Economic Considerations on Patient Blood Management

Submitted by: University of Western Australia
Economic Considerations on Patient Blood Management

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Referrals:

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<td>“Supply”</td>
<td>1.090 million</td>
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<td>“Demand”</td>
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<td>“Blood Supply”</td>
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<td>“Blood Demand”</td>
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<td>“U.S. Blood Supply”</td>
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<td>“European Blood Supply”</td>
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<td>“Asian Blood Supply”</td>
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<td>“Asian Blood Demand”</td>
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Program-Referrals:

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<tr>
<td>“Supply”</td>
<td>28</td>
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<tr>
<td>“Demand”</td>
<td>12</td>
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</tbody>
</table>
Blood Supply vs. Blood Demand

Why the supply focus?
Quotes from this Program

Overall perception:

DEMAND for blood is not in question, beyond control and must be met...
Quotes from this Program

• ... the [ ] supply chain ... may fail to ensure on-time access to safe blood.

• Many challenges obstruct the path ... to improve the safety and sustainability of the blood supply chains.

• APEC approved funding to fully explore the safety and sustainability of blood supply chains ...

Overall focus: Blood SUPPLY must be secured by all means.

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A Seller’s Market: Excess Demand for Blood

Scenario derived from European blood market data:
Price increase by 100% is associated with a demand reduction of only 30%

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The use of NAT for HCV and HIV is estimated to cost between 5.8 million US-$ and 8.4 million US-$ per QALY.

Jackson BR, Busch MP, Stramer SL, Aubouchon JP. The cost-effectiveness of NAT for HIV, HCV, and HBV in whole blood donations. Transfusion 2003;43

Compared to a threshold of $50,000/QALY in public health decision making: 116–168 times higher!
Cost of Blood Safety Measures

“... blood safety interventions ... could be said to be stealing monetary resources from health interventions that would generate more health in the population or value for money”


“... public health policy makers believe that blood safety trumps any economic consideration... this gross misallocation of funds is placing patients unnecessarily at risk of mortality”

Cost-effective Ride to the Airport: Truck vs. Taxi

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Demand for donor blood must be significantly reduced by managing the patient’s own blood, thus leading to improved outcomes.

Supply of blood must be managed and controlled, but not at any cost.
The Rationale of Patient Blood Management

How?

By addressing the key factors leading to allogeneic red blood cell transfusions

Anaemia and ID

BEHAVIOR BASED

TRANSFUSION MEDICINE

Blood Loss
Blood use in elective surgery: the Austrian benchmark study

Hans Gombotz, Peter H. Rehak, Aryeh Shander, and Axel Hofmann

97.4% of all transfusions could have been predicted by:
1. Level of anemia prior to surgery
2. Volume of perioperative blood loss
3. Transfusion trigger
Anemia independently associated with increased:
  • morbidity
  • hospital length of stay
  • Mortality
  • likelihood of transfusion (2-9 fold)

Mussallam KM et al. Lancet 2011
Spahn DR. Anesthesiology 2010; 113(2) 1-14
Beattie WS, et al Anesthesiology 2009; 110(3) 574-81
Shander A. Am J Med 2004; 116(7A) 58S-69S
Bleeding associated with increased
- Morbidity
- ICU and hospital length of stay
- Mortality
  - Elective & emergency surgery ~0.1%
  - Subgroups:
    - Vascular 5-8%
    - Up to 20% with severe bleeding
    - Major organ damage 30-40%

Causes
- On average 75 - 90% local surgical interruption or vessel interruption
- 10-25% acquired or congenital coagulopathy

Shander A. Surgery 2007
Vivacqua et al Ann Thorac Surg 2011
Christensen et al J Thorac Cardiovasc Surg 2009

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RBC transfusion independently associated in a dose-dependent relationship with increased:

• Morbidity
• ALOS
• Mortality

Parsons J et al. Crit Care 2013
Horvath K et al. Ann Thorac Surg 2013
Stone GW et al. Am Heart J  2012
Glance L et al. Anesthesiol 2011
Haijar LA et al. JAMA  2010
Beattie WA et al. Anesthesiology 2009
Chaiwat O et al. Anesthesiology 2009
Surgenor SD, et al Circulation 2006
Malone DL et al. J Trauma 2003
## Reported adverse outcomes associated with transfusion

<table>
<thead>
<tr>
<th>Infection (non-TT)</th>
<th>Thromboembolism (arterial, venous)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septicemia</td>
<td>Diminished postop functional recovery</td>
</tr>
<tr>
<td>Delayed wound healing</td>
<td>Bleeding requiring re-operation</td>
</tr>
<tr>
<td>TRALI</td>
<td>Cancer recurrence</td>
</tr>
<tr>
<td>MOF</td>
<td>Increased mortality</td>
</tr>
<tr>
<td>SIRS</td>
<td>Increased admission to ICU</td>
</tr>
<tr>
<td>ARDS</td>
<td>Prolonged mechanical ventilation</td>
</tr>
<tr>
<td>Vasospasm</td>
<td>Increased ICU length of stay</td>
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<tr>
<td>Low-output heart failure</td>
<td>Increased hospital length of stay</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>Increased hospital readmission</td>
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<tr>
<td>Cardiac arrest</td>
<td></td>
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<tr>
<td>Renal failure</td>
<td></td>
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<tr>
<td>Stroke</td>
<td></td>
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<tr>
<td>Myocardial infarction</td>
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</table>

Thomson A. et al. *Patient blood management - a new paradigm for transfusion medicine?*  
*ISBT Science Series. 2009;4(n2):423-35*
Anemia & Iron Deficiency

Triad of Independent Risk Factors for Adverse Outcomes

Anemia & Iron Deficiency

Induces or exacerbates anemia

Blood Loss & Bleeding

Increases rebleeding risk

Transfusion

Triggers transfusion


Restellini S, AP&T 2012

Hearnshaw SA, et al Aliment Pharmacol Ther 2010

Cost Associated with the Triad of Adverse Outcomes
• First study to assess clinical and health outcomes associated with blood product transfusion across the full spectrum of procedures and clinical conditions in hospitalised patients
• US Nationwide Inpatient Sample (NIS) Database to conduct a retrospective cohort study of all hospitalisations in the US in 2004 (n=38.66 million) to assess in-hospital outcomes associated with blood transfusion.

