirements in critical care. N Engl J Med 1999;340:409–17.

One of the big factors in getting a program to work is to partner with doctors. As with any health care treatment, we see significant clinical variation. A good systematic review article, Reducing the Amount of Blood Transfused A Systematic Review of Behavioral Interventions to Change Physicians' Transfusion Practices Alan Tinmouth, MD; Laura MacDougall, MSc; Dean Fergusson, PhD; Mohammed Amin, PhD; Ian D. Graham, PhD; Paul C. Hebert, MD; Kumanan Wilson, MD ARCH INTERN MED/VOL 165, APR 25, 2005, listed a number of general intervention ideas that have been tried either singly or in combination with doctors. They focused primarily on getting clinicians to tolerate lower levels of anemia before intervention. However, the article could also be more broadly considered to gain some general strategies for reducing clinical variation:

1. Guidelines
2. Education session (group or individual)
3. Reminder system
4. Audit with approval before you can give blood (prospective)
5. Audit with feedback (retrospective)

A key general element to improving the use of blood products like red blood cells, platelets and plasma is to decrease the amount of variation and shift the mean closer to known best practices. That statement could be made about much of medical care today. IHI has two white papers on its website IHI.org that could be helpful: Engaging Physicians in a Shared Quality Agenda and Reducing Costs through the Appropriate Use of Specialty Services.

Here are some specific thoughts on decreasing clinical variation for blood products:

1. Find a champion within the peer group who has a passion for this problem and equip him/her to help with the changes you want to impact.

2. If no champions arise initially, start with the data. Show the group their own data and ask them to help you understand the variation. Don't go in with a judgmental attitude. Let them work out the issues. Let them define a standard. Their standard will probably look like this: an elective surgical patient who is under 65 and hemodynamically stable should receive blood if they have a hemoglobin of 7 or less and not receive any if over 10. In addition, they should not receive any between 7 and 10 unless there are special issues. Apply this new standard, measure the doctors over time and continue to feedback the data to them.

3. Let doctors understand there is probably more risk in using blood then we have realized in the past. There certainly are cases of tragic consequences when a patient has received blood that probably wasn't necessary and had a serious reaction but thankfully those cases are rare. There are many acute reactions that are well known, but there are other potential long-term problems such as graft versus reaction and immunomodulation that are possible because blood is a live tissue.

4. Some countries enforce standards. In New South Wales Australia blood banks are able to develop a restrictive policy that attempts to enforce the standard for stable patients. The surgeon completes a form that documents the hemoglobin level and checks boxes that support the need for blood. If the patient does not meet requirements for blood the surgeon is informed of that. If necessary the supervising hematologist discusses the case with the surgeon.

5. Create a dialogue among physicians so that they can share evidence and best practice, ask questions, etc. One clever use of this was the New South Wales Web site called "the Transfusion Question" http://www.thetransfusionquestion.com.au.

6. In Northern Ireland and elsewhere, the amount of blood used by surgeons is part of their annual review process.

7. Use information technology to apply standards to decrease blood usage. A good example of this was reported by the Mayo Clinic in the article Evidence-based red cell transfusion in the critically ill: Quality improvement using computerized physician order entry * Rana et al Crical Care Medicine 2006:34:1892-7. Overall transfusions decreased in the ICU by 20% which amounted to 200 units.

Measures

In order to move forward with this work, a clear set of measures is needed.
1. A general measure that is used around the world is Units of RBC/per 1000 population.
Here is an example from New South Wales:

Jurisdiction	2007/08 Issues per 1000 Population	Rolling 12 Months* Issues per 1000 Population	2008/09 Approved Plan Issues per 1000 Population
National	36.31	36.12	36.77
NSW	34.22	33.95	35.80
ACT	35.70	35.38	36.82
QLD	38.68	38.12	38.95
VIC	38.54	38.28	37.93
TAS	30.56	29.93	32.01
SA	42.38	43.21	42.77
WA	30.64	30.99	30.00
NT	27.86	27.80	30.19

* October 2007 to September 2008

The challenge with this measure is that the age characteristic of the population can skew it. Younger patients use less blood. One study showed an average use of blood at 42.88 per 1000 but those over 65 used it at a rate of 245 per 1000. Evidence-based red cell transfusion in the critically ill: Quality improvement using computerized physician order entry E.C. Vamvakas1 and H.F. Taswell MD Emeritus Member Transfusion Volume 34 Issue 6, Pages 464 – 470.

2. The Blood Transfusion Improvement Collaborative that was facilitated by Ms Bernie Harrison in New South Wales Australia used the following measurement strategy:

"The following performance measures were used by BTIC to measure appropriateness of red cell transfusion in haemodynamically stable patients. The collaborative teams collected data on 20 consecutive transfusion episodes during the testing or actions periods (PDSA cycles) so that it could be determined if the changes being made resulted in improvement in the appropriateness of red cell transfusion.
BTIC was testing changes on heamodynamically stable patients, therefore it was necessary to exclude unstable patients using the following criteria:
Exceptions: Unstable patients defined as:
_ BP<100mmHg
_ HR >120/min
_O2 <90%
_ RR >40/min"

More detail can be found on the extranet under BTIC Final Report.

