"Are we there yet"

Difficulties (and solutions) in a PBM program.

Leading with Innovation
Serving with Compassion
ST. MICHAEL'S HOSPITAL
A teaching hospital affiliated with the University of Toronto

John Freedman
St Michael's Hospital
Professor Emeritus, Medicine &
Laboratory Medicine & Pathobiology
University of Toronto

VELUT ARBOR ÆVO

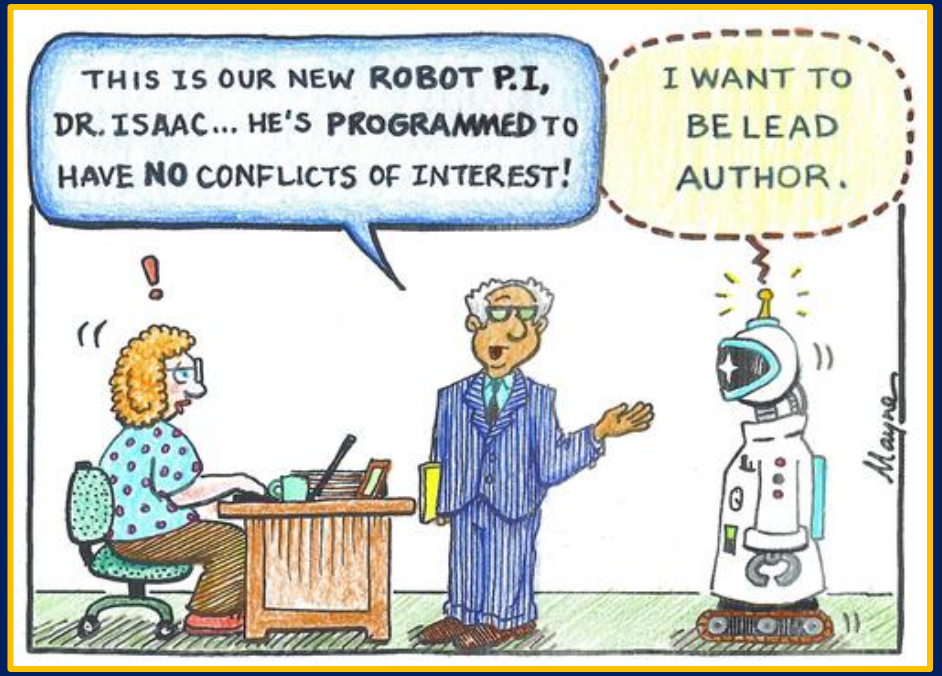
- Blood occupies a somewhat privileged position in modern medicine, in that it has evolved as a treatment option without the same level of research scrutiny – at least on the patient outcomes side of things – that other treatments are subjected to.

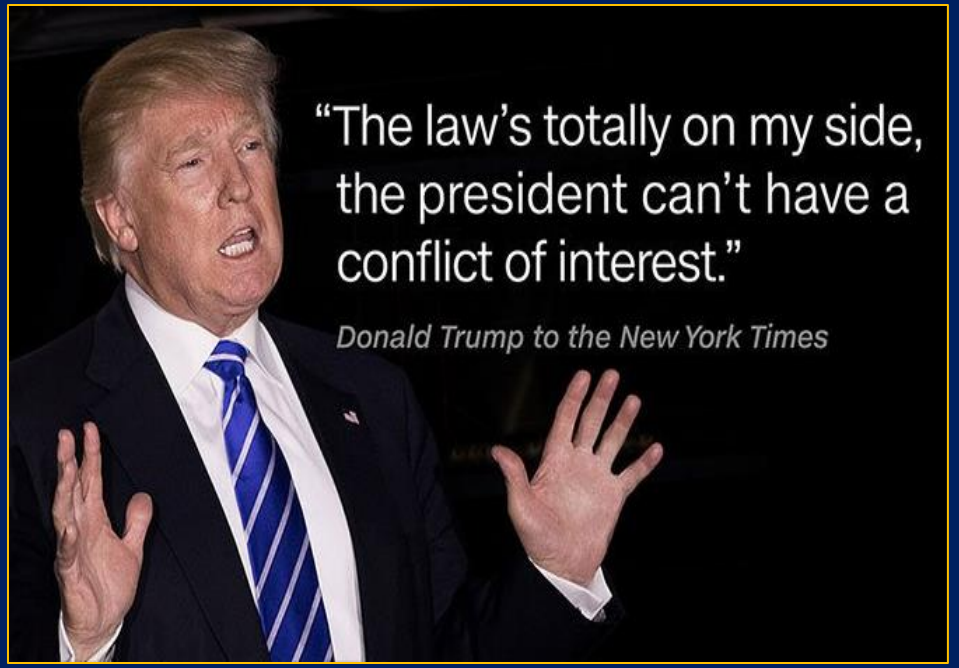
Objectives

To discuss:

- Why a change is needed in transfusion
- The ONTraC program in Patient Blood Management (PBM)
- ONTraC: Problems and solutions

I have no conflicts of interest



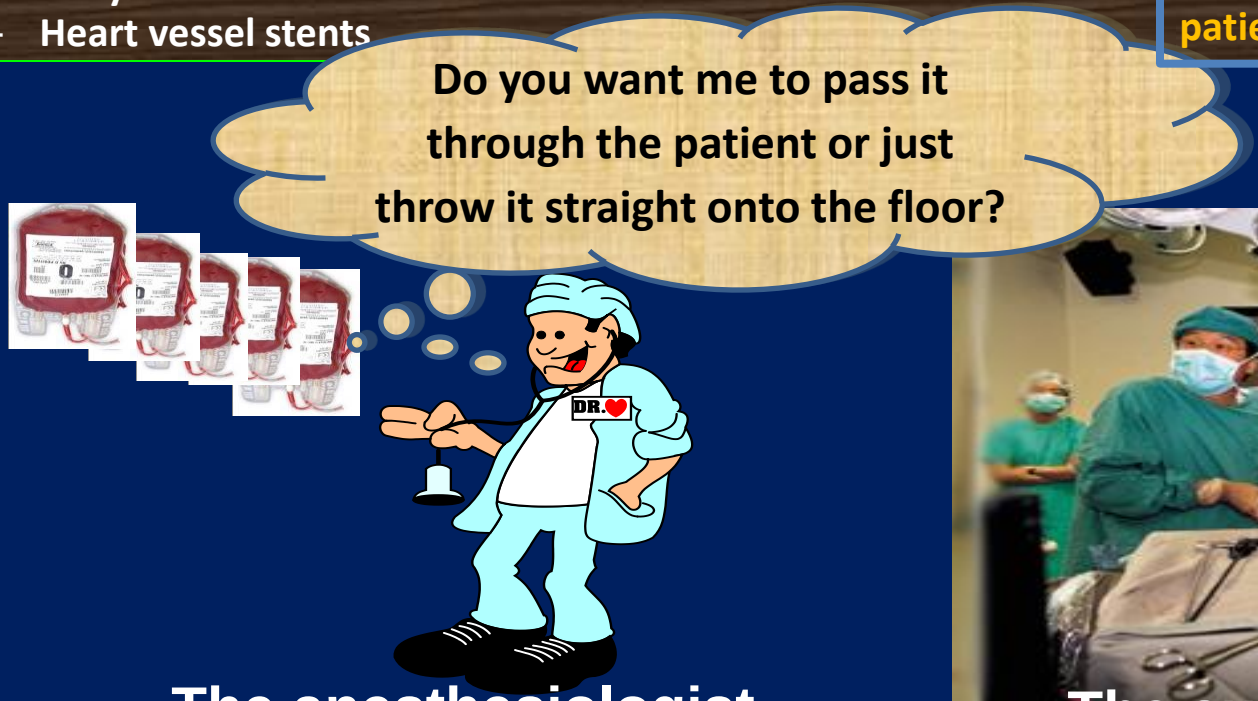


Transfusion Medicine – time for a change

- National Summit in USA on Overuse in 2013 identified 5 overused
- treatments that can harm patient safety and quality:
  - Antibiotic use for the common cold
  - ***Blood transfusions***
  - Ear tubes for children
  - Early scheduled births
  - Heart vessel stents

Blood transfusions occur in 1:10 hospital stays with a procedure (AHRQ).

One of the top 5 fastest growing procedures in hospitalized patients.



The anesthesiologist

The surgeon

"Blood transfusions are safer than they have ever been"

This statement is not only untrue, but misleading.

Safer in developed countries from the risk of transfusion-transmitted infections, but …..

Disease transmission (viral/bacterial/prion);

Transfusion reactions: allergic, hemolytic, TRALI, TACO, etc

Errors

Transfusion-related immunosuppression/immunomodulation (TRIM)

Perception of (transfusion) risk

Often has little to do with

- Science
- Evidence
- Economics

RISKS of transfusion

Virus TTI

Residual risk ★ Per unit

HIV	**1:10 million**
HCV	**1:5-7 million**
HBV	**1:1-1.7 million**
HTLV	**1:1.1 million**

Chiavetta et al, CMAJ, 169:67-73, 2003

Risk of death from: (actuarial tables)

MVA	**1: 9,000**
Home accident	**1: 10,000**
Murdered in Canada	**1: 85,000**
General anaesthesia	**1: 20-200,000**
Lightning	**1: 3,000,000**

Adverse effects of transfusion:

Transfusion-related immunosuppression/immunomodulation (TRIM)

Transfusion correlated with:

- ↑ time to extubation
- ↑ ICU length of stay
- ↑ post-op length of stay
- ↑ post-op morbidity
- ↑ post-op mortality
- ↓ long term survival
- More units used: ↑ risk

TRIM:

◊ **Infections:** 23 peer-reviewed articles, >13,000 pts:

Odds ratio for bacterial infection 3.5 (1.4-15.2)

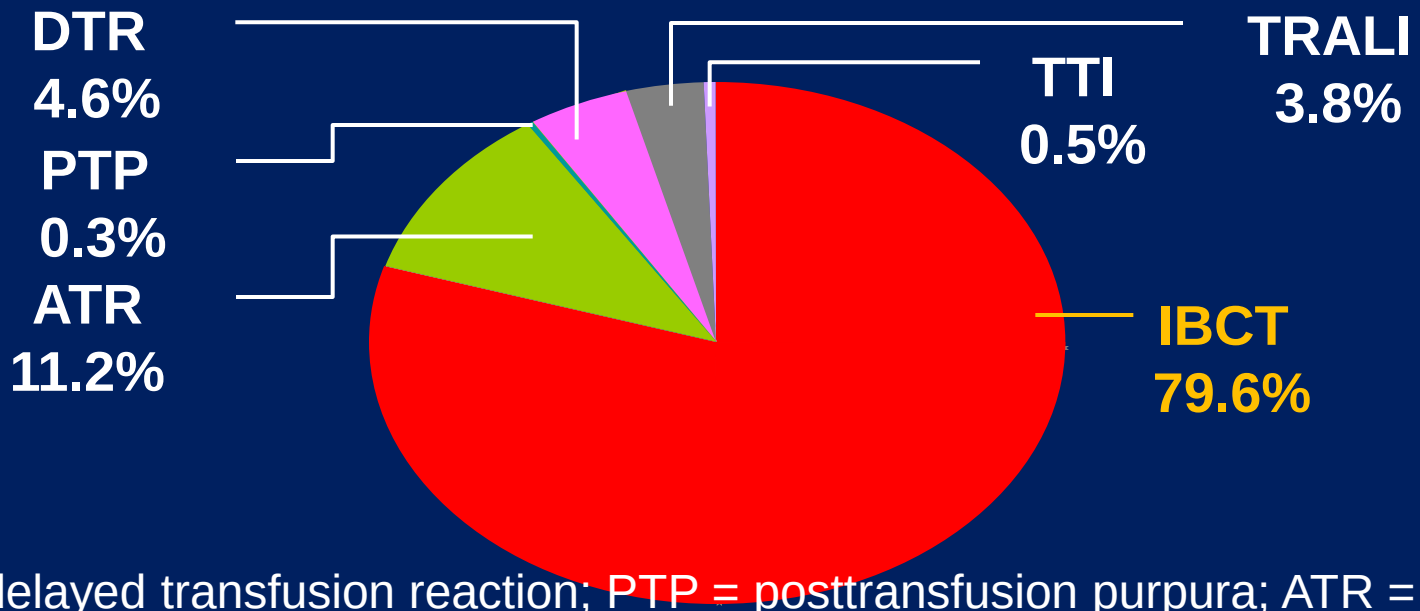
(Hill, J Trauma, 54:908, 2003)

◊ **Cancer recurrence** ?

RBC transfusion is strongest independent predictor of all-cause morbidity & mortality after isolated CABG

- each unit transfused → an additive risk. (Koch CG et al Crit Care Med 34:1608, 2006)

Serious Hazards of Transfusion (SHOT)



DTR = delayed transfusion reaction; PTP = posttransfusion purpura; ATR = acute transfusion reaction; TRALI = transfusion-related acute lung injury; TTI = transfusion transmitted infection; **IBCT = incorrect blood component transfused**

***Serious Hazards of Transfusion Annual Report 2005*. Available at: http://www.shotuk.org/SHOT%20report%202005.pdf. Accessed May 2008.**

IBCT due to errors in:-
(SHOT 1996/97 to 2001/01)

- Blood centre 2%
- Transfusion laboratory 28%
- Collection, administration
- Prescription, sampling, request

68% Wards

- Other 1%
- Unknown <1%

What is the cost of transfusion?

Direct and indirect costs: Product; Tubing; Supplies, Labour, Transport, Lab testing, Hospital Blood Bank (crossmatching, etc), Clerical; Nursing

Further resource use in increased ICU & hospital LOS, Rx complications, etc, (large multicentre study → transfusion can increase hospitalization costs by 40% & estimated a total cost at ≈$1400/unit. **[80,045 INR]**

Shander A, Best Pract Res Clin Anaesthesiol 21:271, 2007; Shander et al, Transfusion 50:753, 2010

Supply vs Demand

As Boomers age, potential demand grows exponentially

Age	<40	40-70	>70 years
Use: Units RBC/1000 pop^{n}	5	40	200

SUPPLY

DEMAND

What's best for the patient?

What's best for the blood supply?

Need to make sure we are asking the right question!!

ON TEENAGERS, ADULT:

Statistics show that teen pregnancy drops off significantly after age 25.

Mary Anne Tebedo, Republican state senator from Colorado Springs (contributed by Harry F. Pancco)

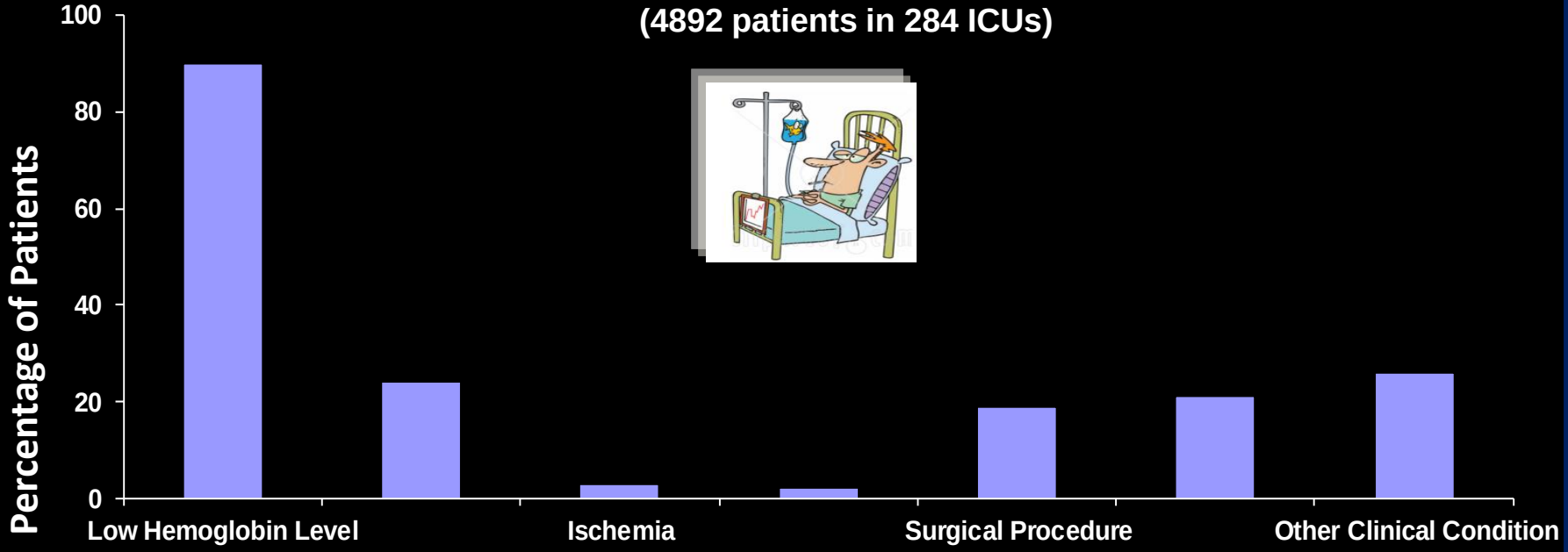
Federal Agents Raid Gun Shop, Find Weapons

Why do we transfuse red cells?

Reasons For Initiating a Blood Transfusion

Shander A, Goodnough LT. Pharmacotherapy, 27(9 Pt 2):57S–68S, 2007

(4892 patients in 284 ICUs)



Most patients transfused for laboratory-diagnosed anemia, not symptoms

In the presence of clinical uncertainty, the default position has been to administer a blood transfusion; this is not usually the case with other therapies.

Benefit of RBC transfusion: What can we conclude?

- Evidence of benefit from RBC transfusion is hard to find
- No prospective randomized trials have ever been done to establish the life-saving benefit of RBC transfusion
- Most benefit is assumed and not scientifically proven
- Some patients will benefit, but we need to be better able to identify who they are
- Giving more blood is not better
- Many transfusions are probably unnecessary

So when should we transfuse?

Anemia often accepted as a normal part of doing business

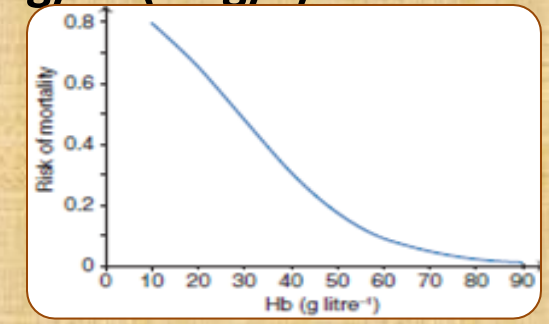
- 30-70% of patients come to surgery anemic
- Long tradition of accepting anemia as a relatively harmless problem that can be corrected easily with transfusion; for many this remains the default position

- BUT anemia is an independent risk of morbidity & mortality (regardless of Hb level). Preop anemia → 5-fold ↑ in odds of post op mortality **(Beattie SW et al. Anesthesiology. 2009; 110:574-81.**
- Anemia increases cost of delivering health care by > 50% **(Nissenson et al. J Manag Care Pharm, 2005; 11:565-74)**
- *In the ICU, most patients anemic at time of admission. Hb typically declines by at least 0.5 g/dL/day in first 3 d of ICU stay. Continues to decline if sepsis/severe illness. These patients particularly may be at risk from anemia (cardiovascular, respiratory, metabolic compromise). Multifactorial.*

Isbister J, Shander A. Transfus Med Rev, 2011; 25:89-101

Establishing a definitive “hemoglobin transfusion threshold" has proven difficult, but studies have shown that mortality increases in patients with Hb below 5 g/dL (50 g/L).

Beattie



For healthy individuals, the threshold may be even lower, but co-morbid conditions such as trauma, sepsis and cardiovascular disease may influence this threshold.

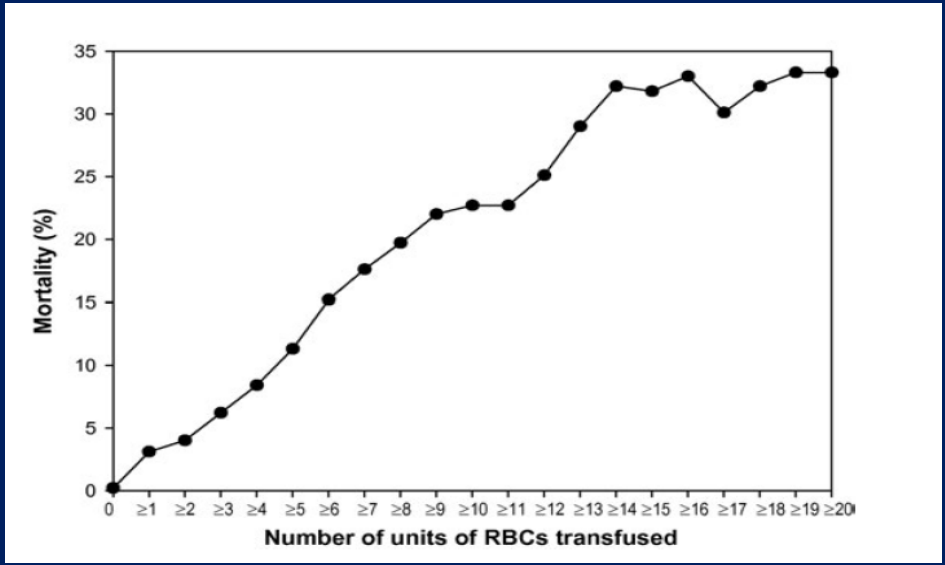
- Many hospitals are steering towards a hemoglobin trigger for transfusion of 70 g/L regardless of comorbidities.
  - Some institutions use 70 g/L for ‘healthy’ patients and 80 g/L for patients with cardiorespiratory problems.
- The main point is to avoid transfusing ‘healthy’ patients based on hemoglobin alone.

