Anaemia & Risk

- Mr Toby Richards
- Professor of Surgery
- Vascular Surgeon
- University of Western Australia

PREVENTT

Preoperative intravenous iron to treat anaemia in major surgery

UK/FER/17/0122
Thank You / Disclosures

Grants:
NHMRC
NIHR – HTA
SHINE award for Innovation
Rosetree Foundation
NIAA / BJA /
Mason Trust
UCH vascular charity
UCH friends charity
Vifor Pharma
Covidien / UCL
Vifor Pharma / UCL
Pharmacosmos
Acelity

NIHR – RfPB
Stoke Association

Industry:
Gideon-Ricter
Pharmacosmos
Vifor Pharma
Medtronic
Covidien
Acelity
Saatchi & Saatchi Health
Native
Veniti
Cook
Gore
Baxter
KCI

Associations:
K-PBM
LATM
AAGBI
ASGBI
FIGO
BBTS
NHSBT
NATA
ANZSCA
BioIron
ACTA / STS
VS
CX iLegx
ESVES
LSHTM
UCL
Surgery: - What Problem?

- LA

- Keyhole

Cochrane Database Syst Rev. 2009 Jul 8;(3):CD003677
Surgery: - The Problem

- Blood Loss
- Transfusion
US Veterans Database (NSQIP) (n=227,425)

Anaemia (n=69,229; 30.4%)

30day mortality
30day composite morbidities (9 defined areas)

Multivariate regression
(9 defined subgroups)
(56 cofactors)
Preoperative anaemia and postoperative outcomes in non-cardiac surgery: a retrospective cohort study

Harms associated with single unit perioperative transfusion: retrospective population based analysis

Elizabeth L Whitlock,1 Helen Kim,1 Andrew D Auerbach2

346 Hospitals in USA 2009-2011

N =1,583,819 Elective surgery

41,421 Transfused

52% 2 units
## NOT Older or Sicker?

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole dataset</th>
<th>Not transfused</th>
<th>Transfused</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of patients</td>
<td>1,583,819</td>
<td>41,421</td>
<td>41,421</td>
<td>—</td>
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<tr>
<td>No (%) with stroke/MI</td>
<td>8,044</td>
<td>336 (0.81)</td>
<td>496 (1.1)</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

### Adjusted odds ratios for stroke/MI†

<table>
<thead>
<tr>
<th>pRBC use (units) (reference: 0 units):</th>
<th>Whole dataset</th>
<th>Not transfused</th>
<th>Transfused</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.33 (1.90 to 2.86)</td>
<td>1.71 (1.31 to 2.24)</td>
<td>&lt;0.001*</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2.37 (2.00 to 2.81)</td>
<td>1.73 (1.36 to 2.20)</td>
<td>&lt;0.001</td>
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<tr>
<td>3</td>
<td>3.13 (2.28 to 4.31)</td>
<td>2.24 (1.56 to 3.22)</td>
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<td></td>
</tr>
<tr>
<td>≥4</td>
<td>4.87 (3.86 to 6.14)</td>
<td>3.16 (2.36 to 4.23)</td>
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</tbody>
</table>

### Subgroup variable

<table>
<thead>
<tr>
<th>Subgroup variable</th>
<th>Colectomy (partial and total)</th>
<th>Small bowel resection</th>
<th>Hip/knee replacement or revision</th>
<th>Spine, including fusion and laminectomy</th>
<th>Hysterectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of patients</td>
<td>37,989</td>
<td>16,179</td>
<td>432,419</td>
<td>196,802</td>
<td>112,960†</td>
</tr>
<tr>
<td>No (%) transfused</td>
<td>1748 (4.6)</td>
<td>647 (4.0)</td>
<td>15,516 (3.6)</td>
<td>3903 (2.0)</td>
<td>1747 (1.6)</td>
</tr>
<tr>
<td>No (%) with stroke/MI (%)</td>
<td>689 (1.8)</td>
<td>309 (1.9)</td>
<td>1447 (0.33)</td>
<td>670 (0.34)</td>
<td>115 (0.10)</td>
</tr>
</tbody>
</table>