Business Case Implications

A general rule of thumb for the use of packed red blood cells is that for every hundred beds in a hospital, it will spend a little less than a million dollars. At least one organization, St Vincent's, in Indianapolis was able to decrease blood usage by 35% over the course of the last 10 years. A number of organizations have reported decreases of 20% to 30%. The cost of blood can be described in many ways. You can consider just the cost of blood procurement, to the fully loaded cost of blood administration that considers the labor of the hospital lab, supplies and nursing time to the additional cost of never events that will not be reimbursed. Lastly, blood is primarily a cost for hospitals, with very little if any revenue generated. More blood is used in elderly patients and hospitals are paid on a DRG basis. In the out patient setting, Medicare reimburses around 75% of cost for a unit of packed red blood cells.

So a typical hospital of 300 beds that would spend around $2.7 million on blood, a 20% reduction would lead to a basic saving of $540,000 a year based on the simple cost of blood usage. It is true that there might be some loss of revenue, mostly from the outpatient world, but again it appears that Medicare reimbursement does not cover even blood costs.

The table below from the 2007 National Blood Collection and Utilization Survey Report shows blood cost in 2006 and 2004.

Table 9-1. Mean Hospital Amount ($) Paid per Selected Component Unit in 2006 and 2004

Component	Average Amount Paid ($)*		
	2006	2004	% Change
Red cells, leukocyte filtered	213.94	201.07	6.4
Plasma, frozen within 24 hours of phlebotomy	59.84	56.29	6.3
Whole-blood-derived platelets, not leukocyte reduced, not irradiated	84.25	63.67	32.3
Apheresis platelets, leukocyte reduced	538.72	510.05	5.6
Cryoprecipitate	53.31	—	—

*Calculations are based on unweighted estimates.

This table below 2007 National Blood Collection and Utilization Survey Report shows outpatient reimbursement rates

Table 9-4. CMS Hospital Outpatient Prospective Payment System Rates for Selected Blood Components

Blood Component	Reimbursement Code		Reimbursement Rate		
	CPT/ HCPCS	APC	2006†	2004*	% Change
Red Blood Cells (leukocyte-reduced)	P9016	954	163.16	119.26	36.8
Fresh Frozen Plasma (frozen between 8 and 24 hours after phlebotomy)	P9017	955	70.40	95.00	–25.9
Whole-blood-derived platelets	P9019	957	51.50	41.44	24.3
Apheresis platelets (leukocyte-reduced)	P9035	09501/1014	493.12	408.81	20.6
Cryoprecipitate	P9012	952	47.10	29.31	60.7

*Department of Health and Human Serives. Medicare program; Chages to the Hospital Outpatient Prospective Payment System and Calendar Year 2004 Payment Rates; Final rule w/ comment period.
†Medicare Program; Changes to the Hospital Outpatient Prospective Payment System and Calendar Year 2006 Payment Rates; Final rule w/ comment period.
CMS = Centers for Medicare and Medicaid Serives; CPT = current procedural terminology; HCPCS = health-care common procedure coding system; APC = ambulatory patient classification.

Expert Faculty

There are many people around the world who have been working on the appropriate use of red blood cells and other blood products. During the course of this investigation we have had the opportunity to talk with a number of key people who have led collaboratives on this work, have consulted on improving blood use in hospitals or have strong research and academic credentials for this work.

1 Bernie Harrison Bernie.Harrison@CEC.HEALTH.NSW.GOV.AU]
2Bruce Spiess MD at VCU medical center bdspiess@vcu.edu
3Aryeh Shander, MD- Chair of Anesthesia, Englewood Hospital, Englewood, NJ
Aryeh.Shander@ehmc.com
4 Timothy Hannon, MD, MBA- Anesthesiologist at St Vincent's in Indianapolis, Ind, THannon@bloodmanagement.com
5 Simon Body, MBBS- Anesthesiologist at Harvard, Brigham and Women's Hospital, Boston
Body@zeus.bwh.harvard.edu

VII. Conclusions and Recommendations:
This is a “shovel ready” topic with lots of passionate faculty who have improved the use of blood around the world.

1. Recommend that an expedition, seminar or both are done for this topic.
    a. Recruit key faculty from the list
    b. Along with this paper, the key articles and change package from the Australian collaborative can be found on the extranet.
2. As IHI gains greater knowledge and experience on this topic, they should push this subject to national attention

VI. Open Questions:

VIII: Appendices:

See extranet for additional resources