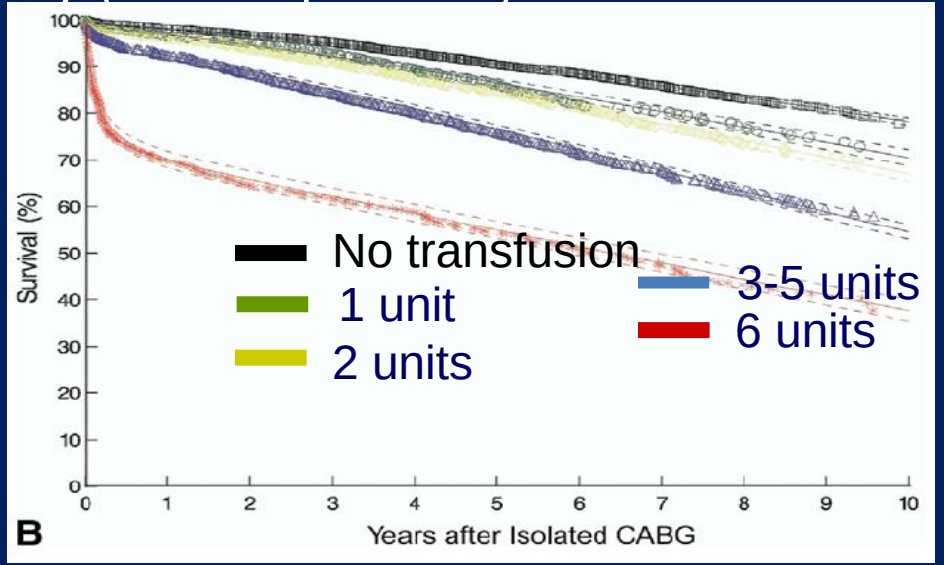
Hare GMT, Freedman J, Mazer CD: Risks of anemia and related management strategies: can perioperative blood management improve patient safety? **Can J Anaesth 60:168-175, 2013**.

Beattie WS, Anesthesiology, 2009; Shander A, Br J Anaesth, 2011; Carson JL, Lancet 1988, 1996

Why Do We Need to Change Transfusion Practice?

Transfusion and Mortality (dose dependent)





Karkouti et al. Transfusion 2004; 44:1453-1462.

Koch CG et al. Ann Thorac Surg. 2006; 81:1650

Variability in transfusion rates:

80,000, on-pump CABG, 408 hospitals: RBC rate ranged from 7.8 - 98.8%

Bennett-Guerrero et al. JAMA 304:1568-1575, 2010.

- **In the presence of clinical uncertainty, the default position has been to administer a blood transfusion; this is not usually the case with other therapies.**

- **Blood transfusion is inherently hazardous and costly and should only be prescribed when there is evidence that patient benefit would outweigh the potential for harm.**

Upto 60% of transfusions are unnecessary or inappropriate: given to stable non-bleeding patients.

Shander A, Goodnough LT: Pharmacotherapy. 2007; 27(9 Pt 2):57S-68S

BUT, known risks should outweigh perceived benefits every time

In 1997, the Krever Commission Report on transfusion-transmitted AIDS in Canada stated that 'blood components and blood products will never be without risk. The best way to reduce that risk is to reduce their use'

Despite important advances to reduce transfusion risks, this statement remains true today.

Precautionary principle for transfusions:

- Transfuse only when absolutely need to
- Tolerate anemia – restrictive transfusion trigger
- If need to transfuse, give as little as possible
- This shift has led to the focus on Patient Blood Management, aimed at using blood transfusion in the most optimum way.

A paradigm shift

"Blood transfusion -- an expensive and potentially hazardous alternative to Patient Blood Management".

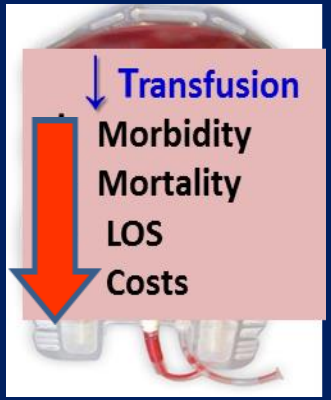
Patient Blood Management (PBM)
= Blood Conservation
= Bloodless Medicine or Bloodless Surgery

Patient Blood Management (PBM) is the timely multidisciplinary application of evidence-based medical and surgical concepts designed to maintain hemoglobin concentration, optimize hemostasis and minimize blood loss in an effort to improve patient outcome.

PBM is one of the few areas of medicine where you can:

- **Improve outcomes**
- **Reduce risks**
- **Save costs**

All at the same time



SOCIETY FOR THE ADVANCEMENT OF BLOOD MANAGEMENT

www.sabm.org
www.ontracprogram.com

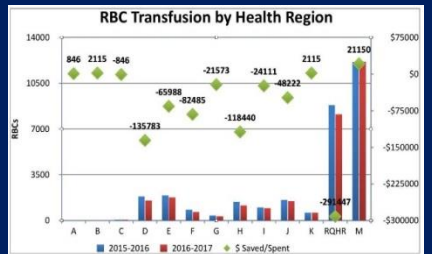
pbm@saskhealthauthority.ca (Patient Blood Management Resources)

- Investigation of Iron Deficiency Anemia Algorithm January 13, 2018
- Pre-Operative Anemia Algorithm January 13, 2018
- Pre-Operative Hemoglobin Assessment and Optimization Algorithm January 13, 2018
- RBC Screening Algorithm January 13, 2018
- RQHR PPO (#290) - Intravenous Iron Therapy January 13, 2018
- RQHR PPo (#601) - Ordering of Red Blood Cells - Adults January 13, 2018
- RQHR PPO (#627) - Ordering of Human Fibrinogen Concentrate (RiaSTAP™) June 21, 2018

Anemia: A problem to which transfusion is rarely the answer. Presentation – Jan 25, 2017 Jan 13, 2018

Patient Blood Management. Presentation - November 22, 2016 January 13, 2018 May 17, 2018

Transfusion Article on Improved Blood Usage (Ryan Lett)) 26-Oct-2017

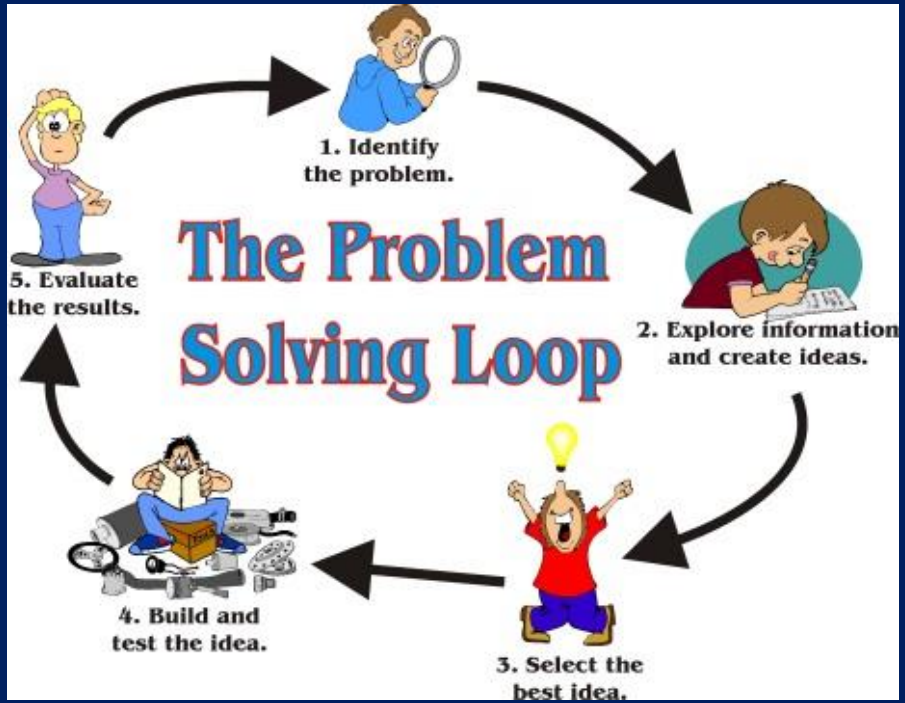


Transfusion ↓ by 1783 uRBC
Direct cost savings of $291,000 & indirect cost savings of $964,600 in associated lab & facility costs.

- ↑ Single unit & IV Fe

ONTraC: Problems & dealing with them

- Types of problems -- **many;** Selected problems

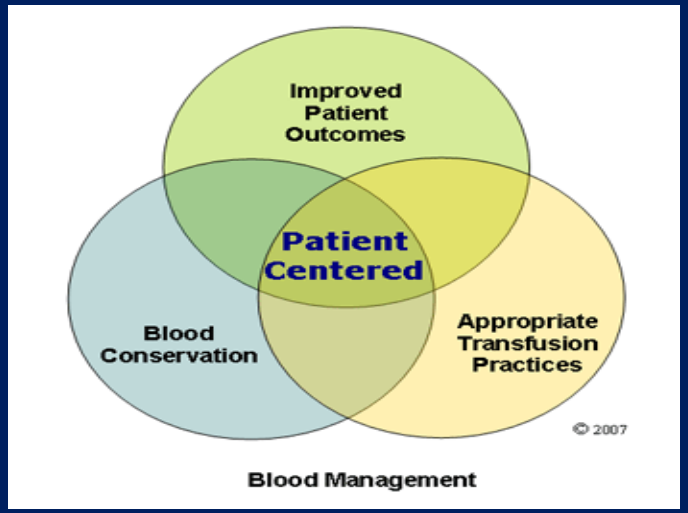


History of the Program

- Began 2002 as initiative to enhance blood management in the province
- Driving factors at the time included:
  - recommendations from the Krever commission,
  - the projected shrinking of the eligible donor base, and
  - increasing health-care costs
- Only 3 hospitals in Canada had PBM programs at that time

A NETWORK of ONTARIO TRANSFUSION COORDINATORS

Ontario MOH



NTraC
ontario transfusion coordinators

2002

❖Enhance transfusion practice outside of the Blood Bank

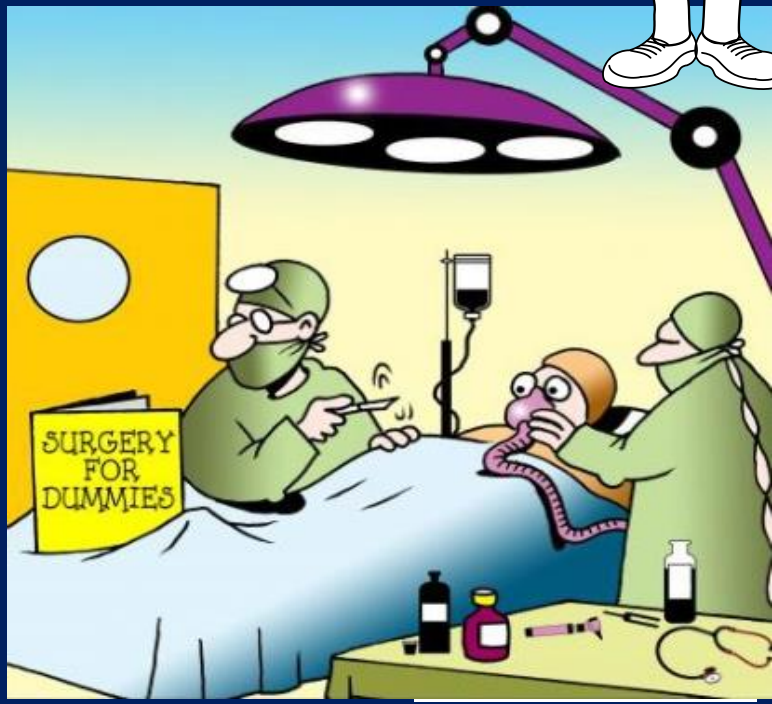
* 'clinical bridge' between Transfusion Service & rest of hospital

Interact with physicians, nurses & patients to promote blood conservation and alternatives to allogeneic transfusion

Anticipated a 5 to 10% reduction in red cell use

What is ONTraC?

- Ontario Transfusion Nurse Coordinators Program
- A network of PBM nurse coordinators in 25 hospitals in Ontario, aiming to implement PBM within their institutions
- MOH funded - 1st government sponsored PBM program; (hospital 'freebie')
- Focus: elective surgical setting
- Has been successful in reducing transfusion rates, changing practices and improving clinical outcomes
- Cost-effective
- MOH formal review (by KPMG) 2009; "Evergreen" funding
- Potential difficulty: blood is 'free' in Canada



Ontario
MINISTRY OF HEALTH AND LONG-TERM CARE

25 hospitals: 70% of province blood (400K units/yr)

www.ontracprogram.com

Program description

- Funding from Ontario Ministry of Health through St Michael's Hospital
- Provide each hospital with Coordinator salary+benefits, computer, small additional sundries
- Formal contract and Instructions for hospital to be signed by CEO annually
- Initial training for new hires
- Ongoing education: conferences, meetings, emails, articles, mutual help
- Access to advice & support from program management
- A lot of data collection (which frustrates the coordinators) and analysis
- Monitoring & assessment, including site visits to hospitals by program manager/director
- Provide progress and financial reports to the Ministry of Health

Freedman J et al, Transfusion, 48:237-250, 2008.
Freedman J et al, Transfusion and Apheresis Science, 33:343-349, 2005.
Freedman J: Transfus Apheres Sci, 50:32-36, 2014

Focused role for Coordinators

To use advanced knowledge & skills to provide optimal care to patients/families.

1. Management of a patient blood management program (50% of time)
2. Patient, Family, Staff Education (25%)
3. Program Data Management (20%)
4. Local institutional/regional activities (5%)

Freedman et al, Transfusion, 48:237-250, 2008;

Targeted Procedures

Initial

- TKA
- AAA
- CABG
- Radical Prostatectomy

Current

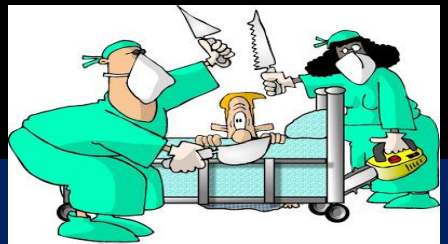
- TKR and THR
- Gyne (open hysterectomy & myomectomy)
- CABG
- CABG plus valve(s)
- Valves
- Additional: spine, colon, etc

PBM

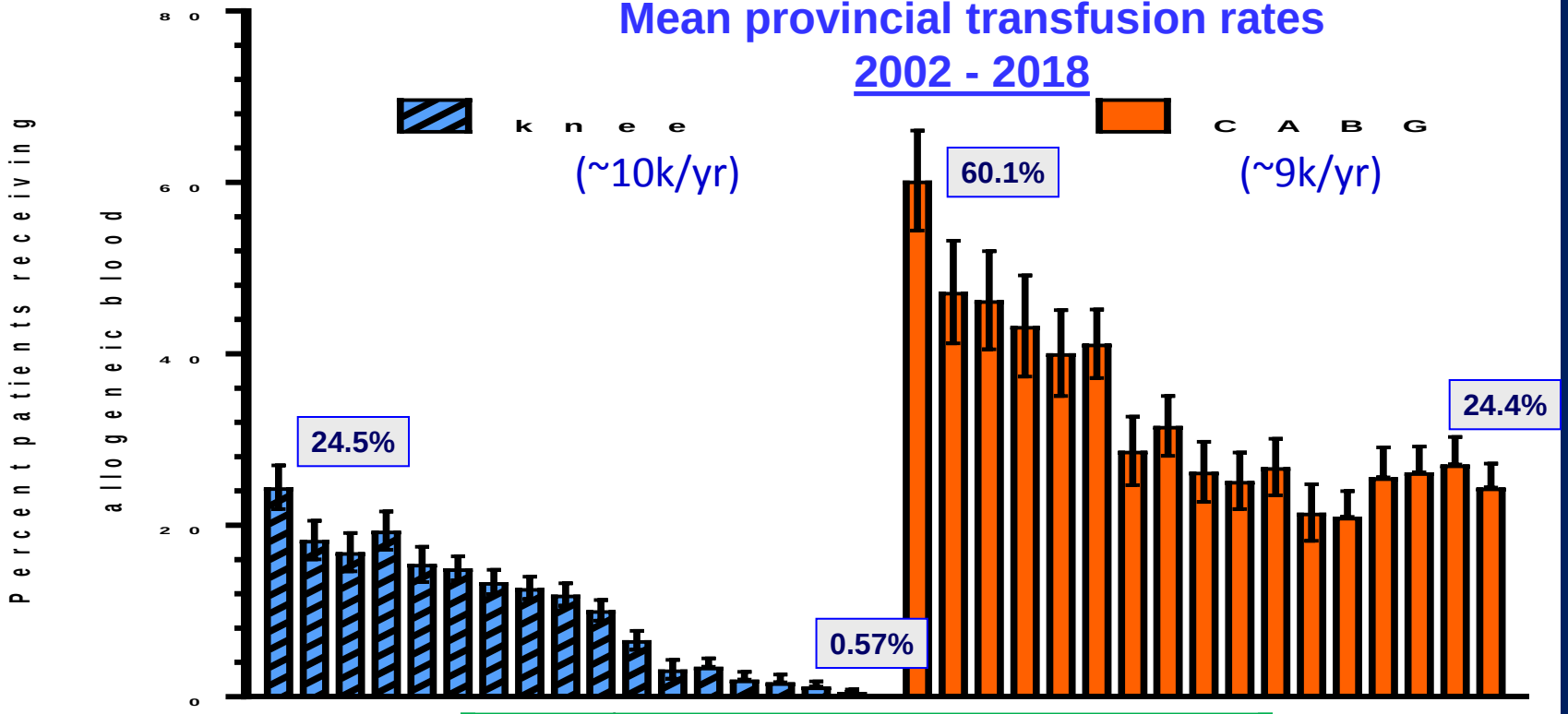
Pre-operative
Operative
Post-operative

Mitigating the risk of transfusion:

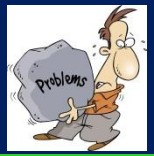
- Correcting (pre-operative) anemia (recognition & management)
- Reducing diagnostic blood loss
- Transfusion triggers/tolerating anemia
- Minimizing transfusion amount
- Autotransfusion (PAD, cell salvage)
- Optimize coagulation (anticoagulants, antiplatelet drugs)
- Surgical blood loss reduction
- CPOE & clinical decision support



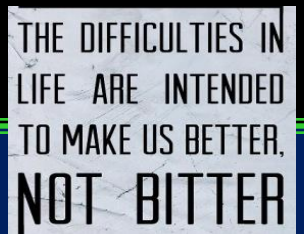
Mean provincial transfusion rates
2002 - 2018



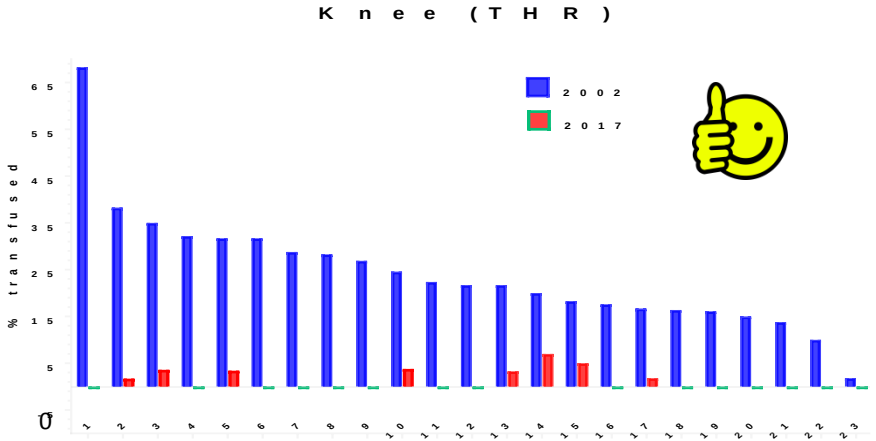
	RBC Units transfused (mean)			
	Per Txed pt		Per pt overall	
	Baseline	2017	Baseline	2017
KNEE	2.1	1.6	0.51	0.05
CABG	3.3	2.4	2.01	0.64

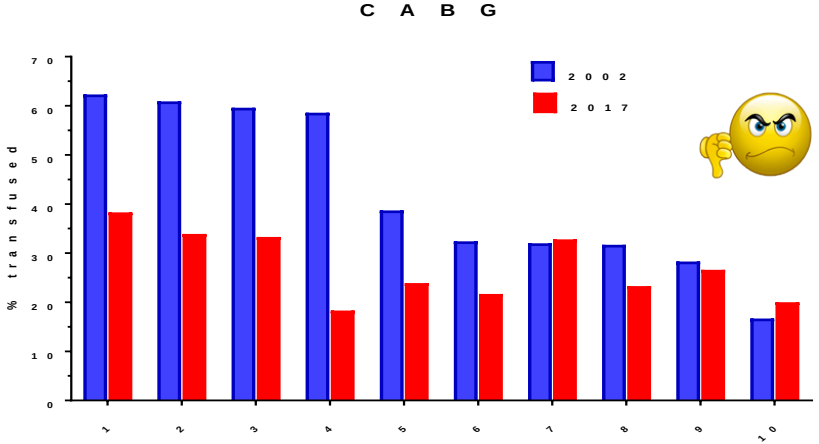
Difficulties  Pitfalls

- Emphasis on shorter wait times for surgery
- Changing evidence: EPO, Aprotinin, PAD, IV iron
- Costs and accessibility to some patient blood management measures
- Turnover of coordinators, physicians, administrators - reversal of gains
- Can be quite difficult to recruit physician & administrative champions
- Need to understand the individual institution's “culture” in order to successfully introduce change



Inter-institutional variability





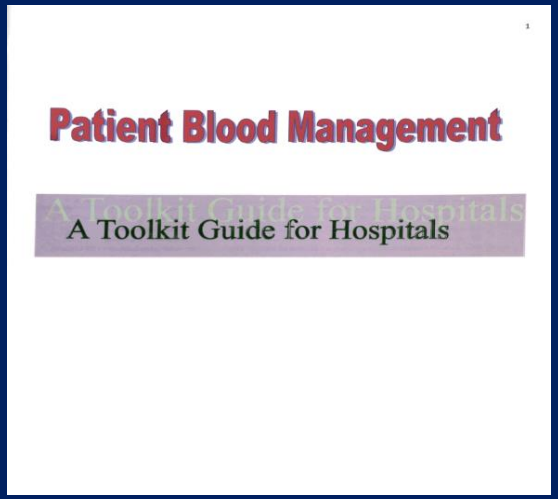
A standardized approach for detecting, evaluating & managing anemia in the pre-op setting is an important aspect of an effective PBM program

Pre-operative approach

- **early assessment at pre-admission clinic** (3-5 weeks before surgery)
- **identify patients at risk of transfusion ahead of surgery**
- **discuss informed consent and transfusion alternatives**
- **identify, investigate, and treat anemia**

  (family doctor, surgeon, anesthetist, hematologist)
- **develop individualized treatment plans for patients**
- **facilitate treatments – erythropoietin, oral/IV iron, TxA, cell salvage etc**

ONTraC Algorithm for Preoperative Hemoglobin Optimization and Anemia Management



Available on the ONTraC website:

www.ontracprogram.com

ONTraC Ontario Transfusion Coordinators

Preoperative Hemoglobin Optimization and Anemia Management

ONTraC Ontario Transfusion Coordinators

Goal: Transfusion avoidance in adult surgical patients

Risk Factors for Transfusion: Hemoglobin (HGB) less than (<) 130 g/L, weight less than 65 Kg, elderly, female, complex or repeat surgical procedure, renal insufficiency (creatinine clearance <40 ml/min), antiplatelet agents, anticoagulants, some supplements

Transfusion Avoidance Strategies: Early assessment (28 days before surgery) and evidence based, coordinated interventions as required.