### Odds ratio for stroke/myocardial infarction (95% CI)

<table>
<thead>
<tr>
<th>pRBC use (units) (reference: 0 units):</th>
<th>Whole dataset</th>
<th>Not transfused</th>
<th>Transfused</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.36 (1.33 to 4.19)</td>
<td>2.05 (0.66 to 6.30)</td>
<td>1.26 (0.78 to 2.03)</td>
<td>1.43 (0.65 to 3.14)</td>
</tr>
<tr>
<td>2</td>
<td>2.21 (1.38 to 3.54)</td>
<td>2.84 (1.32 to 6.11)</td>
<td>1.77 (1.22 to 2.56)</td>
<td>1.73 (0.90 to 3.33)</td>
</tr>
<tr>
<td>3</td>
<td>2.56 (1.06 to 6.17)</td>
<td>1.80 (0.23 to 13.9)</td>
<td>3.29 (1.61 to 6.74)</td>
<td>3.87 (1.46 to 10.3)</td>
</tr>
<tr>
<td>≥4</td>
<td>1.96 (0.84 to 4.54)</td>
<td>4.37 (1.45 to 13.1)</td>
<td>3.05 (1.29 to 7.21)</td>
<td>4.27 (1.73 to 10.5)</td>
</tr>
</tbody>
</table>
Western Australia

77% or the population resides in the Perth Metropolitan Area
• 2008 W.A. Government PBM program
  • Jurisdictional Change Management
  • Quality improvement & Patient Safety
  • 5 years

– Literature Review
  • Multidisciplinary
  • Multimodal
Drivers for change: Western Australia Patient Blood Management Program (WA PBMP), World Health Assembly (WHA) and Advisory Committee on Blood Safety and Availability (ACBSA)

BLOOD MANAGEMENT

Increased hospital costs associated with red blood cell transfusion


<p>| TABLE 3. Top 10 adjusted DRGs with highest volume of acute-care inpatients transfused and adjusted incremental costs associated with RBC transfusion |</p>
<table>
<thead>
<tr>
<th>Adjusted DRG family</th>
<th>Inpatients transfused RBCs</th>
<th>Adjusted cost without RBC transfusion</th>
<th>Adjusted cost with RBC transfusion</th>
<th>Adjusted incremental cost†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q61–RBC disorders</td>
<td>430 (78.32)</td>
<td>2,524 (2,324-2,724)</td>
<td>4,626 (4,278-4,977)</td>
<td>2,102</td>
</tr>
<tr>
<td>I08–other hip and femur procedures</td>
<td>261 (35.75)</td>
<td>11,084 (10,590-11,577)</td>
<td>20,322 (19,341-21,302)</td>
<td>9,238</td>
</tr>
<tr>
<td>G46–complex gastroscopy</td>
<td>200 (51.15)</td>
<td>5,549 (5,160-5,938)</td>
<td>10,174 (9,452-10,897)</td>
<td>4,625</td>
</tr>
<tr>
<td>G47–other gastroscopy</td>
<td>189 (29.12)</td>
<td>4,110 (3,870-4,350)</td>
<td>7,536 (7,074-7,998)</td>
<td>3,426</td>
</tr>
<tr>
<td>I03–hip replacement</td>
<td>164 (20.50)</td>
<td>17,542 (16,758-18,327)</td>
<td>32,164 (30,544-33,785)</td>
<td>14,622</td>
</tr>
<tr>
<td>R61–lymphoma and nonacute leukemia</td>
<td>149 (36.17)</td>
<td>6,791 (6,173-7,409)</td>
<td>12,452 (11,278-13,625)</td>
<td>5,661</td>
</tr>
<tr>
<td>G02–major small and large bowel procedures</td>
<td>102 (21.21)</td>
<td>14,976 (14,012-15,939)</td>
<td>27,457 (25,553-29,361)</td>
<td>12,481</td>
</tr>
<tr>
<td>Q60–reticuloendothelial and immunity disorders</td>
<td>95 (33.45)</td>
<td>5,881 (5,347-6,415)</td>
<td>10,783 (9,787-11,779)</td>
<td>4,902</td>
</tr>
<tr>
<td>G61–GI hemorrhage</td>
<td>92 (25.34)</td>
<td>2,687 (2,515-2,859)</td>
<td>4,927 (4,595-5,260)</td>
<td>2,240</td>
</tr>
<tr>
<td>R60–acute leukemia</td>
<td>88 (65.67)</td>
<td>11,256 (9,193-13,320)</td>
<td>20,639 (16,860-24,417)</td>
<td>9,383</td>
</tr>
</tbody>
</table>
Drivers for Change