• Of the 38.66 million admissions 5.8% (2.33 million) were transfused blood products

• After adjustment for age, gender, comorbidities, admission type or DRG transfusion was associated with:
  – 1.7 increased odds of death (P<0.0001)
  – 1.9 increased odds of infection (P<0.0001)
  – 2.5 days longer LOS
  – $17,194 higher charges (P<0.0001)
  – \$40.06 billion in extra charges for transfused patients

Morton et al 2010
Manila 10-2014
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  – 2.5 days longer LOS
  – $17,194 higher charges (P<0.0001)

  → **$57 billion** in extra charges for transfused patients (2013 dollars, Medical Services CPI adjusted)

Morton et al 2010

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Coping with the Triad
Triad of Independent Risk Factors for Adverse Outcomes

Anemia & Iron Deficiency

- Induces or exacerbates anemia
- Triggers transfusion
- Increases rebleeding risk

Blood Loss & Bleeding

Transfusion

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Optimise red cell mass
Minimise blood loss & bleeding
Harness & optimise physiological reserve of anaemia

1st Pillar
Anemia, Iron Deficiency

2nd Pillar
Blood Loss & Bleeding

3rd Pillar
Harness & optimisation of anaemia

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1st Pillar: Optimise red cell mass

2nd Pillar: Minimise blood loss & bleeding

3rd Pillar: Harness & optimise physiological reserve of anaemia

Perioperative multidisciplinary multimodal patient-specific team approach
Perioperative multidisciplinary multimodal patient-specific team approach

1st Pillar
Optimise red cell mass
- Detect anaemia
- Identify underlying disorder(s) causing anaemia
- Manage disorder(s)
- Refer for further evaluation if necessary
- Treat suboptimal iron stores/iron deficiency/anaemia of chronic disease/iron-restricted erythropoiesis
- Treat other haematologic deficiencies
- Note: Anaemia is a contraindication for elective surgery

PREOP

INTRAOP
- Time surgery with haematological optimisation

POSTOP
- Optimise erythropoiesis
- Be aware of drug interactions that can increase anaemia

2nd Pillar
Minimise blood loss & bleeding
- Identify and manage bleeding risk
- Minimise iatrogenic blood loss
- Procedure planning and rehearsal

- Meticulous haemostasis and surgical techniques
- Blood-sparing surgical devices
- Anaesthetic blood conserving strategies
- Autologous blood options
- Maintain normothermia
- Pharmacological/haemostatic agents

- Vigilant monitoring and management of post-operative bleeding
- Avoid secondary haemorrhage
- Rapid warming / maintain normothermia (unless hypothermia specifically indicated)
- Autologous blood salvage
- Minimise iatrogenic blood loss
- Haemostasis/anticoagulation management
- Prophylaxis of upper GI haemorrhage
- Avoid/treat infections promptly
- Be aware of adverse effects of medication

3rd Pillar
Harness & optimise physiological reserve of anaemia
- Assess/optimise patient's physiological reserve and risk factors
- Compare estimated blood loss with patient-specific tolerable blood loss
- Formulate patient-specific management plan using appropriate blood conservation modalities to minimise blood loss, optimise red cell mass and manage anaemia

- Optimise cardiac output
- Optimise ventilation and oxygenation

- Optimise anaemia reserve
- Maximise oxygen delivery
- Minimise oxygen consumption
- Avoid/treat oxygen consumption promptly
- Restrictive transfusion thresholds

Hofmann et al. Current Opinions in Anaesthesiology 2012
Savings with PBM
Behaviour-Based Transfusion Practice

Inter-Hospital Variability of Transfusion Rates in Matched THR Patients – Study I (n=1,347)

Potential to reduce demand for blood?

Inter-Hospital Variability of Transfusion Rates in Matched THR Patients - Study I & II (n=2,570)

27.7% reduction in txn rate
44.1% reduction in txn index
0.00% mortality

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Benefits of PBM Programs

- reduction by 10 - 95%
- reduction up to 68%
- reduction by 16-33%
- reduction up to 43%
- reduction up to 43%
- reduction of composite morbidity up to 41%, and infection rate up to 80%
- reduction by 10-24%

Problem:

Solution:

Benefit:

- Safety
- Mortality & Morbidity
- ALOS
- Health Care $$$

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The Five Biggest Problems In Health Care Today

1. Too much unnecessary care
2. Avoidable harm to patients
3. Billions of dollars wasted
4. Perverse incentives in how we pay for care
5. Lack of transparency

All addressed by PBM

- 1st Pillar: Optimise red cell mass
- 2nd Pillar: Minimise blood loss & bleeding
- 3rd Pillar: Harness & optimize physiological reserve of anemia
What if these countries matched the WA benchmark?

≈ 16 Mio. RBCs

≈ 3.5 Mio. patients

Reallocation of ≈ $24 Bn.
Blood Supply vs. Blood Demand

Thank you!