Interventions must take into consideration age, gender, anticipated surgical blood loss and pre-existing medical conditions.

HGB Less than (<) 100 g/L

Consider delaying procedure. Refer to appropriate physician for investigation.

HGB 100 – 130 g/L

Evaluate: for blood loss (GI, menstrual, recurrent epistaxis) **anticoagulant status, renal/hepatic failure.** Refer to appropriate physician for investigation to treat underlying cause if able.

Check: CBC, differential, reticulocyte count (retic), *Ferritin, Iron indices, Creatinine, Serum B_{12}, Folate testing may be helpful

*False elevations may occur with inflammation, Infection and chronic disease.

HGB Greater than (>) 130 g/L

Evaluate needs of surgical procedure. Consider Iron, B12, and folic acid

Microcytic (MCV <80)
Consider: iron deficiency, thalassemia, anemia of chronic disease, Sideroblastic anemia. Refer to appropriate physician for investigation.

Normocytic (MCV 80-100)
Consider: anemia of chronic disease, renal insufficiency, nutritional deficiency, hemolysis, primary bone marrow disorder. Refer to appropriate physician for investigation.

Macrocytic (MCV >100 <110 mild; > 110 marked)
Consider: B_{12} deficiency, hepatic disease, thyroid disease, folate deficiency, alcoholism, medications (HIV antiviral, Hydrea®, Septra®, Methotrexate®) myelodysplasia, cytopenias, reticulocytosis. Refer to appropriate physician for investigation.

TSAT<.20, Retic low TIBC >72 mcmol/L Ferritin <30 mcg/L

Iron saturation (TSAT) < .20 (20%) retic low Ferritin 30-100 mcg/L

TSAT- low, retic -low TIBC <45 mcmol/L Ferritin >100 mcg/L

Folate low

B_{12} Low

Iron deficient

Probable iron deficient

Anemia of chronic disease

Start Folic acid 5 mg po daily

Start Vitamin B_{12} Therapy 1,000 to 2,000 mcg PO or SL daily OR IM 1000 mcg qweek x 4, then 500 mcg qmonth

Start Iron Therapy
1. Oral Iron: 100 – 200 mg elemental iron by mouth per day e.g. Ferrous Fumarate 300 mg, 1-2 tabs; Feramax® 150 mg per day **or**
2.Proferrin ®11 mg , 1–3 tabs per day
3. IV Iron infusion(E.g.iron sucrose**) if oral iron therapy is contraindicated or not tolerated or short time to surgery. Note: New preparations are safer than older formulations

HGB ≤ 130 g/L

Consider Erythropoietin With Iron

Epoetin Alfa (Erythropoietin)** HGB optimization using erythropoietin: **USUAL** target is HGB 130 g/L, **MAXIMUM** target in renal and oncology patients to less than 120g/L. Patients with pre-existing thrombotic events should be monitored closely.

Standard Dosing: Epoetin Alfa 20,000 – 40,000 units subcutaneously (600 units/kg) weekly to a maximum of 4 doses depending on presenting hemoglobin and time to surgery.

Short dosing schedule is available for urgent cases: Epoetin Alfa 300 IU/kg given for 10 consecutive days prior to surgery, on the day of surgery, and for four days immediately thereafter.

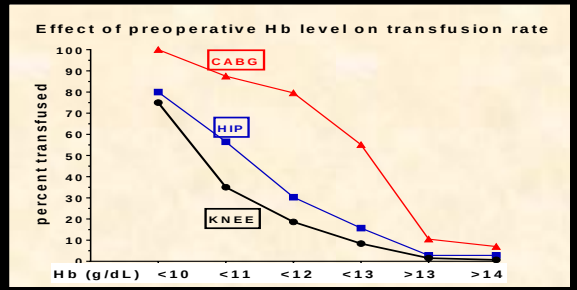
****May be Accessed in Ontario through** Third party provider or Ontario Drug Benefits Plan (Exceptional Access Program, Trillium)

Developed by Ontario Transfusion Coordinators (ONTraC), the Patient Blood Management initiative funded by the Ministry of Health and Long Term Care of Ontario 2007, Revised 2012, 2013, 2016

www.ontracprogram.com

Effect of pre-operative Hb level on transfusion rate

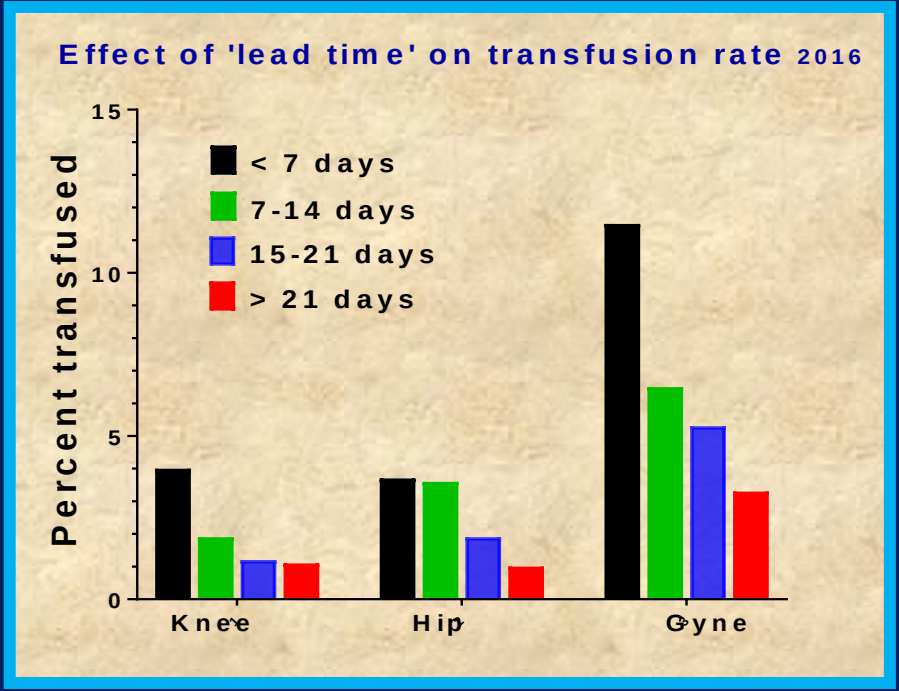
Pre-op Hb	Percent transfused				
	Knee	Hip	CABG	CABG+valve	Valves
• Hb < 100 g/L	25.0%	100%	50.0%	100%	76.9%
• Hb < 110 g/L	25.0%	54.6%	68.8%	90.0%	72.4%
• Hb < 120 g/L	12.7%	16.1%	67.2%	88.2%	68.0%
• Hb < 130 g/L	5.0%	6.6%	59.0%	79.0%	56.5%
• Hb > 130 g/L	0.6%	0.8%	17.5%	43.1%	20.9%
• Hb > 140 g/L	0.5%	0.4%	10.8%	33.3%	16.9%



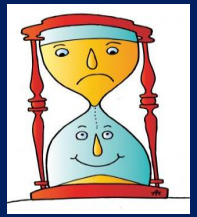
Pre-op Hb of 100 g/L has a seven-fold higher likelihood of transfusion than Hb 130 g/L

Lead time to optimize preoperative treatment of anemia

A lead time at least 3-4 weeks prior to surgery recommended to allow sufficient time to diagnose & optimize treatment of anemia based on the identified cause.



See/refer patients as early as possible



But only 60% arthroplasties & 40% CABGs seen > 15 days prior to surgery

Difficulties & Pitfalls

- Emphasis on shorter wait times for surgery
- Changing scientific evidence: e.g. EPO, Aprotinin, PAD, IV iron
- Costs and accessibility to some patient blood management measures
- Turnover of coordinators, physicians, administrators - reversal of gains
- Can be quite difficult to recruit physician & administrative champions
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Treatment

Arnold
Pumping iron

Lance
Winning the Tour de France

Iron: oral, IV

ESA: EPO

Delay surgery if needed for optimization

Erythropoiesis stimulating agents (ESAs) e.g. Eprex, (Darbopoietin)

Where an ESA is used, it must be combined with iron therapy.

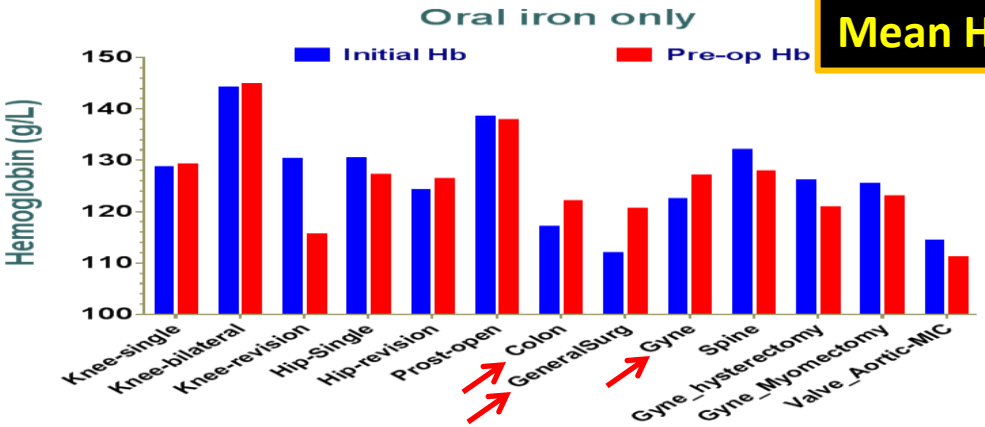
ESAs have been recommended in:

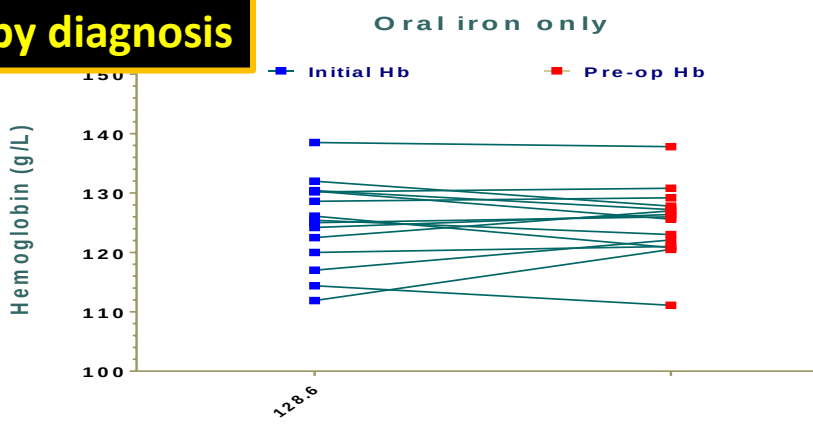
- **Anemia of chronic kidney disease**
- **Anemia of HIV/AIDS**
- **Anemia of non-myeloid malignancies**
- **Surgical patients with anemia of chronic disease (in Ontario not covered, need EAP approval)**

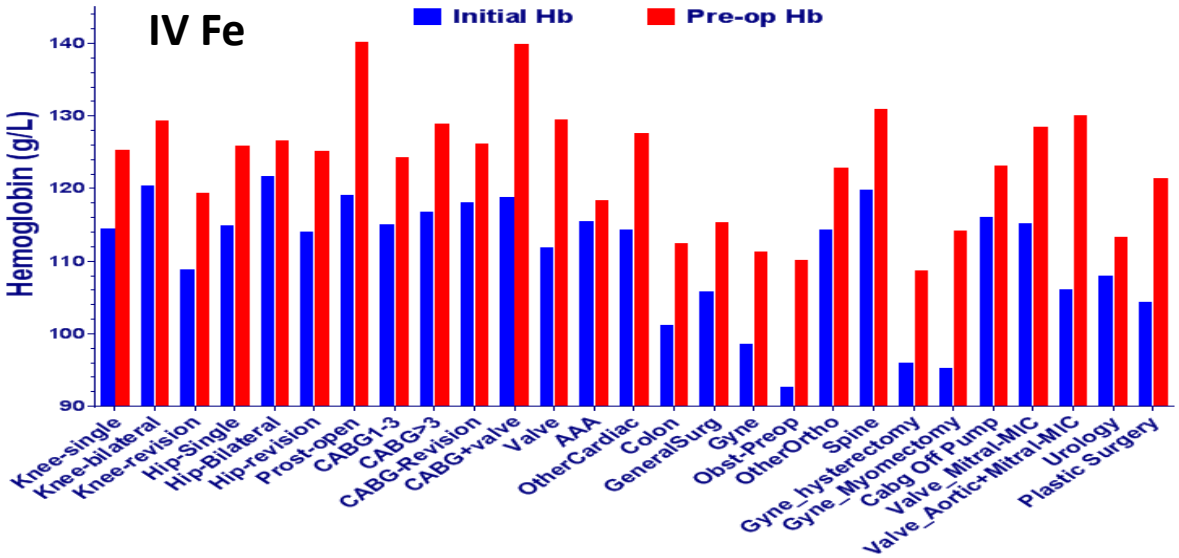
In 2011, FDA & Health Canada issued recommendations for more conservative dosing of ESAs because of data showing increased risks of cardiovascular events (stroke, thrombosis and death) with ESAs in CKD patient. **WARNING: ESAs MAY INCREASE THE RISK OF DEATH, MYOCARDIAL INFARCTION, STROKE, VENOUS THROMBOEMBOLISM, THROMBOSIS OF VASCULAR ACCESS AND TUMOR PROGRESSION OR RECURRENCE.**

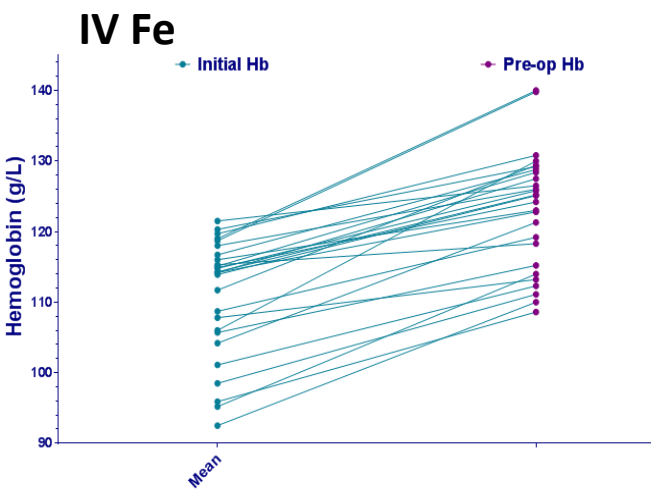
However, flaws in the studies responsible for the warnings have been pointed out and the extensive use of Eprex in the perisurgical setting has not in general been associated with an increase in adverse events.

Mean Hb by diagnosis



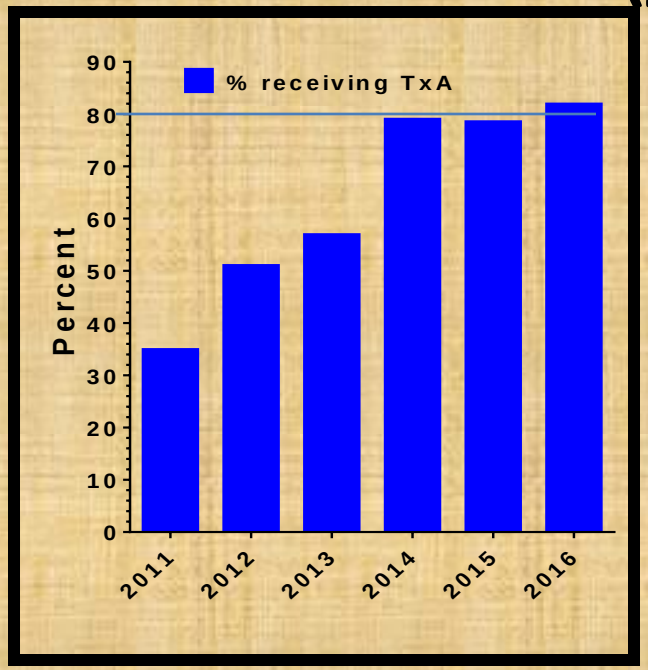




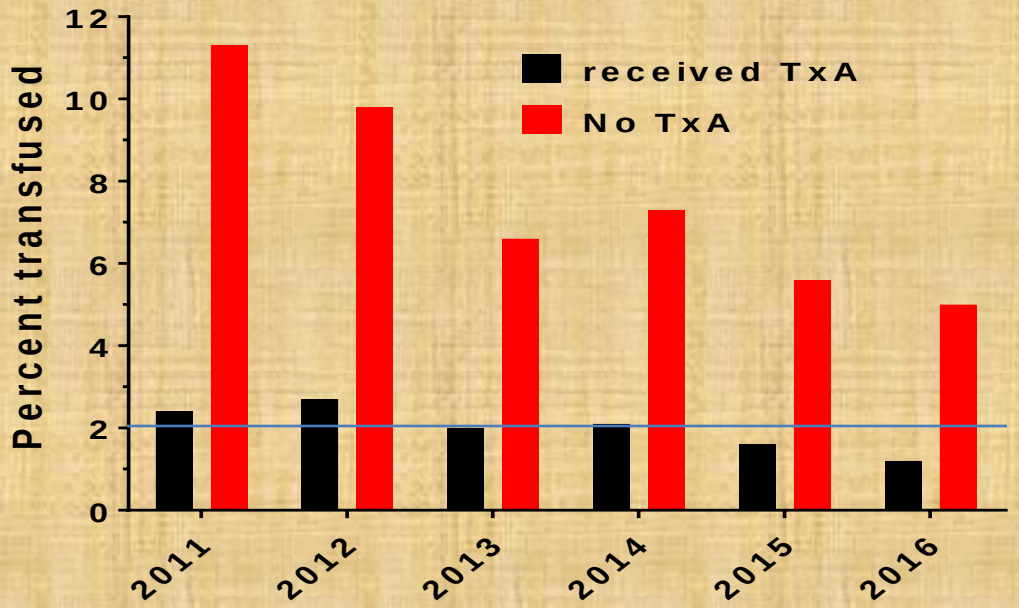


NTraC
ontario transfusion coordinators

Antifibrinolytics: Tranexamic acid (joint arthroplasty)