- Supply
- Cost
- Variability
- Safety
- Clinical
Patient Blood Management (PBM)

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

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

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 infections promptly
- Restrictive transfusion thresholds

Perioperative multidisciplinary multimodal patient-specific team approach
1. Defrost the Hardened Status quo
   • Urgency
   • Leadership
   • Vision & Strategy
   • Communication of change

2. Introduce New Practises
   • Empower a broad base
   • Quick wins
   • Consolidate gain

3. Change Culture
   • Institutionalise
Mean red cells transfused per discharge
WA Public Metro Hospitals, discharges 2008-2013

- Haematology/Oncology
- General/Physical Medicine
- General Surgery
- Orthopaedics
- Nephrology/Dialysis
- Gastroenterology
- Cardiothoracic Surgery
- Vascular Surgery
- Gerontology
- Obstetrics
Patient Blood Management (PBM)

WHO WHA63.12

“Bearing in mind that patient blood management means that before surgery every reasonable measure should be taken to optimize the patient’s own blood volume, to minimize the patient’s blood loss and to harness and optimize the patient-specific physiological tolerance of anaemia following WHO’s guide for optimal clinical use (three pillars of patient blood management).”
HOW to manage preop Anaemia?
National Comparative Audit of Blood Transfusion

2015 Audit of Patient Blood Management in Adults undergoing elective, scheduled surgery

(http://hospital.blood.co.uk/audits/national-comparative-audit/national-comparative-audit-reports/)
# 2015 Blood Transfusion (NG24)

<table>
<thead>
<tr>
<th>Section</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Alternatives to blood transfusion for patients having surgery - Intravenous and oral iron</td>
<td>Offer oral iron before and after surgery to patients with iron-deficiency anaemia. Consider intravenous iron before or after surgery for patients who: • have IDA and cannot tolerate or absorb oral iron or who are unable to adhere to oral iron treatment • are diagnosed with functional iron deficiency • are diagnosed with IDA and the interval between diagnosis of anaemia and surgery is predicted to be too short for oral iron to be effective</td>
</tr>
<tr>
<td>1.2 Red blood cells - Thresholds and targets</td>
<td>Use restrictive red blood cell transfusion thresholds for patients who need red blood cell transfusions and who do not: • have major haemorrhage or • have acute coronary syndrome or • need regular blood transfusions for chronic anaemia When using a restrictive red blood cell transfusion threshold, consider a threshold of 70 g/L and a haemoglobin concentration target of 70–90 g/L after transfusion Consider a red blood cell transfusion threshold of 80 g/L and a haemoglobin concentration target of 80–100 g/L after transfusion for patients with acute coronary syndrome</td>
</tr>
</tbody>
</table>

### 1.1 Alternatives to blood transfusion for patients having surgery - Intravenous and oral iron

Offer oral iron before and after surgery to patients with iron-deficiency anaemia. Consider intravenous iron before or after surgery for patients who:

- have IDA and cannot tolerate or absorb oral iron or who are unable to tolerate oral iron treatment
- are diagnosed with functional iron deficiency
- are diagnosed with IDA and the interval between diagnosis of anaemia and surgery is predicted to be too short for oral iron to be effective

Use restrictive red blood cell transfusion thresholds for patients who need red blood cell transfusions and who do not:

- have major haemorrhage
- have acute coronary syndrome
- need regular blood transfusions for chronic anaemia

When using a restrictive red blood cell transfusion threshold, consider a threshold of 70 g/L and a haemoglobin concentration target of 70–90 g/L after transfusion.