Lower transfusion rates when TxA given



Difficulties & Pitfalls

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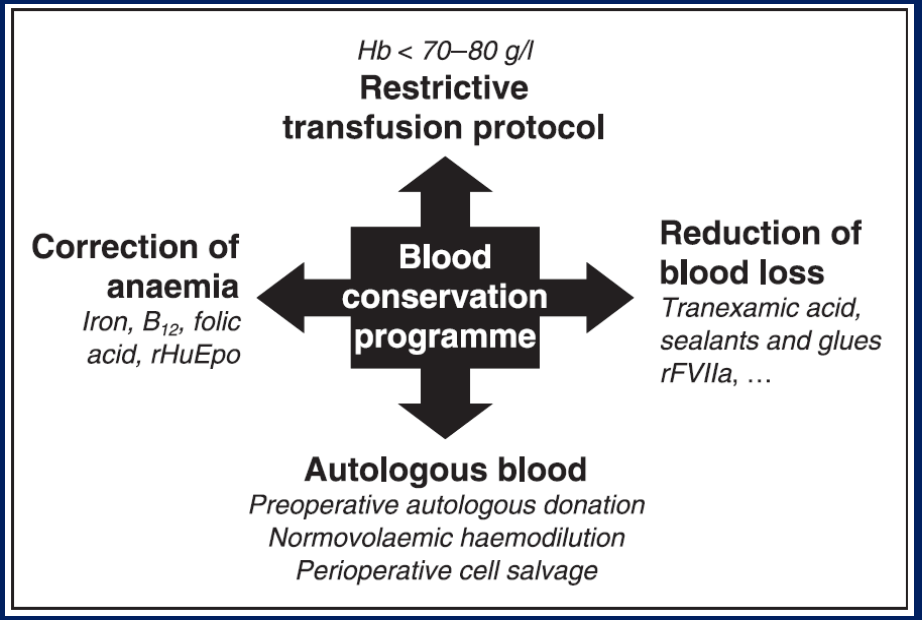
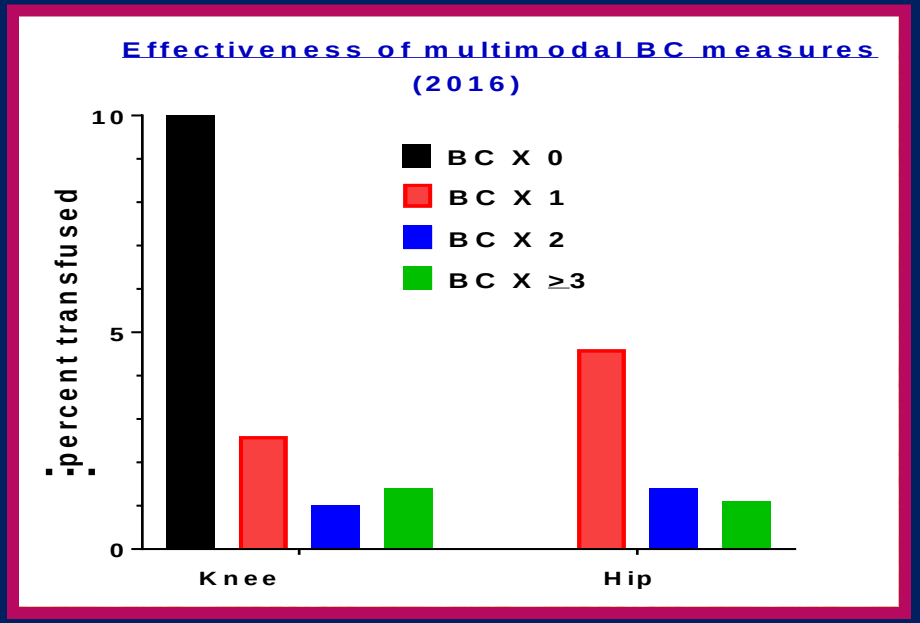
How do we get these:

- **Insurance**
- **EAP**
- **Self pay**

Problems with administration of products -- space

Multimodal BC measures



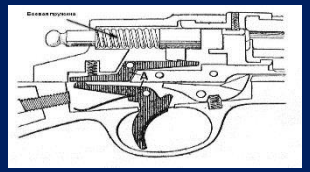


	Knee (% transfused)
Any BC - no	10.0% (N=20)
Any BC - yes	1.6% (N=1102)

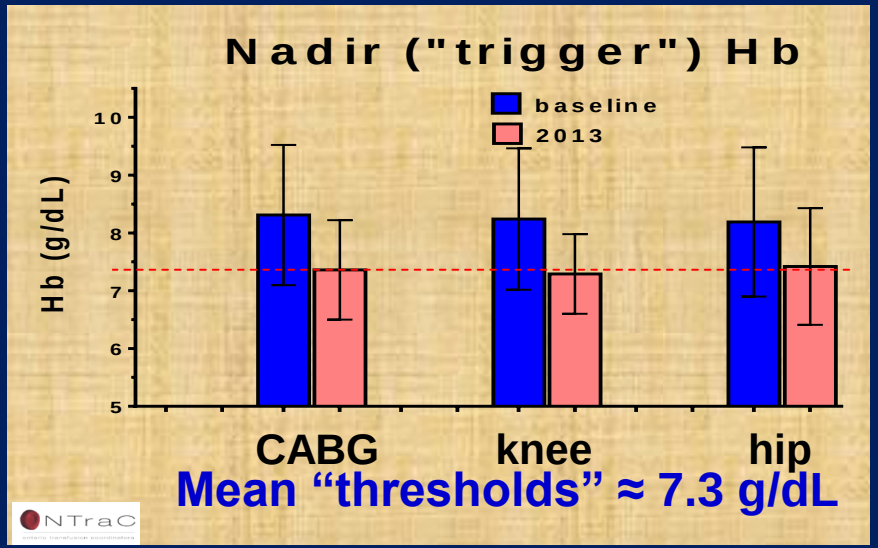
Tolerate lower hemoglobin values

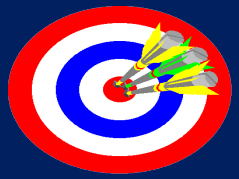
- The Hb level selected should be viewed as a threshold rather than a trigger; if the Hb is below the threshold level, a transfusion may be considered but is not mandatory.

- Nevertheless, despite need for clinical evaluation, many clinicians mainly use hemoglobin values to guide transfusion decisions.



trigger





target

TRANSFUSION doi 10.1111/j.1537-2995.2012.03591.x

Hemoglobin 'targets' equally important but quite varied

"a Hb level at discharge greater than 10.0 g/dl, or even 9.0 g/dl, in a transfused patient serves as a surrogate for excessive transfusion."

Edwards et al: Transfusion, 2012 52:2445-51

2016	% transfused patients with discharge Hb		
	Hb > 100	Hb > 110	Hb > 120
CABG	21.1	5.9	1.3
Valves	18.6	7.3	1.6
Knee	27.8	11.1	0
Hip	15.8	0	0
CABG +Valve	16.2	2.2	0.7
Gyne	14.6	4.8	0

But may not be inappropriate: check; ? A 'flag'

Difficulties & Pitfalls

- Emphasis on shorter wait times for surgery
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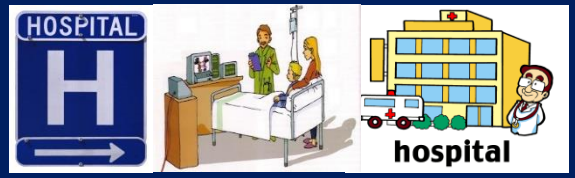
- Transfusion rates are not patient dependent, but are institution (geography) dependent (Bennett-Guerrero . JAMA, 304:1568, 2010)
- High-transfusion hospitals and Low-transfusion hospitals
- 30% of the variation surgeon dependent, 70% hospital specific (Jin. Ann Thorac Surg 95:1269, 2013)
- So need to change 'culture' in hospitals



But we know about this, don't we?
So why haven't we changed?

Change is good! YOU go first.

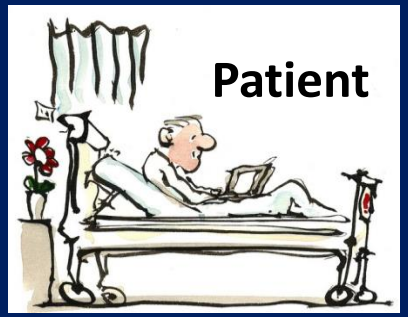
So what to do

Multidisciplinary

Nurse

Physician

Lab
(BTS
Haem)



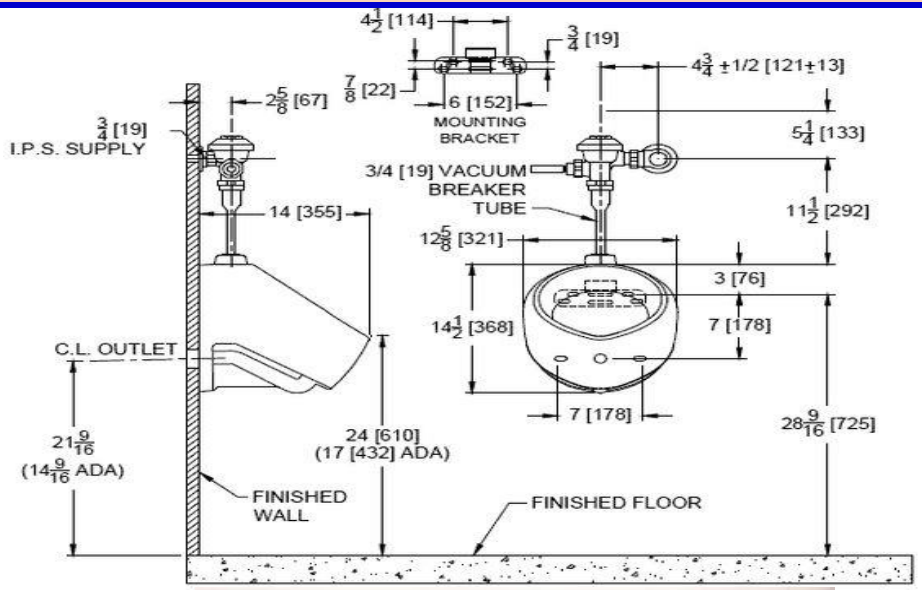
Administration

Difficulties & Pitfalls

- Emphasis on shorter wait times for surgery
- Changing scientific evidence: e.g. EPO, Aprotinin, PAD, IV iron
- Costs and accessibility to some patient blood management measures
- Turnover of coordinators, physicians, administrators → reversal of gains
- Can be quite difficult to recruit physician & administrative champions
- Need to understand individual institution's “culture” to successfully introduce change
- Maintaining program momentum in face of competing priorities

How to get ‘buy-in’

One needs a PLAN (but what is it?)



And sometimes the plans go awry

Cc: to relevant department chiefs

Dr. John Big Boss
President & Chief Executive Officer
City Hospital
South Porcupine, Ontario

ONTraC Participation Agreement, Fiscal Year 2015-2016

Dear CEO:

We are pleased to inform you that the Ministry of Health continues to fund and support a provincial Patient Blood Management (PBM) program through placement of PBM Coordinators in Ontario Hospitals.

Through this program, the PBM coordinators assist & facilitate measures to avoid inappropriate blood transfusions … reducing transfusion rates … improved patient care & safety, reduction in postop infections and length-of-stay in non-transfused patients … significant cost savings to the blood system & hospitals.

Financials – how much $$ will be given; what it is to be used for; unspent funds; required financial statements from sites (quarterly & year-end, signed by CFO).

BUT !!!! → → → →

Added 2017

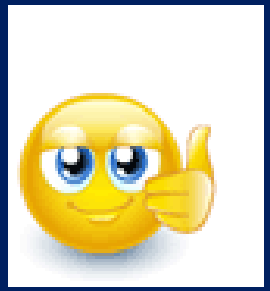
Your hospital is a participant in this initiative to enhance optimal transfusion practices and provide/ facilitate alternatives to blood transfusion where appropriate. The ONTraC program has, thanks to the efforts in the participating hospitals, been highly successful e.g. mean provincial transfusion rates for knee surgery have decreased from 22.6% in 2002 to 1.2% in 2017; in CABG from 60.1% to 26.6% in 2016. The successes of the program have also been shown by significantly shorter length-of-stays and lower infection rates in non-transfused patients and annual cost savings to the province in purchasing of red cells of > $15 million and to the healthcare system overall of over $40 million compared to baseline.

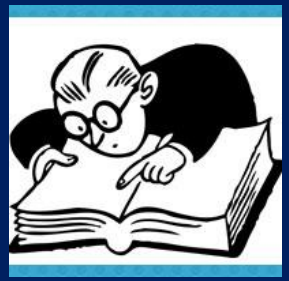
Below is some of the data collected for your hospital. More complete analyses have been provided to your hospital coordinator, …… , and may be obtained from her/him.

Percent patients transfused with red blood cells (and hospital ranking among participating hospitals)

			2015			2016			2017			
Procedure	Number participating hospitals	Bench mark trans-fusion rate	Provincial average	Your Hospital transfusion rate	Your Hospital ranking	Provincial average	Your Hospital transfusion rate	Your Hospital ranking	Provincial average	Your Hospital transfusion rate	Your Hospital ranking	Meets bench mark
Knee	24	3%	2.02%	0%	1	1.7%	0%	1	1.2%	3.8%	17	No
Hip	24	3%	3.93%	5.2	14	2.1%	0%	1	2.5%	0%	1	Yes
CABG	10	25%	25.6%	25.6%	6	26.2%	31.7%	8	27.1%	26.6%	6	No
Valves	10	30%	42.8%	36.2%	4	31.2%	28.6%	5	36.5%	35.6%	5	No
CABG+Valve	10	55%	58.2%	60.7%	6	54.8%	60.9%	7	56.5%	45.8%	3	Yes
Gynecology	18	8%	10.1%	7.3%	4	8.0%	5.6%	3	7.6%	2.9%	1	Yes

- Consequences:





- But ……

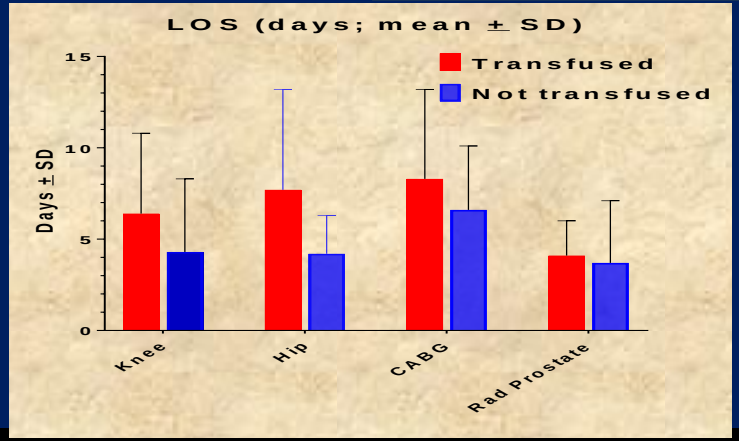
Data Collection

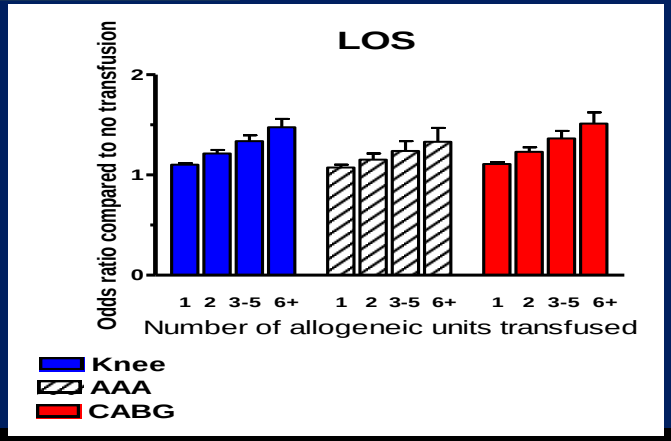
- Aggregate data and site-specific data
- Data is used as a driver for change – “buy in”
- Coordinators to share results with key people in their organizations and their transfusion committees
- Can be used to benchmark against other sites
- Reported to the MOHLTC

Outcomes measured

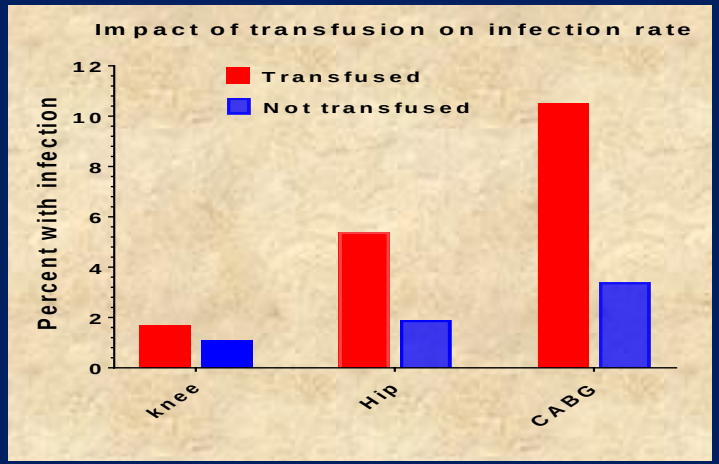
- Infections
- Length of stay
- Mortality
- Cost savings

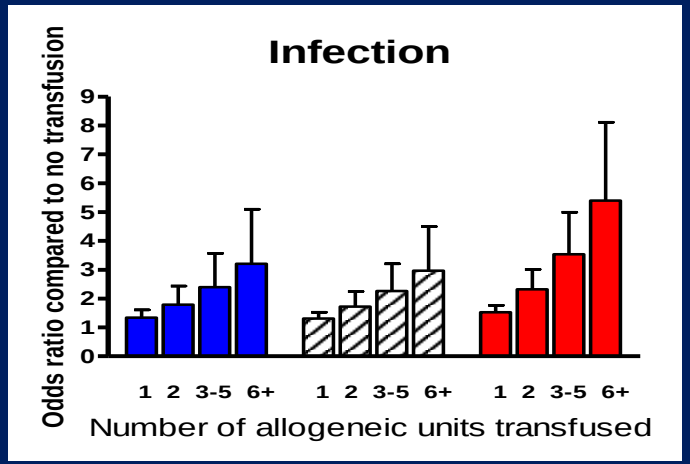
Transfusion, LOS, infections





Multivariate analysis: allogeneic transfusion is an independent predictor of LOS





PBM reduces costs:

COST SAVINGS – 2016 compared to baseline

(annual for CABG, Knee and Hip surgeries only)

Savings for RBC purchase only (@ $450/unit)	**$ 13,570,200**
Savings to health care system overall*	**$ 35,914,200**

* Shander A, Best Pract Res Clin Anaesthesiol 21:271, 2007; Shander et al, Transfusion 50:753, 2010; Freedman et al, Transfusion, 48:237-250, 2008.

Cost of program $ 3,400,000
(but program provides savings beyond the 3 procedures above)

In addition to catering to many patients' preferences, improving quality of care & patient safety, the program very cost-efficient & cost-effective

CLINICAL DECISION MAKING

Clinical Experience

Repeating one's own mistakes with increasing confidence over time

Evidence Based Medicine

Minimal variation in clinical practice with people perpetuating the mistakes of others

Nothing is black and white, medicine is practiced in the context of constant uncertainty

Lessons Learned in ONTraC

- Need senior hospital leadership support
- Cardinal to success is a local champion - a well-respected physician who will work closely with the Coordinators developing new procedures/protocols and presenting them to the staff.
- Teamwork and communication are paramount
- Need to develop algorithms & pamphlets relevant for their institution; tailor to institution realities as much as possible; not “one size fits all”
- Assess patient early and treat pre-op anemia
- **start with more; lose less; save/give back what you can**

Lessons Learned

- Assess patient early and treat pre-op anemia
- To change practice needs data on current transfusion rates & practices – get 'buy-in' by sharing comparative data - no-one likes to be worse
- Essential to keep focus on blood conservation/PBM; prevent co-opting of coordinator to other tasks; seen as a 'freebie'; puts coordinator in a difficult position (not research; not a hemovigilance/safety officer)
- Despite difficulties, a focused PBM Coordinator and a focused program dedicated to the concept can result in more appropriate blood use

At the hospital level key elements include:

1. **A PBM policy supported by Hospital Transfusion Committee, with senior medical/nursing/management support**

2. **Hospital-wide awareness & education**

- Medical, nursing, laboratory staff, in all clinical areas administering blood
- Clinical champions in key disciplines
- Include in induction for new staff
- Clear messages: posters, intranet, newsletter

Cardinal to success is a local champion, a well-respected physician who will work closely with Coordinator developing procedures/ protocols and presenting them to the staff.

3. **Guidelines for appropriate use of blood and alternatives (order sets)**

4. **Informing & involving patients**

5. **IT to support collecting blood usage data, support audit, computerized physician order entry (CPOE) systems**

6. **Audit and data collection – benchmarking ; feedback data to relevant teams**

PBM is not easy

Bloodless medicine (or blood conservation or PBM)
Requires coordination of services across a variety of departments…. cooperation between outpatient scheduling, surgical and anesthesia physicians and their clinic personnel, operating room scheduling, intensivists and hematologists to get the patient prepared, …the billing office….

This is in contrast to a transfusion, which can usually be accomplished with a one phone call …. A plethora of new techniques and therapies available … relative merits, alone and in combination, still needs to be investigated, **but it is becoming standard of practice.**

[from T Kickler, Johns Hopkins, Transfusion 43:550, May 2003]

Failures:

- Decreasing phlebotomy/diagnostic blood loss
- CPOE
- Cell saver
- Point of care testing
- Topical hemostatics
- Early notifications pre-op
- Expansion to medical patients
- Gender differences

What makes this program different?