Consider a red blood cell transfusion threshold of 80 g/L and a haemoglobin concentration target of 80–100 g/L after transfusion for patients with acute coronary syndrome.

---

<table>
<thead>
<tr>
<th>PBM</th>
<th>Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBM1</td>
<td>Pre-operative anaemia management</td>
</tr>
<tr>
<td>PBM2</td>
<td>Pre-operative transfusion allowed</td>
</tr>
<tr>
<td>PBM3</td>
<td>Pre-operative transfusion allowed only if preoperative anaemia optimisation has been attempted where appropriate</td>
</tr>
<tr>
<td>PBM4</td>
<td>Pre-operative transfusion - single unit transfusion policy</td>
</tr>
<tr>
<td>PBM5</td>
<td>Pre-operative anticoagulant and antiplatelet management</td>
</tr>
<tr>
<td>PBM6</td>
<td>Patients having intra operative transfusion in whom at least one PBM measure has been attempted (where appropriate)</td>
</tr>
<tr>
<td>PBM7</td>
<td>Patients having intra operative transfusion in whom all PBM measure have been attempted (where appropriate)</td>
</tr>
<tr>
<td>PBM8</td>
<td>Post operative transfusion allowed (whether or not PBM measures attempted) - FIRST EPISODE</td>
</tr>
<tr>
<td>PBM9</td>
<td>Post operative transfusion following the single unit policy - FIRST EPISODE</td>
</tr>
<tr>
<td>PBM10</td>
<td>Post operative in whom at least one PBM measure has been attempted (where appropriate) - FIRST EPISODE</td>
</tr>
<tr>
<td>PBM11</td>
<td>Post operative in all PBM measures have been attempted (where appropriate) FIRST EPISODE</td>
</tr>
</tbody>
</table>
RESULTS

• Locations 190
• N= 2853
• RBC = 6284 units RBC

— Age 72 years (62-80)
— Female 62%

— Blood Loss= 1200 (726-2000) mL.
— [Hb]= 83 (75-97) g/L
Patient Blood Management

PILLAR 1 PreOP
• Anaemia
• Anticoag / antiplt

PILLAR 2 IntraOP
• Cell Salvage
• Anti-fibrinolytics
• Adjuncts
• POC
PBM 1 – Preop Anaemia

Anaemic patients had associated higher Blood Transfusion

Odds Ratio 1.78  CI: 1.48 -2.14, p< 0.0005).
logistic regression, adjusting for age, sex and surgery type

Anaemic patients had associated higher mortality

Odds Ratio 3.41  CI: 1.74 -6.68, p< 0.0001).

<table>
<thead>
<tr>
<th></th>
<th>Alive</th>
<th>Died</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaemic</td>
<td>1,335 (97.2)</td>
<td>39 (2.8)</td>
<td>1,374</td>
</tr>
<tr>
<td>Not Anaemic</td>
<td>1,283 (99.1)</td>
<td>11 (0.9)</td>
<td>1,294</td>
</tr>
<tr>
<td>Total</td>
<td>2,618 (98.2)</td>
<td>50 (1.9)</td>
<td>2,668</td>
</tr>
</tbody>
</table>
Iron Deficiency
Global and regional cause-specific anemia prevalence for 1990 and 2010.

Nicholas J. Kassebaum et al. Blood 2014;123:615-624

©2014 by American Society of Hematology
Iron Deficiency is the disease
Q2 Of those symptoms of iron deficiency, which symptoms concerned/troubled/impacted/affected you and triggered you to seek help and advice Please tick 1 to maximum of 3

Answered: 293    Skipped: 0

- Fatigue
- Exhaustion
- Shortness of breath
- Heart palpitations
- Dizziness
- Hair Loss
- Brain fog
- Anxiety
- Chest pain
- Headache

Finally settling down to my vegan, gluten free, soy free, antibiotics free, raw, non GMO, organic, fat free, low carb meal!
How is Iron Absorbed?