Key is the “network” aspect

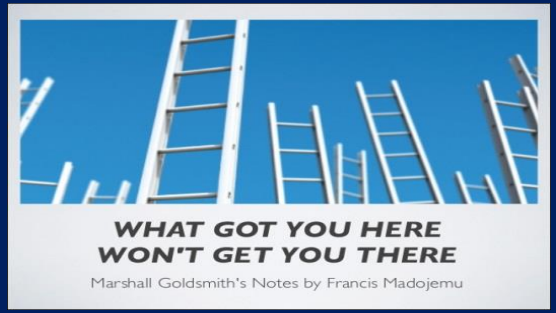
- Governmental funding (provides long-term continuity & stability)
- Voluntary participation of institutions
- Dual responsibility/accountability of coordinators (hospital & program)
- Allows for multicentre collaboration
- External evaluation of data and of performance
- Ability to analyze large numbers of similar patients
- Ability to compare data with comparable hospitals / procedures
- Steering committee (advisory body that reviews program reports which include financial & clinical data, and program outcomes, monitors progress towards annual goals, and provides recommendations)

- Are we there yet

Getting

There

But



Blood transfusion is a lot like marriage.
It should not be entered into lightly,
unadvisedly or wantonly,
or more often
than is absolutely necessary.

[Beal RW: Aust N Z J Surg 46:309, 1976]

TRAGIC REALLY, HE DIED BECAUSE NO ONE KNEW HIS BLOOD TYPE
I'LL NEVER FORGET THE LAST INSPIRATIONAL WORDS HE WHISPERED TO ME...
...BE POSITIVE!

Thank you

"Science, my lad, is made up of mistakes, but they are mistakes which it is useful to make, because they lead little by little to the truth"

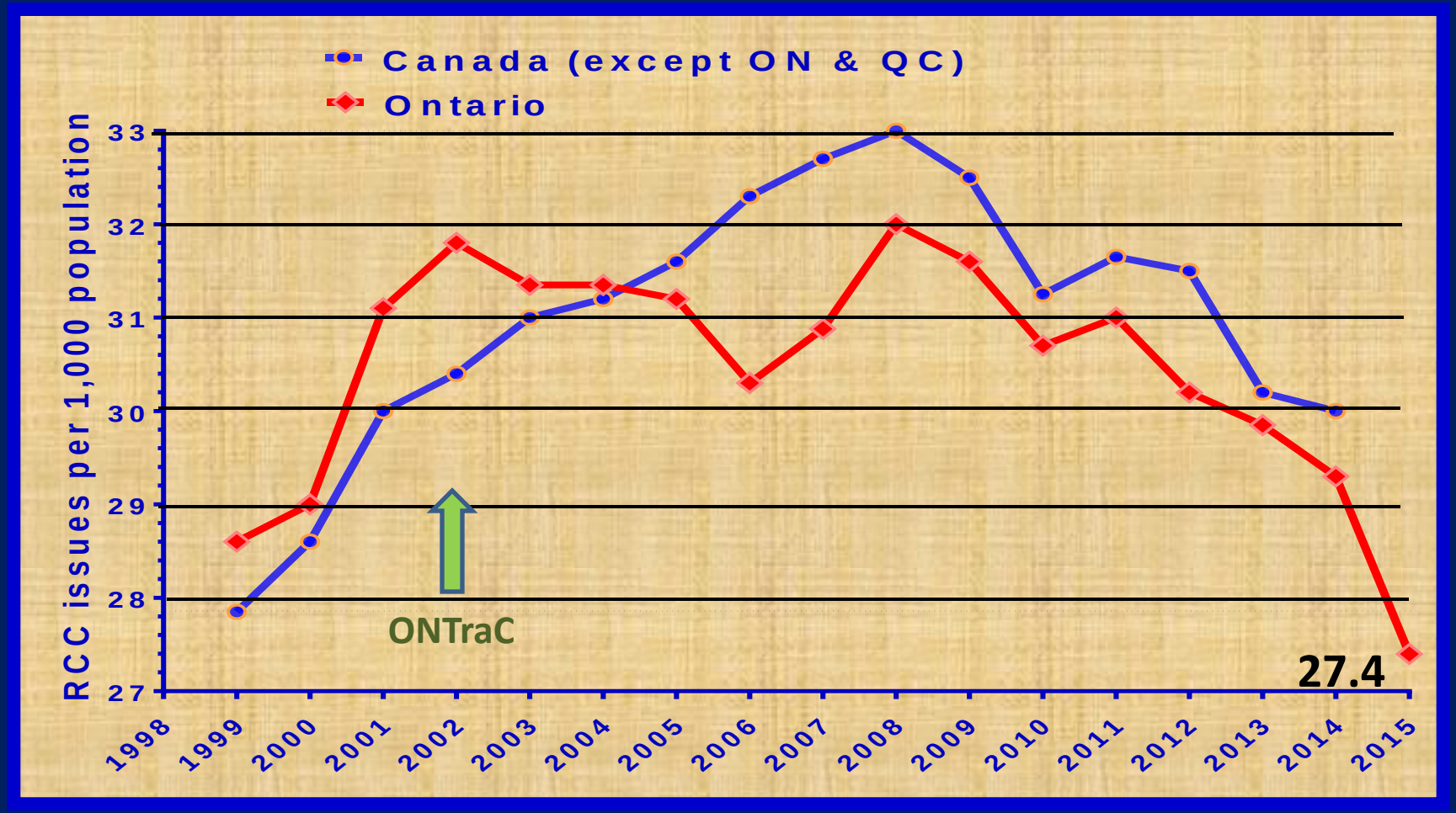
Jules Verne A Journey to the Centre of the Earth

- Patient blood management (PBM) is the predominant paradigm in clinical transfusion medicine.

- The success of PBM can be seen by the falling demand for RBC units around the world & many clinical trials have demonstrated how restrictive transfusion thresholds are associated with better clinical outcomes.

- As the pattern of practice has changed, an increasing proportion of people working in transfusion medicine are working in PBM audit and implementation compared to traditional blood banks and laboratories.

Annual red cell use: Ontario vs rest of Canada

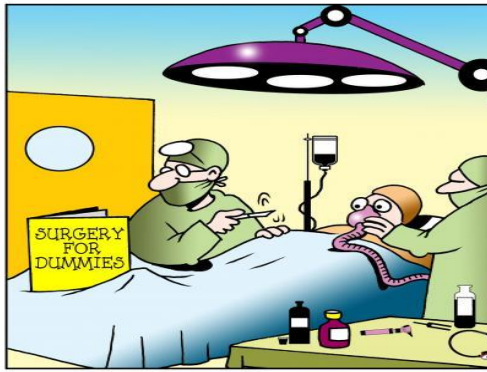


Reducing perioperative blood loss:

A variety of approaches have been employed to reduce perioperat-ive blood loss. Development of protocols involves multidisciplinary collaboration between surgeons, anesthesiologists, hematologists, transfusion medicine and pharmacy.

Approach may vary depending on surgical procedure.

- **Reversal of antithrombotic medications**
- **Point of care testing/thromboelastography, to assess coagulation and guide blood product use**
- **Topical hemostatic agents (fibrin glue/sealant)**
- **Hemostatic drugs - Procoagulant; Antifibrinolytic**
- **Perioperative blood salvage**



Blood utilization assessment -- paradigm shift:

Traditional measures: blood outdates, blood wastage, C/T ratios ☹

Evolving quality indicators: transfusion & clinical outcomes:

- ☺ improved patient safety and quality of care,
- ☺ reduced transfusion-related costs,
- ☺ preserved blood inventory

Endorsed by:

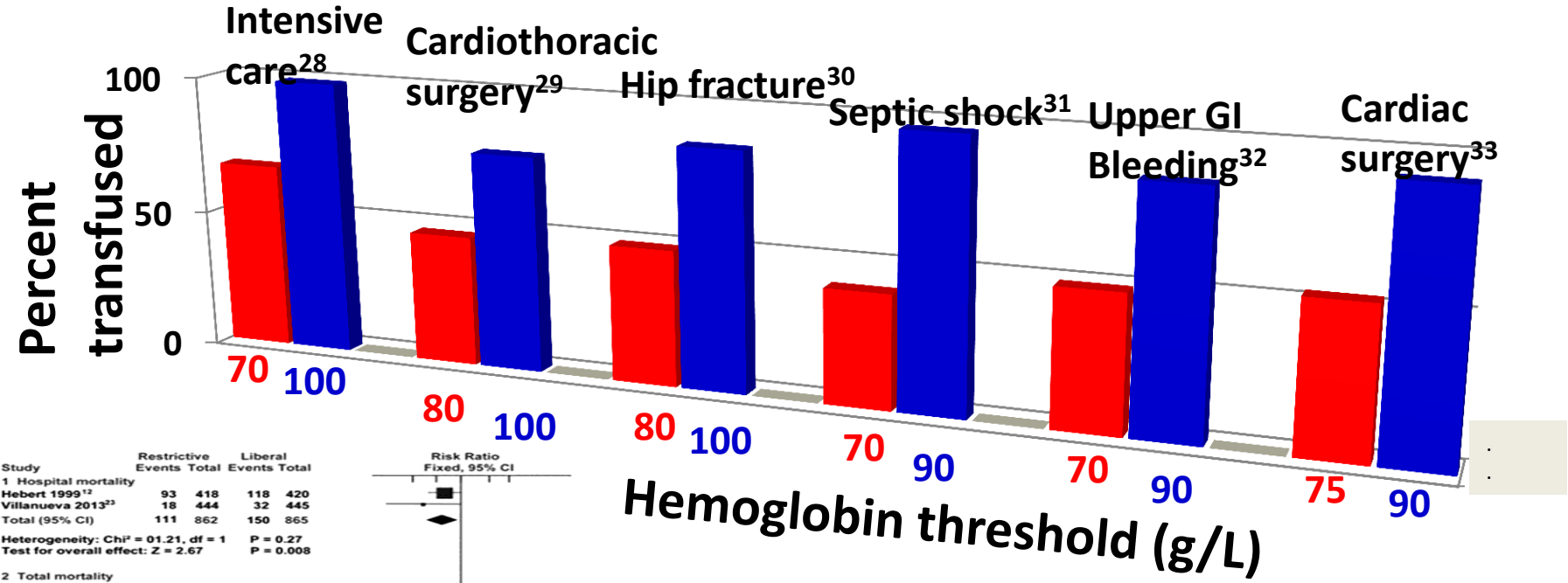
Joint Commission: 2010-2012 Strategic Objective

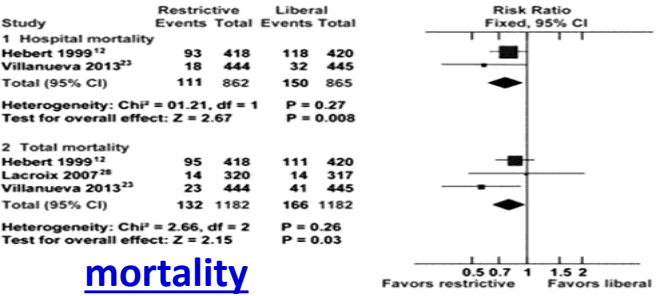
World Health Alliance: (WHA 63.12, 2011)

Blood Products and Patient Safety Advisory Committee to the FDA: 6/6/2011

Key trials showing reduced transfusion with lower hemoglobin thresholds

(Restrictive strategy in red; liberal strategy in blue)





mortality

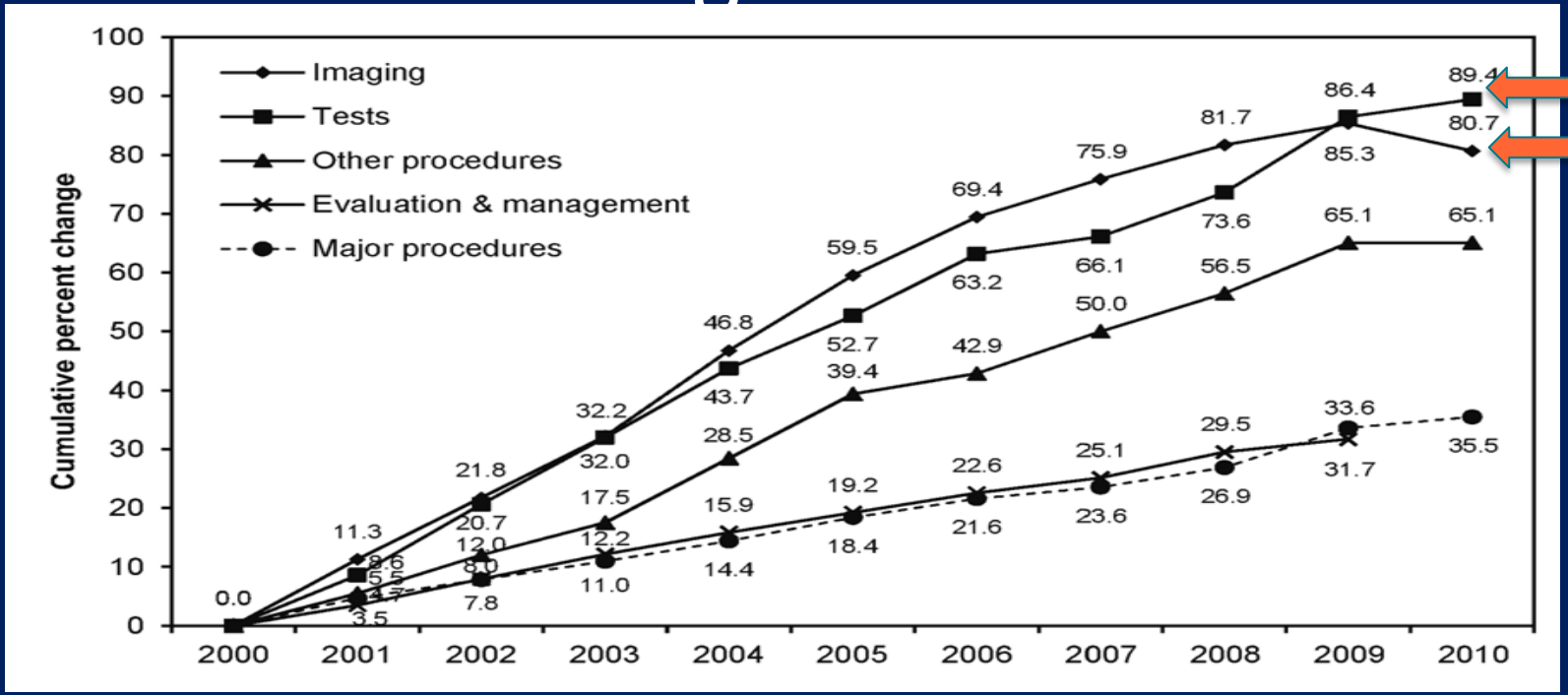
Hospital-Acquired Anemia (HAA):

- Phlebotomy for diagnostic testing can result in iatrogenic anemia & transfusion -- the term "Medical Vampires" coined 30 yrs ago. In critically ill patients, almost half the volume of blood transfused was accounted for by diagnostic phlebotomy.

- Two studies found average daily blood sampling volume in ICU was 41 mL (represented 17% of total blood loss when in ICU for > 3 days).

- Traditionally, when drawing blood from indwelling devices (such as arterial or central venous catheters), the initial sample used to clear the line is discarded. A process and device to re-infuse the initial blood taken to 'clear the line' (drawback blood) was associated with a 50% reduction in diagnostic blood loss.

Ordering more services…



Lab Tests

Imaging

Medicare Payment Advisory Commission. A Data Book: Healthcare Spending and the Medicare Program; 2012.

Nearly a third of tests and treatments are unnecessary !!!

CMAJ News, April 6, 2017

PBM reduces costs

COST SAVINGS – 2016 compared to baseline

(annual for CABG, Knee and Hip surgeries only)

Savings for RBC purchase only (@ $450/unit) $ 13,570,200

* Shander A, Best Pract Res Clin Anaesthesiol 21:271, 2007; Shander et al, Transfusion 50:753, 2010; Freedman et al, Transfusion, 48:237-250, 2008.

Cost of program $ 3,200,000

(but program provides savings beyond the 3 procedures above)

In addition to catering to many patients' preferences, improving quality of care & patient safety, the program very cost-efficient & cost-effective

- A guiding principle should be that less is more. Many Choosing Wisely campaigns have recommended that **single-unit RBC transfusions** be given for non-bleeding hospitalized patients, echoing recommendations published > 20 years ago by the American College of Physicians.

- Prescribe additional units only after reassessment of the patient.

- Reported that even with a single-unit dose, liberal transfusion is still associated with higher frequency than restrictive of pulmonary edema/TACO (particular concern in patients with CHF. Observational studies found that risk of TACO increases with every RBC unit transfused.

To transfuse, or not to transfuse?

- While there are still unanswered questions on how, when and why blood transfusions are carried out, there are medical situations in which a blood transfusion is the only option.

- It can make the difference between life & death and it is important that we don't lose sight of the fact that blood transfusions may be life-saving.

- Still don’t have clear evidence for which patients will benefit from a transfusion.

- The message is that while we don't want to scare people, there is a need for a precautionary approach. You shouldn't be doing something to a patient if there is no evidence of benefit.

Primum non nocere.

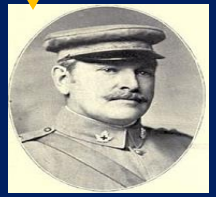
Louis Riel

The Riel rebellion

The Codd flag

April 24, 1885: In the chaos of a battle over Canada's new western territories, this flag became the first recorded use of the Red Cross emblem in Canada -- created by Lieutenant-Colonel Alfred Codd during the Battle of Fish Creek in present-day Saskatchewan. It distinguished medical personnel of the militia as they tended to battlefield wounded. There was no Red Cross Society in Canada in 1885, but that he improvised his own RC flag suggests at least a rudimentary understanding of the Geneva Conventions in the Canadian militia.

During the Battle of Batoche, Dr George Sterling Ryerson created this flag (Turkey red on factory cotton) to identify his medical transport. When Ryerson raised his home-made flag the firing ceased. Ryerson went on to help establish the St John Ambulance Association in Ontario and the **Canadian Red Cross Society**.



Prior to **1909**, the Red Cross in Canada did not have an entity of its own & carried on under the authority of the British Red Cross. However, it was felt that there should be in every country a committee to co-operate in times of war with the hospital services of the armies and a permanent body in Canada affiliated with the British RC was desirable.

In **1909**, an act was passed by the Canadian Parliament incorporating The Canadian Red Cross Society (CRCS). The Saskatchewan Branch came into being on **Jan 7th, 1913**, and in **Sept 1914**, the Saskatoon Branch of the CRCS was formed. The first printed annual report of the Saskatchewan Division in 1916 lists CH Wilson as the Branch Secretary, and members of the Provincial Executive committee from Saskatoon were Arthur Moxon and AF Lenon.

As might be expected, the members of these branches and many, many volunteers gave unstintingly of their time and talents in rendering great services to the various efforts of the Society during the First World War. Records of this service seem not available, but from verbal reports, Saskatoon people did their share.

AM Blue: A history of the Canadian Red Cross Saskatoon Branch 1914-1969.

After the WWI ended, Saskatchewan, and all Branches of the Red Cross in the Dominion, were honour-bound to cease activities in accord with the traditional attitude of the Society throughout the world. Thus, the Saskatoon Branch became inactive until arrangements were made whereby the CRCS could make a real contribution to alleviate suffering during peacetime. A Branch office was opened in the then C. P. R. building in Saskatoon and became an active centre for directing efforts.

In **1939**, when the world was again ravaged by brutal conflict, the Saskatoon Branch became very active. For some time, the Branch had been closed and its business was conducted in the office of the President, Mr AM Blue and Honorary Secretary Mrs SE Bushe. Branch representatives attended the first wartime meeting called by the Saskatchewan Division in Regina, following which committees were set up.

Mrs Bushe carried on most efficiently throughout the war years of a voluntary basis along with Mrs May Stacey, a veteran in the service of the Red Cross (Saskatoon Branch) during the WWI, and many, many others, who volunteered and gave wonderful support.

AM Blue: A history of the Canadian Red Cross Saskatoon Branch 1914-1969.

1938 produced only $800 in funds in Saskatoon, but as soon as war broke out, and citizens became involved in the Armed Services and war activities, the money became more plentiful. People realized there was a needed and the Red Cross could fill that need. The financial contributions increased from $800 to a wartime campaign realizing $60, 000.

Experience in the First World War had shown that healthy human blood made available for injection into veins of people suffering from certain wounds was an important feature in their treatment back to health. During the Second World War, this experience was enlarged and blood collected was used in many hospitals overseas.

Dr Stanbury, who was an authority on the process of blood donation and transfusion, introduced voluntary system into Canada through the Canadian Red Cross as being the most feasible agency to carry on this effort. Stanbury later became National Commissioner of The Canadian Red Cross Society, in Toronto.

Collection of blood started late in 1941, in Regina, under Dr DF Moore, and soon after in Saskatoon under Prof GW Rea. The whole blood was sent to Connaught Laboratories in Toronto for harvesting serum until August 1942, when a laboratory for this was set up at the University in Saskatoon, and the serum was sent to Toronto for lyophilization. 92,146 donations from Saskatchewan and 5,537 from Alberta were treated there.

It was soon apparent that if an adequate supply was to be obtained, a much wider field needed to be covered. This was brought to the attention of the B'nai Brith in Saskatoon which donated a car to enable various sections of the province to be visited to collect blood. The car was manned by a crew experienced in treating blood donors & the response was so good that two mobile motor vehicles, equipped for work, were commissioned.

Donations were obtained from almost every source, and the original car was sent to Regina for Red Cross use. All sorts and conditions of people who had the proper blood type were glad to become donors (including jail inmates) in this contribution to the war effort.

Some idea of the magnitude is seen below. Owing to the University and its equipment there, Saskatoon was the focal point.

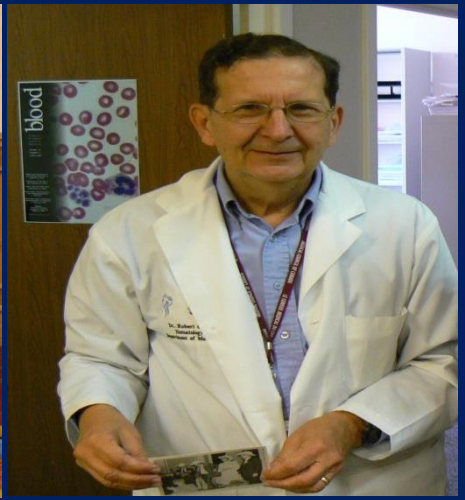
Here are the blood donations supplied by a town and two cities of Saskatchewan from **September 1942 to June 1945**:

CLINIC	Pop 1945	1942	1943	1944	1945	TOTAL
Saskatoon	(45K)	1, 396	5, 390	7, 125	2, 840	**16,751**
Regina	(65K)	1, 420	5, 883	5, 658	3,289	**16, 250**
Unity	(<600)	25	489	60	173	**757**

AM Blue: A history of the Canadian Red Cross Saskatoon Branch 1914-1969.

2015 Hemophilia Saskatchewan

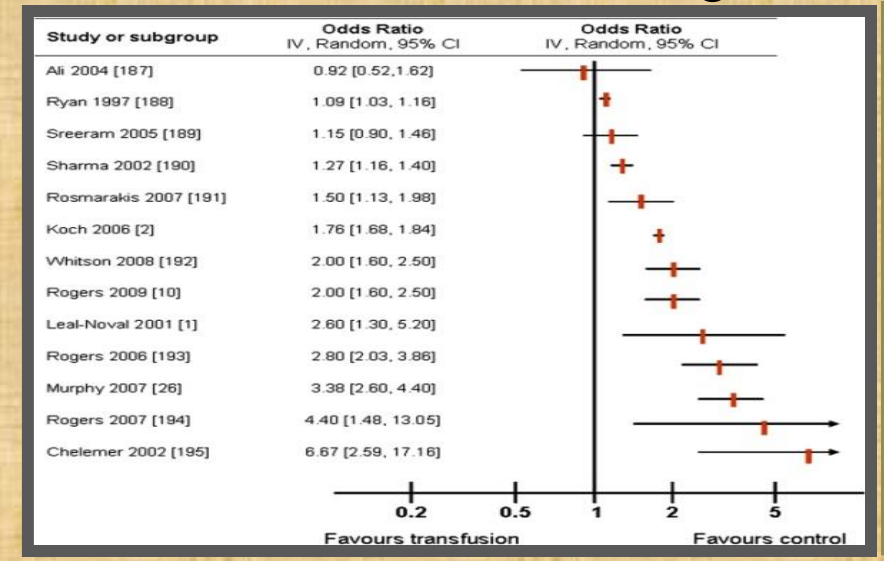
Picture from L-R front row: Jennifer King, Vanessa Lockhart, Nancy Hodgson, Anne Lukian, Derek Bissonnette
L-R middle row: Celena Moody, Dr. Roona Sinha, Dr. Robert Card, Russell Quinn, Wendy Quinn, Micaella Fiacco, Michelle Sims, Tara Schlosser
L-R back row: Daryn Moody, Dr. Kelsey Brose, Jae Won Hur, Aaron Stewart, JoAnn Nilson

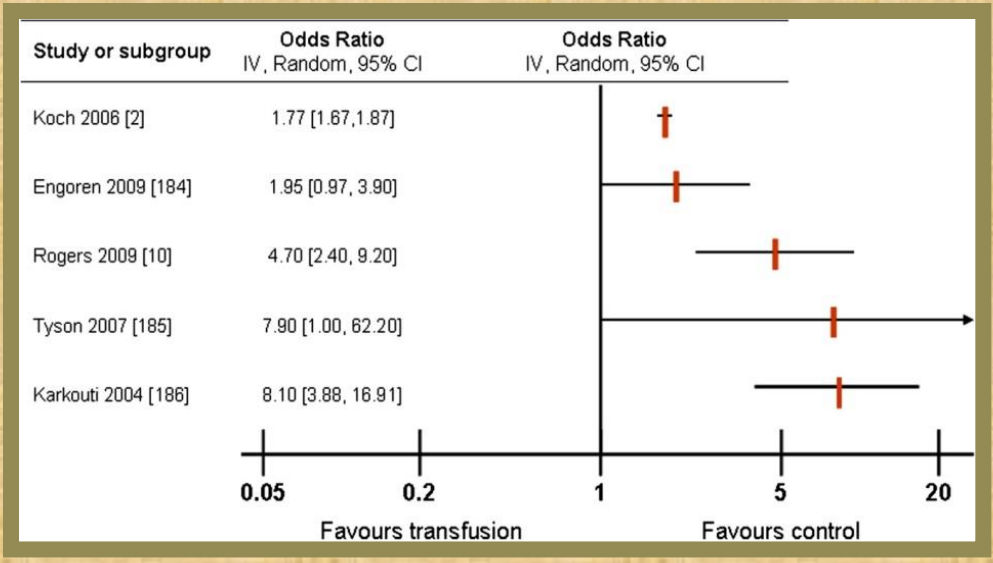


blood

Increasing evidence suggests that blood transfusions during surgery are associated with poorer short & long term outcomes.

effect of RBC transfusion on postoperative infection & mortality (in hospital & 30 day)





Favours Control i.e. no transfusion

•Ranucci M et al: Patient blood management during cardiac surgery: Do we have enough evidence for clinical practice? J Thorac Cardiovasc Surg, 2011; 142:249.e1-32.

Surgenor SD et al. The association of perioperative red blood cell transfusions and decreased long-term survival after cardiac surgery. Anesth Analg 2009;108:1741-1746

Randomized trials showed that lower Hb thresholds are well tolerated in critically ill and cardiac surgical patients, contributing to the trend to tolerate lower Hb and decrease transfusions.

***Hajjar LA et al: JAMA 304:1559, 2010 ; Lacroix J et al: N Engl J Med 356:1609, 2007**

Analysis 1.1. Comparison 1 Blood transfusions, Outcome 1 Patients exposed to blood transfusion (all studies).

Review: Transfusion thresholds and other strategies for guiding allogeneic red blood cell transfusion

Comparison: 1 Blood transfusions

Outcome: 1 Patients exposed to blood transfusion (all studies)

Study or subgroup	Restrictive n/N	Liberal n/N	Risk Ratio M-H,Random,95% CI	Weight	Risk Ratio M-H,Random,95% CI
Blair 1986	5/26	24/24		2.9 %	0.21 [0.10, 0.44]
Bracey 1999	74/212	104/216		7.3 %	0.72 [0.58, 0.91]
Bush 1997	40/50	43/49		7.8 %	0.91 [0.77, 1.08]
Carson 1998	19/42	41/42		6.1 %	0.46 [0.33, 0.65]
Colomo 2008	68/109	95/105		7.9 %	0.69 [0.59, 0.81]
Foss 2009	22/60	44/60		5.8 %	0.50 [0.35, 0.72]
Grover 2005	37/109	46/109		6.1 %	0.80 [0.57, 1.13]
Hebert 1995	18/33	35/36		6.4 %	0.56 [0.41, 0.77]
Hebert 1999	280/418	420/420		8.5 %	0.67 [0.63, 0.72]
Johnson 1992	15/20	18/18		6.9 %	0.76 [0.58, 0.99]
Lacroix 2007	146/320	310/317		8.2 %	0.47 [0.41, 0.53]
Lotke 1999	16/62	65/65		5.3 %	0.26 [0.17, 0.40]
So-Osman 2010	109/299	119/304		7.5 %	0.93 [0.76, 1.14]
Topley 1956	8/12	10/10		5.3 %	0.68 [0.45, 1.04]
Webert 2008	26/29	29/31		8.0 %	0.96 [0.82, 1.12]
Total (95% CI)	**1801**	**1806**		**100.0 %**	**0.63 [0.54, 0.74]**

Total events: 883 (Restrictive), 1403 (Liberal)

Heterogeneity: $Tau^2 = 0.07$; $Chi^2 = 123.82$, df = 14 (P<0.00001); $I^2 = 89\%$

Test for overall effect: Z = 5.79 (P < 0.00001)

0.1 0.2 0.5 1 2 5 10

Favours Restrictive Favours Liberal

Carless et al: Cochrane Reviews, 2010, 2012

Collective impact of these studies has promoted a clinical attitude of tolerance for acute & chronic anemia

Precautionary principle for transfusions:

- Transfuse only when absolutely need to
- Tolerate anemia – restrictive transfusion trigger
- If need to transfuse, give as little as possible; used to be thought that if a patient needed a unit of blood, you might as well give them two, but that paradigm has changed.
- This shift has led to the focus on Patient Blood Management, aimed at using blood transfusion in the most optimum way.

A paradigm shift

"Blood transfusion -- an expensive and potentially hazardous alternative to Patient Blood Management".

pbm@saskhealthauthority.ca

Patient Blood Management Resources

- **Investigation of Iron Deficiency Anemia Algorithm January 13, 2018 March 20, 2018 Download**
- **Pre-Operative Anemia Algorithm January 13, 2018 March 20, 2018 Download**
- **Pre-Operative Hemoglobin Assessment and Optimization Algorithm January 13, 2018 January 13, 2018 Download**
- **RBC Screening Algorithm January 13, 2018 January 13, 2018 Download**
- **RQHR PPO (#290) - Intravenous Iron Therapy January 13, 2018 June 22, 2018 Download**
- **RQHR PPo (#601) - Ordering of Red Blood Cells - Adults January 13, 2018 June 22, 2018 Download**
- **RQHR PPO (#627) - Ordering of Human Fibrinogen Concentrate (RiaSTAP™) June 21, 2018 June 21, 2018 Download**

Anemia: A problem to which transfusion is rarely the answer presentation - January 25, 2017 January 13, 2018 March 20, 2018 Download

Patient Blood Management Presentation - November 22, 2016 January 13, 2018 May 17, 2018 Download

Data Collection

- Two data collections annually

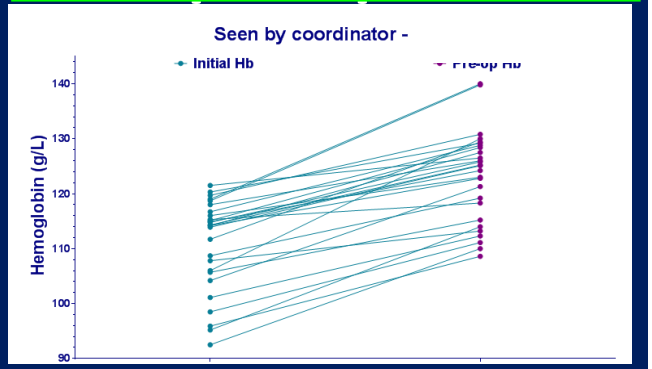
- Targeted Collection – At specific time periods, collect detailed anonymized patient information for a defined number of all consecutive patients admitted for the designated procedures whether seen or not seen (provides a snap shot of transfusion practice at the time)

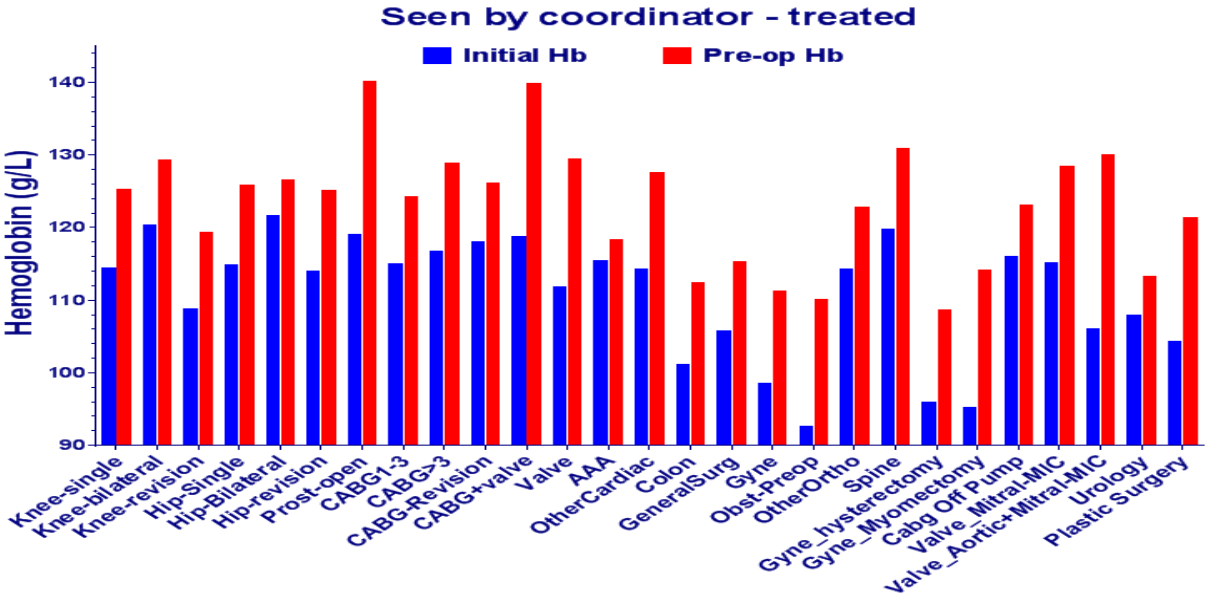
- Non-Targeted collection – Collect on patients seen by the coordinator. Provides information on the coordinator's practices

Difficulties & Pitfalls

- **Emphasis on shorter wait times for surgery**
- Changing scientific evidence: e.g. EPO, Aprotinin, PAD, IV iron
- Costs and accessibility to some patient blood management measures
- Turnover of coordinators, physicians, administrators - reversal of gains
- Can be quite difficult to recruit physician & administrative champions
- Need to understand individual institution's “culture” to successfully introduce change
- Maintaining program momentum in face of competing priorities

Treat pre-op anemia





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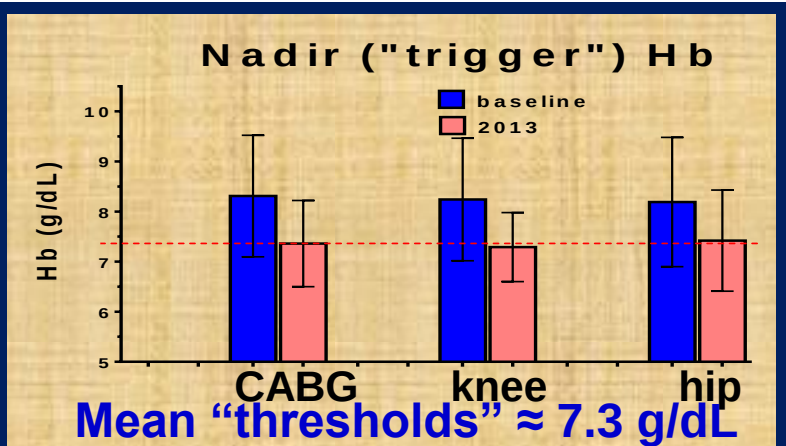
Tolerat values



Mean "thresholds" ≈ 7.3 g/dL

ONTraC
ontario transfusion coordinators

- Transfusion rates are not patient dependent, but are institution (geography) dependent

  (Bennett-Guerrero . JAMA, 304:1568, 2010)

- High-transfusion hospitals and Low-transfusion hospitals

- 30% of the variation surgeon dependent, 70% hospital specific (Jin. Ann Thorac Surg 95:1269, 2013)

- So need to change 'culture' in hospitals

But we know about this, don't we?
So why haven't we changed?

Change is good! YOU go first.

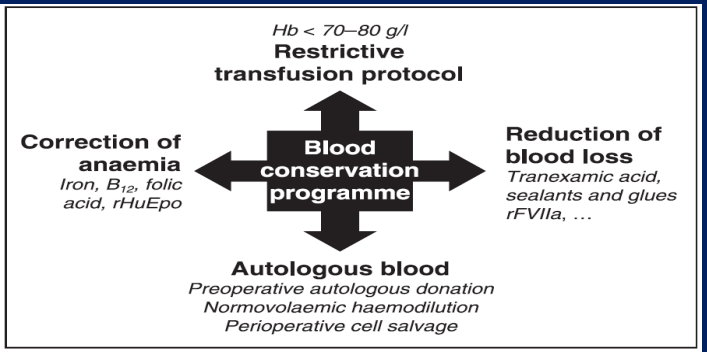
- Transfusion rates are not patient dependent, but are institution (geography) dependent (Bennett-Guerrero et al. JAMA, 304:1568, 2010)
- High transfusion hospital: 2-fold odds of receiving transfusion vs average transfusion hospital

  Low transfusion hospital: 50% lower odds of transfusion vs average transfusion hospital (Qian et al. Ann Surg, 257:266, 2013)
- 30% of the variation surgeon dependent, 70% hospital specific (Jin et al. Ann Thorac Surg 95:1269, 2013)

- So need to change 'culture' in hospitals

2016 Effectiveness of multimodal BC (% transfused)

	knee	hip	CABG+valve	Valve
Any BC X 0	10.0%	…	…	…
Any BC X 1	2.6%	4.6%	57.3%	37.1%
Any BC X 2	1.0%	1.4%	62.2%	42.7%
Any BC X ≥3	3.6%	1.7%	45.0 %	20.1%



Transfusion rates -- 2016

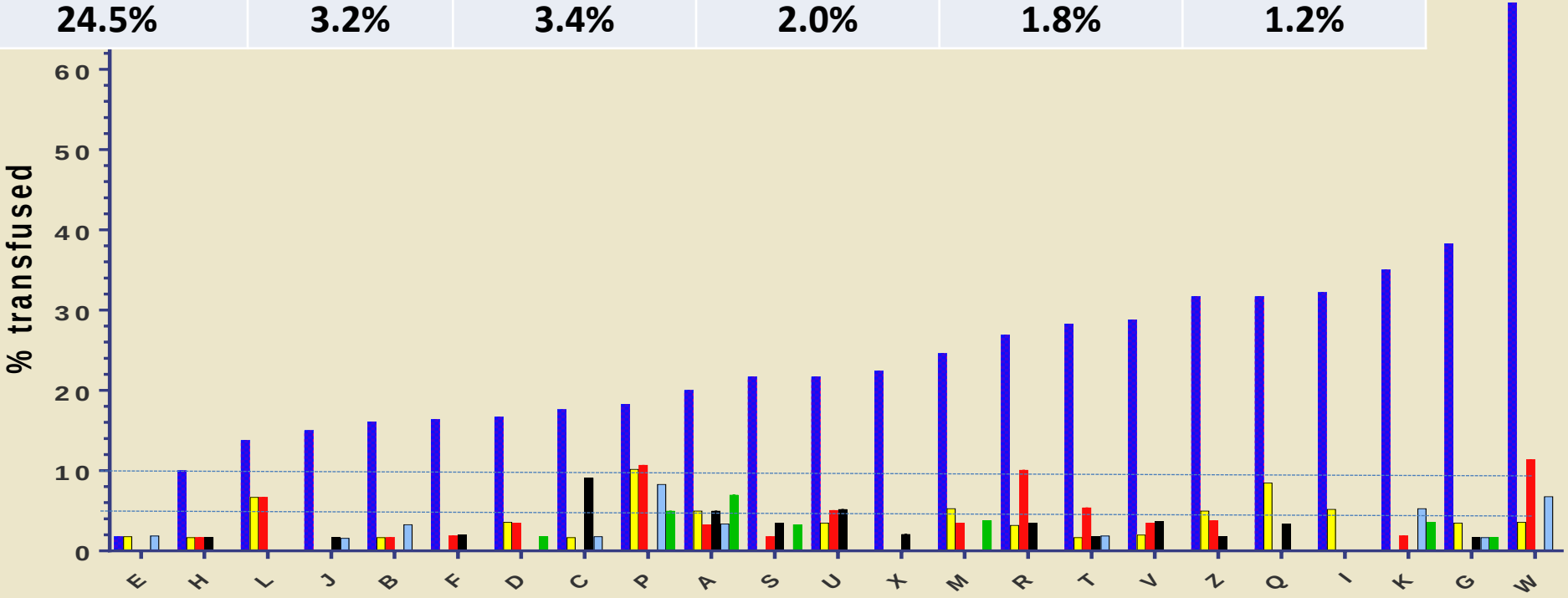
	Knee
Any BC - no	10.0% (N=20)
Any BC - yes	1.6% (N=1102)