Iron intake
- Haem (Fe^{2+})
- Non-haem (Fe^{3+})
- Oral administration (Fe^{2+})

Iron uptake in the gut mucosa cell involves
- Haem oxidase
- Porphobilinogen
- Ferritin

Iron transport across the cell membrane involves
- Ferroportin
- Transferrin

Iron storage in the liver involves
- Hepcidin
- Ferritin

Iron release from macrophages involves
- Receptor-mediated endocytosis
- Transferrin receptor

Nature Reviews | Cardiology
Iron Deficiency
Iron Deficiency

PBM 1 IV iron – a great idea?
What is Iron Deficiency?

A. Inflammation / Cancer
B. Failure Absorption
C. Iron not recycled
D. Reduced EPO
E. BM failure
The Efficacy of Postoperative Iron Therapy in Improving Clinical and Patient-Centered Outcomes Following Surgery: A Systematic Review and Meta-Analysis

Iris Perelman a,b, Remington Winter a, Lindsey Sikora a, Guillaume Martel b,c, Elianna Saidenberg b,c, Dean Fergusson a,b,a

* University of Ottawa, Ottawa, Ontario, Canada
b Ottawa Hospital Research Institute, Ottawa, Ontario, Canada
c Ottawa Hospital, Ottawa, Ontario, Canada

### A) Summary of Results

<table>
<thead>
<tr>
<th>Category</th>
<th>No. of Trials</th>
<th>Mean Difference</th>
<th>Lower CI</th>
<th>Upper CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>12</td>
<td>1.91</td>
<td>0.19</td>
<td>3.62</td>
</tr>
<tr>
<td>IV iron</td>
<td>5</td>
<td>3.40</td>
<td>1.18</td>
<td>5.62</td>
</tr>
<tr>
<td>Oral iron</td>
<td>7</td>
<td>0.77</td>
<td>-1.48</td>
<td>3.01</td>
</tr>
<tr>
<td>Patient Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>10</td>
<td>2.11</td>
<td>0.29</td>
<td>3.94</td>
</tr>
<tr>
<td>Paediatric</td>
<td>2</td>
<td>-0.68</td>
<td>-6.60</td>
<td>5.23</td>
</tr>
<tr>
<td>Cardiac Surgery (Overall)</td>
<td>7</td>
<td>0.67</td>
<td>-1.67</td>
<td>3.01</td>
</tr>
<tr>
<td>IV iron</td>
<td>3</td>
<td>2.20</td>
<td>-1.52</td>
<td>5.91</td>
</tr>
<tr>
<td>Oral iron</td>
<td>4</td>
<td>-0.67</td>
<td>-3.72</td>
<td>2.37</td>
</tr>
<tr>
<td>Orthopedic Surgery (All oral iron)</td>
<td>3</td>
<td>2.24</td>
<td>-1.23</td>
<td>5.72</td>
</tr>
<tr>
<td>Timing of Hb Measurement During Follow-up</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1 Week (Overall)</td>
<td>8</td>
<td>-0.34</td>
<td>-2.77</td>
<td>2.08</td>
</tr>
<tr>
<td>IV iron</td>
<td>4</td>
<td>-2.20</td>
<td>-6.47</td>
<td>2.07</td>
</tr>
<tr>
<td>Oral iron</td>
<td>4</td>
<td>1.27</td>
<td>-1.60</td>
<td>4.14</td>
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<tr>
<td>2-4 Weeks (Overall)</td>
<td>6</td>
<td>3.19</td>
<td>0.15</td>
<td>6.23</td>
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<tr>
<td>IV iron</td>
<td>3</td>
<td>5.69</td>
<td>2.11</td>
<td>9.27</td>
</tr>
<tr>
<td>Oral iron</td>
<td>3</td>
<td>0.57</td>
<td>-2.52</td>
<td>3.67</td>
</tr>
<tr>
<td>10 Weeks (All oral iron)</td>
<td>5</td>
<td>1.14</td>
<td>-2.41</td>
<td>4.70</td>
</tr>
</tbody>
</table>
### Systematic review and meta-analysis of iron therapy in anaemic adults without chronic kidney disease: updated and abridged Cochrane review