Effect of lead time on transfusion rates

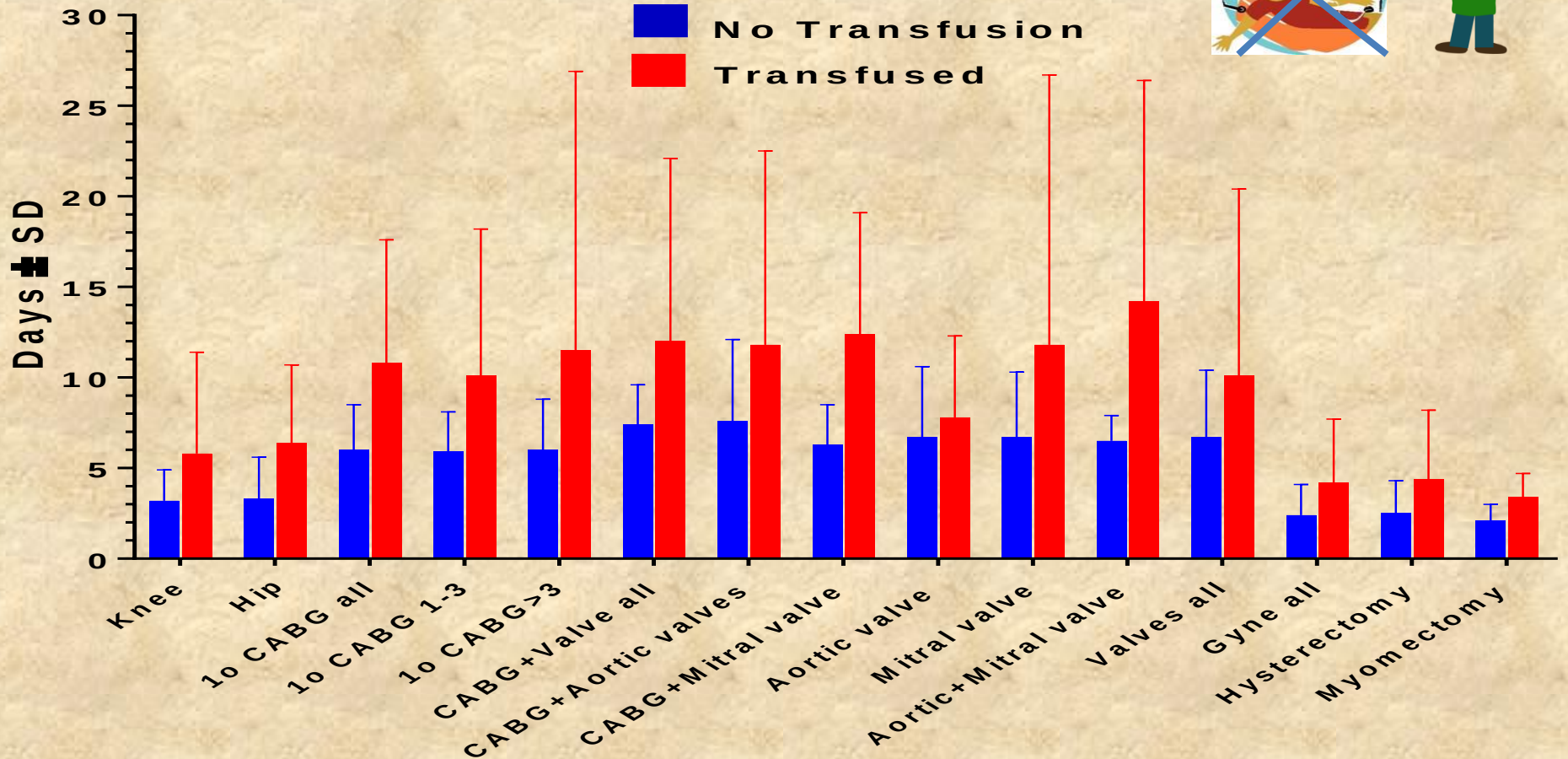
2016	Percent Transfused					
Lead	Knee	Hip	Valves	CABG+Valve	CABG	Gyne
< 7 d	4.0%	3.7%	27.3 %	58.2 %	23.9 %	11.5%
7-14 d	1.0%	3.6%	17.8 %	53.9 %	26.3 %	6.5%
15-21 d	1.9%	1.9%	22.2 %	54.8 %	22.8 %	5.3%
> 21 d	1.1%	1.0%	32.8 %	46.3 %	32.6 %	3.3%

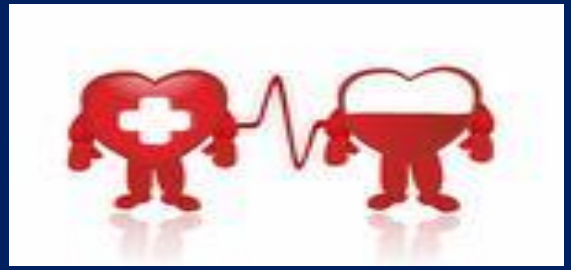
Inter-institutional variability (% transfused)

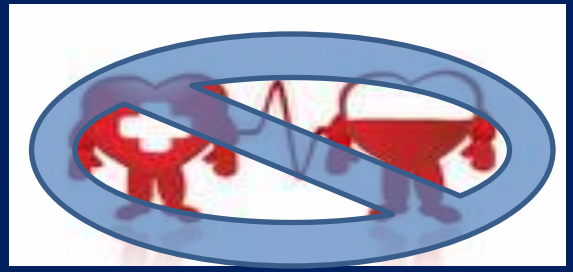
Knee					
Baseline	2013	2014	2015	2016	2017
24.5%	3.2%	3.4%	2.0%	1.8%	1.2%



Length of stay







Objectives

To discuss:

- Why a change is needed in transfusion
- The ONTraC program in Patient Blood Management (PBM)
- ONTraC: Problems and solutions

Anemia often accepted as a normal part of doing business

- 30-70% of patients come to surgery anemic
- Long tradition of accepting anemia as a relatively harmless problem that can be corrected easily with transfusion; for many this remains the default position
- BUT anemia is an independent risk of morbidity & mortality (regardless of level of hemoglobin)
- Anemia increases cost of delivering health care by > 50%.

Isbister J, Shander A. Transfus Med Rev, 2011; 25:89-101

Nissenson AR et al. Economic burden of anemia in an insured population. J Manag Care Pharm, 2005; 11:565-74

We transfuse RBC to restore adequate tissue O_2 delivery, but haven't had good methods to measure tissue O_2 tension accurately after.

Anemia is common: 30% patients preop

In the ICU, most patients anemic at time of admission.

Hb typically declines by at least 0.5 g/dL/day in first 3 d of ICU stay. Continues to decline if sepsis/severe illness.

These patients particularly may be at risk from anemia (cardiovascular, respiratory, metabolic compromise).

Etiology of anemia multifactorial:

phlebotomy, GI bleeding, coagulopathy, blood loss from vascular procedures, renal failure, nutritional deficiencies, marrow suppression, impaired erythropoietin response, etc

What is the cost of transfusion?

Direct and indirect costs: Product; Tubing; Supplies, Labour, Transport, Lab testing, Hospital Blood Bank (crossmatching, etc), Clerical; Nursing

Ontario: cost per unit; cost to province

Further resource use in increased ICU & hospital LOS, Rx complications, etc with a large multicentre observational study → transfusion can increase hospitalization costs by 40% & estimated total cost at **≈$1400/unit**.

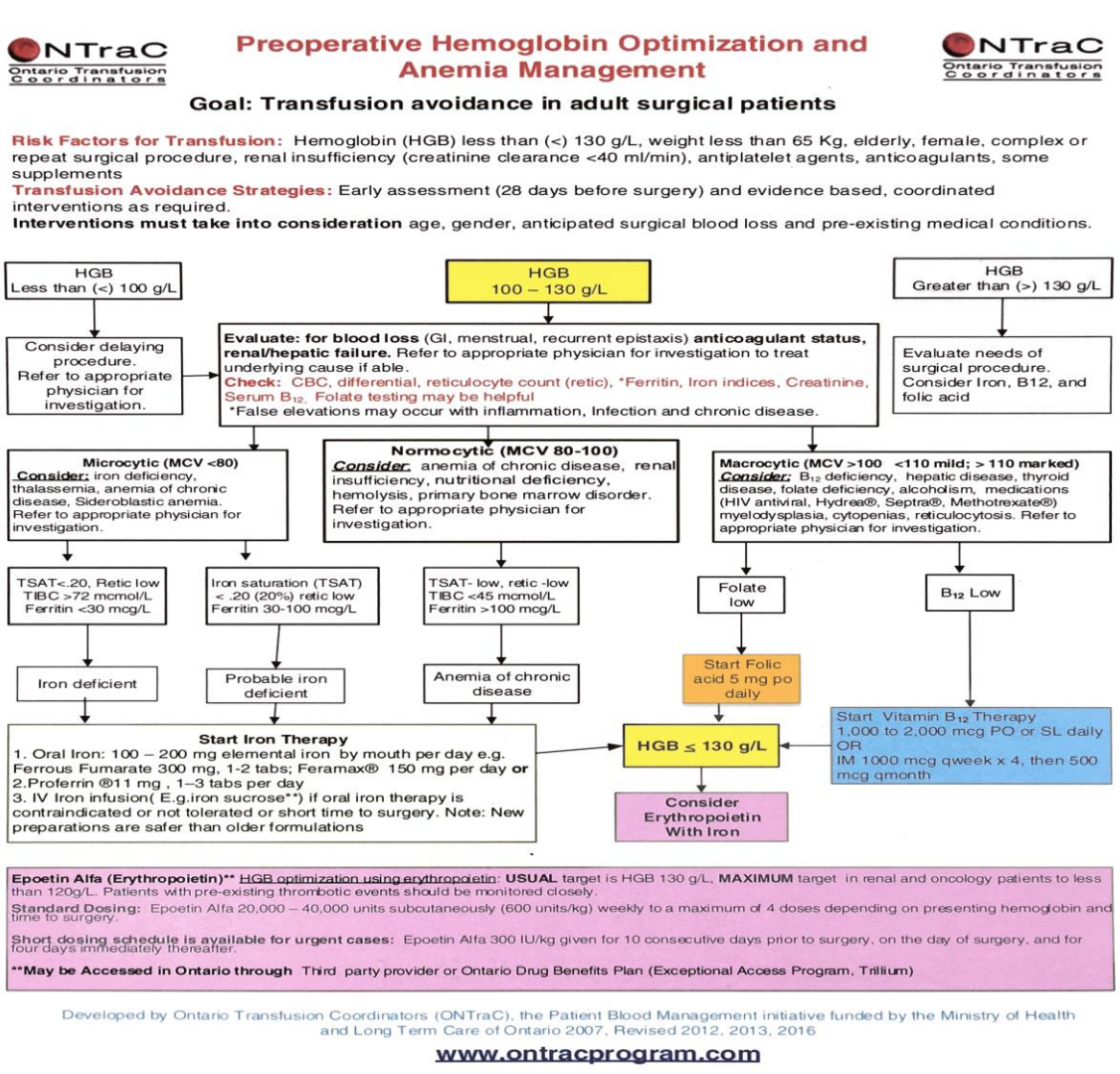
Shander A, Best Pract Res Clin Anaesthesiol 21:271, 2007; Shander et al, Transfusion 50:753, 2010

Supply vs Demand

As Boomers age, potential demand grows exponentially

Age	<40	40-70	>70 years
Use: Units RBC/1000 pop^{n}	5	40	200

ONTraC Algorithm for Preoperative Hemoglobin Optimization and Anemia Management



ONTraC Ontario Transfusion Coordinators

Preoperative Hemoglobin Optimization and Anemia Management

ONTraC Ontario Transfusion Coordinators

Goal: Transfusion avoidance in adult surgical patients

Risk Factors for Transfusion: Hemoglobin (HGB) less than (<) 130 g/L, weight less than 65 Kg, elderly, female, complex or repeat surgical procedure, renal insufficiency (creatinine clearance <40 ml/min), antiplatelet agents, anticoagulants, some supplements

Transfusion Avoidance Strategies: Early assessment (28 days before surgery) and evidence based, coordinated interventions as required.

Interventions must take into consideration age, gender, anticipated surgical blood loss and pre-existing medical conditions.

HGB Less than (<) 100 g/L

Consider delaying procedure. Refer to appropriate physician for investigation.

HGB 100 – 130 g/L

Evaluate: for blood loss (GI, menstrual, recurrent epistaxis) **anticoagulant status, renal/hepatic failure.** Refer to appropriate physician for investigation to treat underlying cause if able.

Check: CBC, differential, reticulocyte count (retic), *Ferritin, Iron indices, Creatinine, Serum B_{12}, Folate testing may be helpful

*False elevations may occur with inflammation, Infection and chronic disease.

HGB Greater than (>) 130 g/L

Evaluate needs of surgical procedure. Consider Iron, B12, and folic acid

Microcytic (MCV <80)

Consider: iron deficiency, thalassemia, anemia of chronic disease, Sideroblastic anemia. Refer to appropriate physician for investigation.

Normocytic (MCV 80-100)

Consider: anemia of chronic disease, renal insufficiency, nutritional deficiency, hemolysis, primary bone marrow disorder. Refer to appropriate physician for investigation.

Macrocytic (MCV >100 <110 mild; > 110 marked)

Consider: B_{12} deficiency, hepatic disease, thyroid disease, folate deficiency, alcoholism, medications (HIV antiviral, Hydrea®, Septra®, Methotrexate®) myelodysplasia, cytopenias, reticulocytosis. Refer to appropriate physician for investigation.

TSAT<.20, Retic low TIBC >72 mcmol/L Ferritin <30 mcg/L

Iron deficient

Iron saturation (TSAT) < .20 (20%) retic low Ferritin 30-100 mcg/L

Probable iron deficient

TSAT- low, retic -low TIBC <45 mcmol/L Ferritin >100 mcg/L

Anemia of chronic disease

Folate low

Start Folic acid 5 mg po daily

B_{12} Low

Start Vitamin B_{12} Therapy 1,000 to 2,000 mcg PO or SL daily OR IM 1000 mcg qweek x 4, then 500 mcg qmonth

Start Iron Therapy

1. Oral Iron: 100 – 200 mg elemental iron by mouth per day e.g. Ferrous Fumarate 300 mg, 1-2 tabs; Feramax® 150 mg per day **or**
2. Proferrin ®11 mg , 1–3 tabs per day
3. IV Iron infusion(E.g.iron sucrose**) if oral iron therapy is contraindicated or not tolerated or short time to surgery. Note: New preparations are safer than older formulations

HGB ≤ 130 g/L

Consider Erythropoietin With Iron

Epoetin Alfa (Erythropoietin)** HGB optimization using erythropoietin: **USUAL** target is HGB 130 g/L, **MAXIMUM** target in renal and oncology patients to less than 120g/L. Patients with pre-existing thrombotic events should be monitored closely.

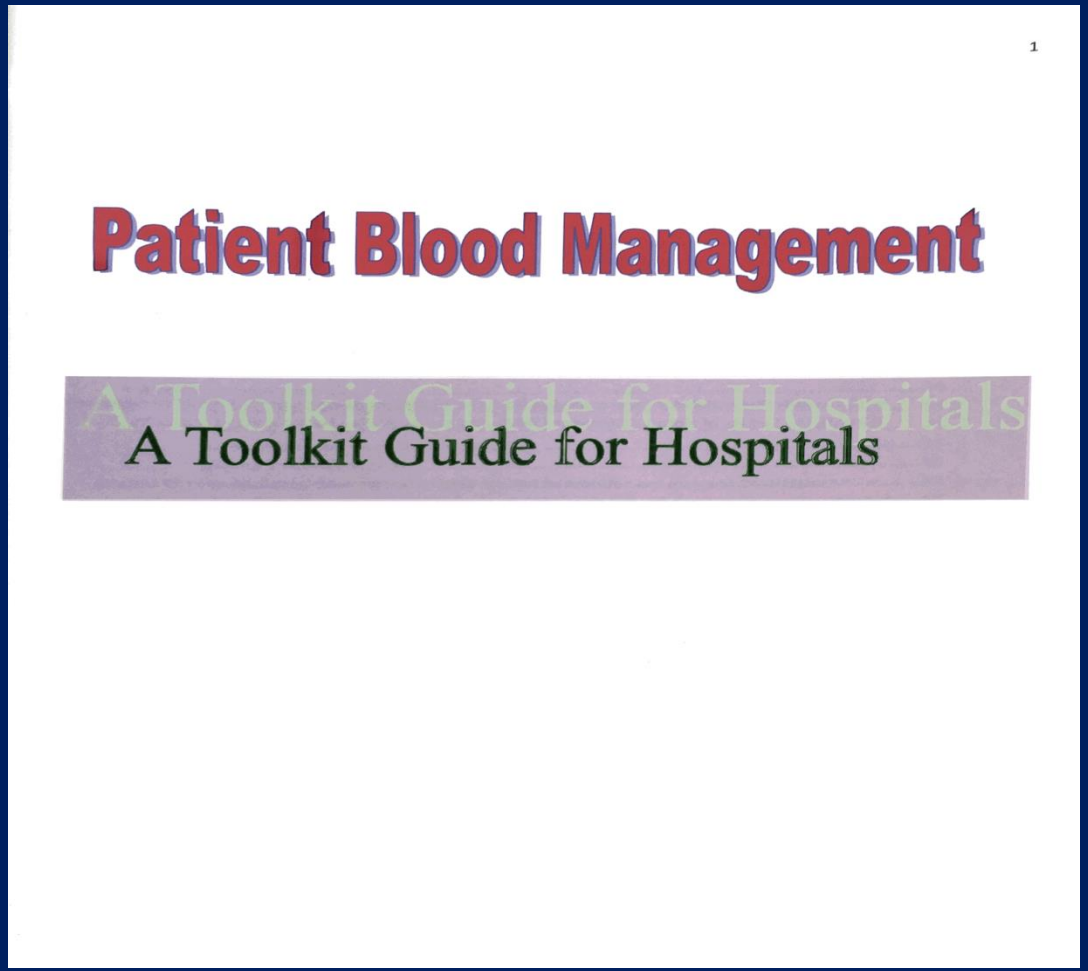
Standard Dosing: Epoetin Alfa 20,000 – 40,000 units subcutaneously (600 units/kg) weekly to a maximum of 4 doses depending on presenting hemoglobin and time to surgery.

Short dosing schedule is available for urgent cases: Epoetin Alfa 300 IU/kg given for 10 consecutive days prior to surgery, on the day of surgery, and for four days immediately thereafter.

****May be Accessed in Ontario through** Third party provider or Ontario Drug Benefits Plan (Exceptional Access Program, Trillium)

Developed by Ontario Transfusion Coordinators (ONTraC), the Patient Blood Management initiative funded by the Ministry of Health and Long Term Care of Ontario 2007, Revised 2012, 2013, 2016

www.ontracprogram.com



Toolkit

Available on the ONTraC website:

www.ontracprogram.com

ONTraC
ontario transfusion coordinators

Lessons Learned

- Need senior hospital leadership support
- Cardinal to success is a local champion - a well-respected physician who will work closely with the Coordinators developing new procedures/protocols and presenting them to the staff.
- Teamwork and communication are paramount
- Need to develop algorithms & pamphlets relevant for their institution; tailor to institution realities as much as possible; not “one size fits all”

Data Collection

- Aggregate data and site-specific data
- Data is used as a driver for change – “buy in”
- Coordinators to share results with key people in their organizations and their transfusion committees
- Can be used to benchmark against other sites
- Reported to the MOHLTC

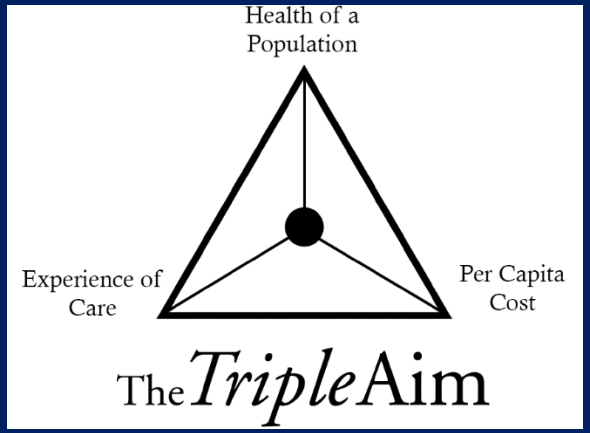
Outcomes measured

- Infections
- Length of stay
- Mortality
- Cost savings

Lessons Learned

- Need senior hospital leadership support
- Cardinal to success is a local champion - a well-respected physician who will work closely with the Coordinators developing new procedures/protocols and presenting them to the staff.
- Teamwork and communication are paramount
- Need to develop algorithms & pamphlets relevant for their institution; tailor to institution realities as much as possible; not “one size fits all”
- Assess patient early and treat pre-op anemia
- To change practice needs data on current transfusion rates & practices – get ‘buy-in’ by sharing comparative data - no-one likes to be worse

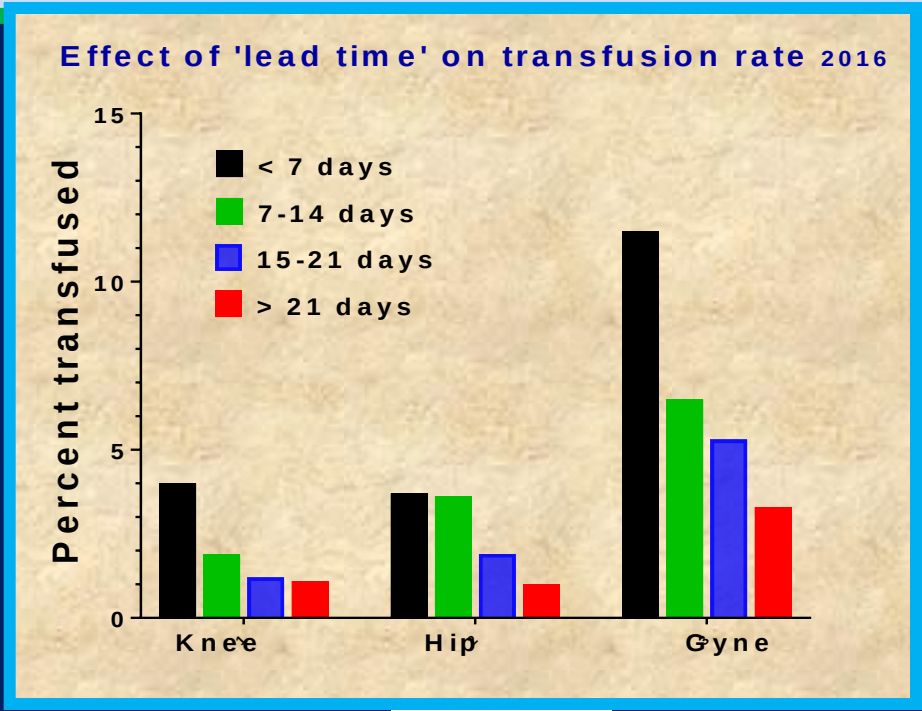
- start with more
- lose less
- save/give back what you can



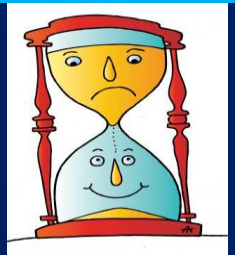
Lead time:

- A lead time at least 3-4 weeks prior to surgery recommended to allow sufficient time to diagnose & optimize treatment of anemia based on the identified cause.

Lead time to optimize preoperative treatment of anemia



See/refer patients **as early as possible**



But only 60% arthroplasties & 40% CABGs **seen > 15 days prior to surgery**

Dr. John Big Boss
President & Chief Executive Officer
City Hospital
South Porcupine, Ontario

ONTraC Participation Agreement, Fiscal Year 2015-2016

Dear CEO:

We are pleased to inform you that the Ministry of Health continues to fund and support a provincial Patient Blood Management (PBM) program through placement of PBM Coordinators in Ontario Hospitals.

Through this program, the PBM coordinators assist and facilitate measures in avoidance of inappropriate blood transfusions in the designated surgical procedures … successful in reducing transfusion rates … improved patient care & safety, reduction in postoperative infections and reduced length-of-stay in non-transfused patients … significant cost savings to the blood system and hospitals.

Financials – how much $$ will be given; what it is to be used for; unspent funds; required financial statements from sites (quarterly & year-end, signed by CFO).

BUT !!!! → → → →

Pre-op Optimization

- Oral Iron
- ESAs
- IV iron
- Delay surgery if needed for optimization

pbm@saskhealthauthority.ca (Patient Blood Management Resources)

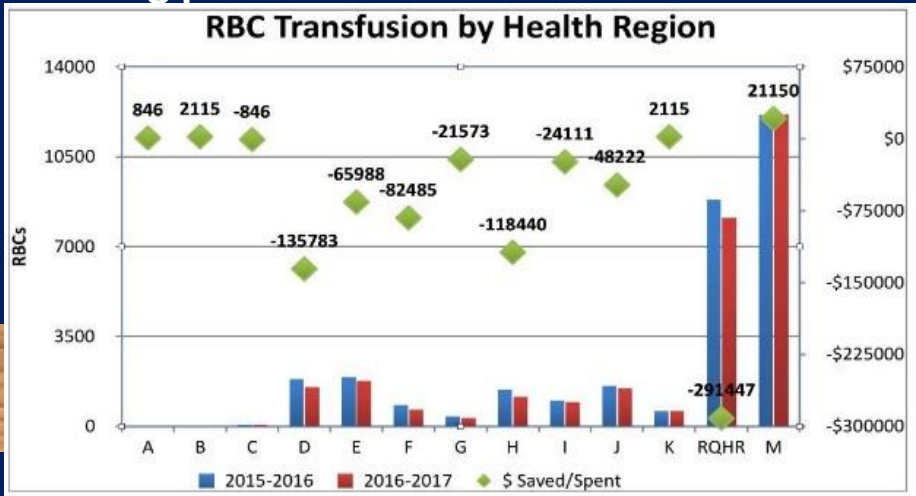
- Investigation of Iron Deficiency Anemia Algorithm January 13, 2018
- Pre-Operative Anemia Algorithm January 13, 2018
- Pre-Operative Hemoglobin Assessment and Optimization Algorithm January 13, 2018
- RBC Screening Algorithm January 13, 2018
- RQHR PPO (#290) - Intravenous Iron Therapy January 13, 2018
- RQHR PPo (#601) - Ordering of Red Blood Cells - Adults January 13, 2018
- RQHR PPO (#627) - Ordering of Human Fibrinogen Concentrate (RiaSTAP™) June 21, 2018

Anemia: A problem to which transfusion is rarely the answer. Presentation – Jan 25, 2017 Jan 13, 2018

Patient Blood Management. Presentation - November 22, 2016 January 13, 2018 May 17, 2018

Transfusion Article on Improved Blood Usage (Ryan Lett)) 26-Oct-2017

- "Last year in Saskatchewan, transfusion volumes ↓ by 1783 units of RBC, especially in Regina Qu'Appelle Health Region with a ↓ of 689 units or a 7.8% reduction year over year.
- … direct cost savings of $291,000 on price of red cells & indirect cost savings of $964,600 in associated lab & facility costs.
- …. tremendous uptake amongst all staff in using appropriate transfusion guidelines, …. the majority of clinicians are choosing wisely and ordering single unit transfusions … shift towards using intravenous iron in stable, non-bleeding patients."

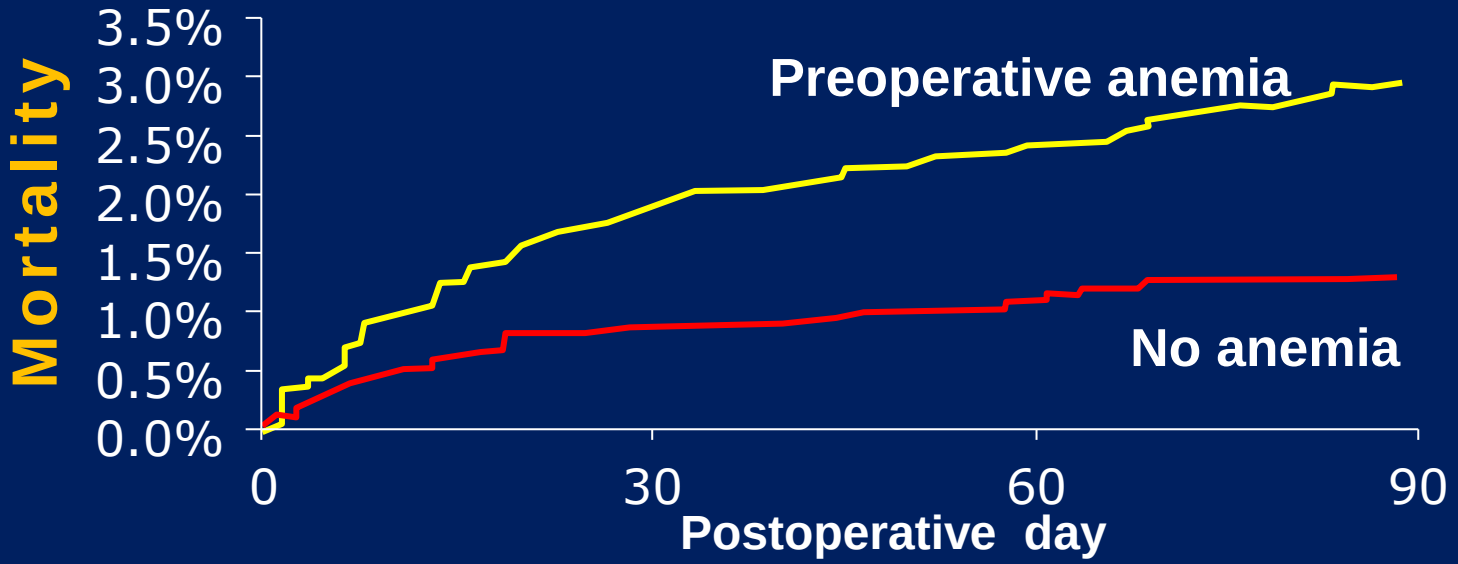


The 2018 Transfusion Medicine Symposium

Friday, October 26, 2018 @ 0730 – 1600, Regina General Hosp

Risk associated with preoperative anemia in noncardiac surgery : A single-center cohort study

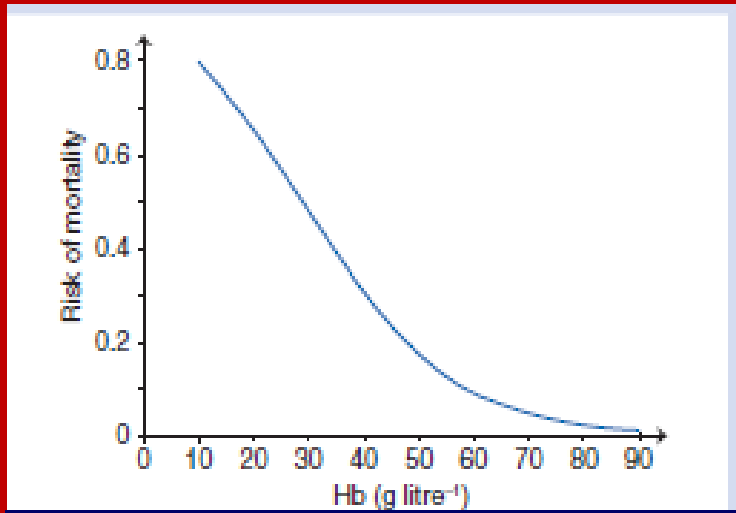
- Retrospective (n= 7,759) 2003 - 2006
- **Preoperative anemia – 5-fold ↑ in odds of post op mortality**
- After adjustment for major confounders, anemia still associated with ↑ mortality



Beattie SW et al. Anesthesiology. 2009; 110:574-81.

Establishing a definitive “hemoglobin transfusion threshold" has proven difficult, but studies have shown that mortality increases in patients with hemoglobin [ ] below 5 g/dL (50 g/L).

For healthy individuals, the threshold may be even lower, but co-morbid conditions such as trauma, sepsis and cardiovascular disease may influence this threshold.



Estimated risk of death at various Hb concentrations in non-cardiac surgical patients.

Beattie WS, Anesthesiology, 2009
Shander A, Br J Anaesth, 2011
Carson JL, Lancet 1988, 1996

Hare GMT, Freedman J, Mazer CD: Risks of anemia and related management strategies: can perioperative blood management improve patient safety? **Can J Anaesth 60:168-175, 2013**.

Lowering the transfusion trigger.

- Many hospitals are steering towards a hemoglobin trigger for transfusion of 7 g/dL regardless of comorbidities.
- Some institutions use 7 g/dL for ‘healthy’ patients and 8 g/dL for patients with cardiorespiratory problems.
- The main point is to avoid transfusing ‘healthy’ patients based on hemoglobin alone.

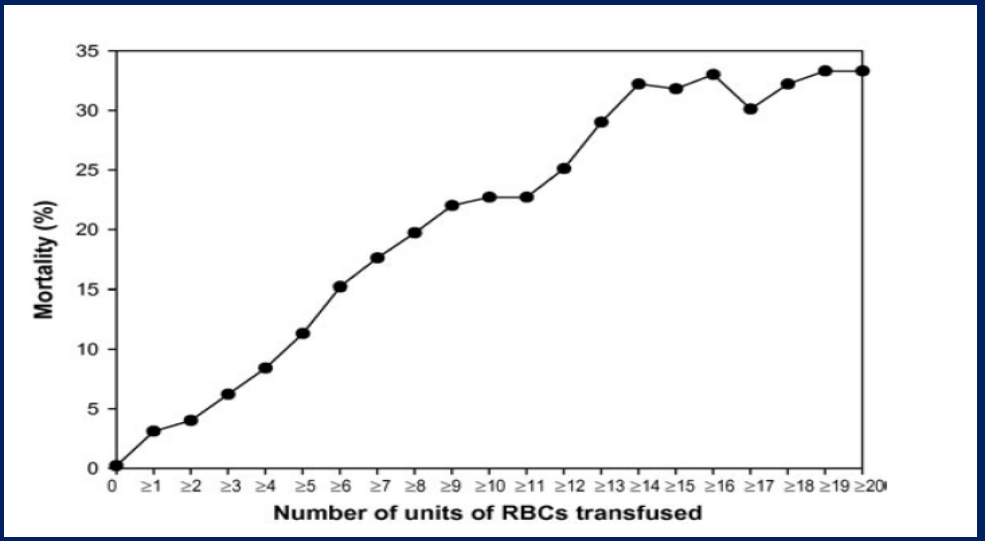
Variability in transfusion rates:

80,000, on-pump CABG, 408 hospitals: RBC rate ranged from 7.8 - 98.8%

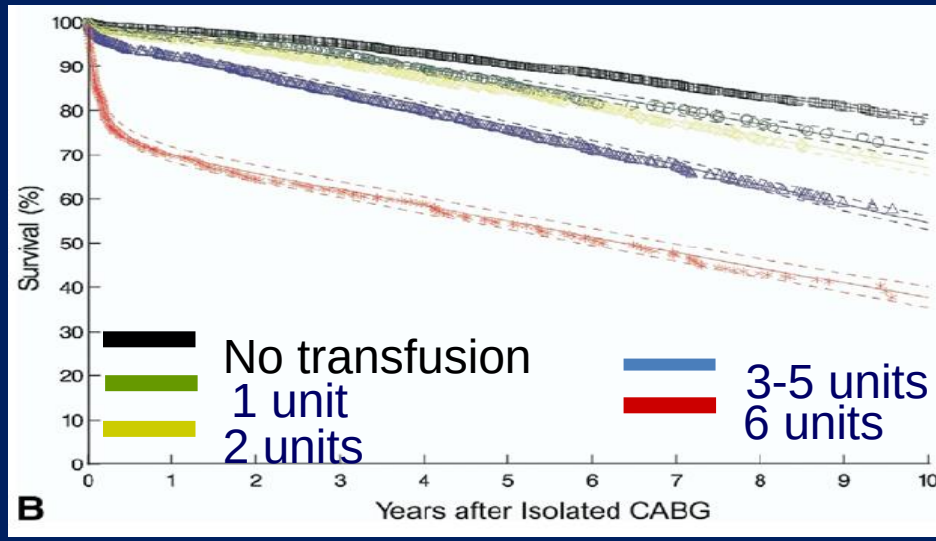
Bennett-Guerrero et al. JAMA 304:1568-1575, 2010.

Why Do We Need to Change Transfusion Practice?

Transfusion and Mortality (dose dependent)



Karkouti et al. Transfusion 2004; 44:1453-1462.



Koch CG et al. Ann Thorac Surg. 2006; 81:1650

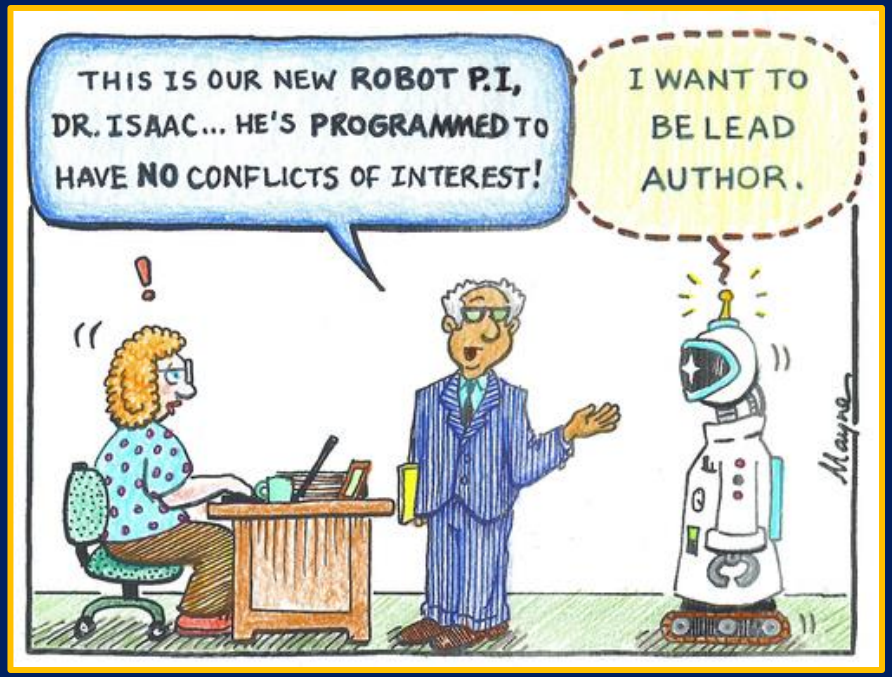
Upto 60% of transfusions are unnecessary or inappropriate: given to stable non-bleeding patients.

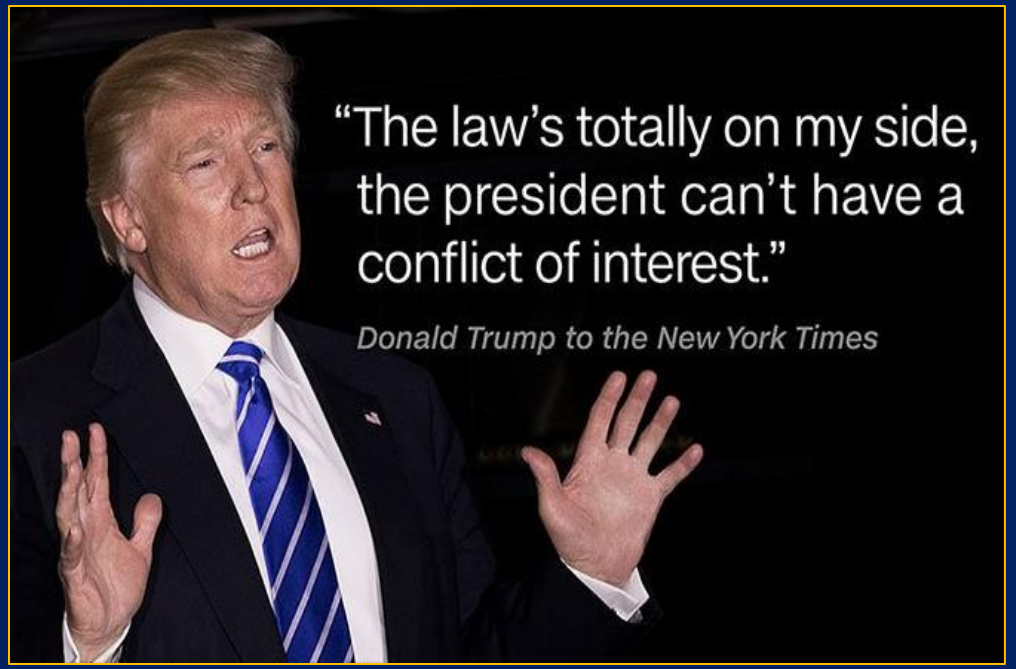
Shander A, Goodnough LT: Pharmacotherapy. 2007; 27(9 Pt 2):57S-68S

Inter-instutional variability in management approaches

A standardized approach for detecting, evaluating & managing anemia in the preop setting is an important aspect of an effective PBM program

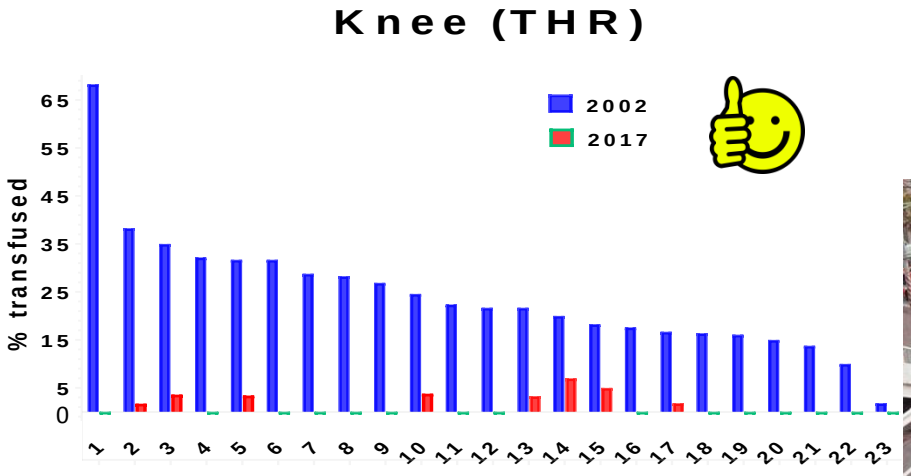
I have no conflicts of interest

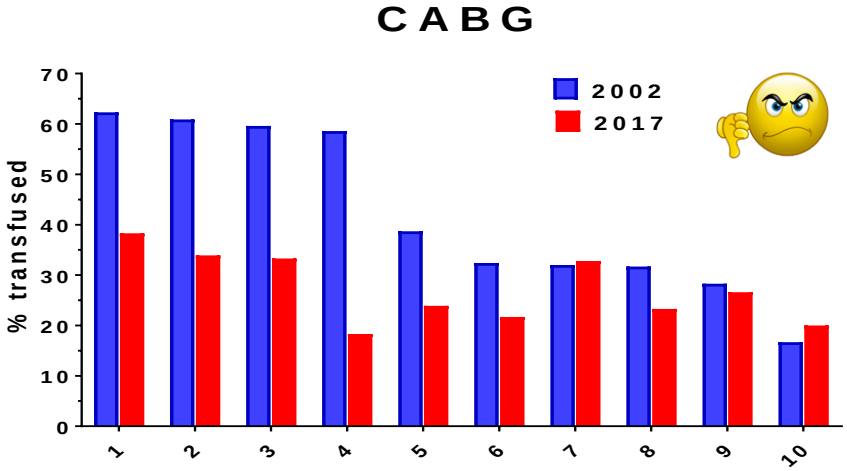




Transfusion Medicine – time for a change

Inter-instutional variability





A standardized approach for detecting, evaluating & managing anemia in the pre-op setting is an important aspect of an effective PBM program