Ben Cleveley¹, Kurinchi Gurusamy¹, Andrew A. Klein², Gavin J. Murphy³, Stefan D. Anker⁴, and Toby Richards¹*  

#### 1.4.1 Final haemoglobin

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Parenteral iron</th>
<th>Oral iron</th>
<th>Mean Difference IV, Random, 95% CI [gm/dl]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean [gm/dl]</td>
<td>SD [gm/dl]</td>
<td>Total</td>
</tr>
<tr>
<td>Auerbach 2004</td>
<td>12.2</td>
<td>2.2</td>
<td>37</td>
</tr>
<tr>
<td>Auerbach 2004</td>
<td>11.9</td>
<td>3.1</td>
<td>41</td>
</tr>
<tr>
<td>Eger 2013</td>
<td>13.9</td>
<td>1.7</td>
<td>42</td>
</tr>
<tr>
<td>Bisbe 2014</td>
<td>11.5</td>
<td>1.2</td>
<td>59</td>
</tr>
<tr>
<td>Dansuwan 2010</td>
<td>10.0</td>
<td>0.8</td>
<td>22</td>
</tr>
<tr>
<td>Kim 2009</td>
<td>10.5</td>
<td>1.4</td>
<td>30</td>
</tr>
<tr>
<td>Kulig 2008</td>
<td>12.3</td>
<td>3.1</td>
<td>136</td>
</tr>
<tr>
<td>Lindgren 2009</td>
<td>13</td>
<td>3.1</td>
<td>45</td>
</tr>
<tr>
<td>Frassler 1998</td>
<td>10.5</td>
<td>3.1</td>
<td>13</td>
</tr>
<tr>
<td>Frenzel 2012</td>
<td>12.59</td>
<td>3.1</td>
<td>219</td>
</tr>
<tr>
<td>Schroder 2005</td>
<td>12.3</td>
<td>2.3</td>
<td>18</td>
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<tr>
<td>Vohal 2001</td>
<td>12.1</td>
<td>3.1</td>
<td>115</td>
</tr>
</tbody>
</table>

**Subtotal (95% CI)** 776  
**Heterogeneity:** Tau² = 0.06; Ch² = 16.31, df = 11 (P = 0.13); I² = 33%  
Test for overall effect: Z = 4.69 (P < 0.00001)  

#### 1.4.2 Change in haemoglobin

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Parenteral iron</th>
<th>Oral iron</th>
<th>Mean Difference IV, Random, 95% CI [gm/dl]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean [gm/dl]</td>
<td>SD [gm/dl]</td>
<td>Total</td>
</tr>
<tr>
<td>Abrahamsen 1965</td>
<td>4.7</td>
<td>3.6</td>
<td>10</td>
</tr>
<tr>
<td>Beck-da-Silva 2013</td>
<td>1.04</td>
<td>3.6</td>
<td>8</td>
</tr>
<tr>
<td>Henry 2007</td>
<td>2.4</td>
<td>1.1</td>
<td>41</td>
</tr>
<tr>
<td>Mercier 2010</td>
<td>1.6</td>
<td>3.6</td>
<td>75</td>
</tr>
<tr>
<td>Ohljenek 2001</td>
<td>0.7</td>
<td>0.7</td>
<td>25</td>
</tr>
<tr>
<td>Ohljenek 2001</td>
<td>1.5</td>
<td>0.9</td>
<td>29</td>
</tr>
<tr>
<td>Van Wyk 2009</td>
<td>3.2</td>
<td>2.3</td>
<td>228</td>
</tr>
</tbody>
</table>

**Subtotal (95% CI)** 414  
**Heterogeneity:** Tau² = 0.09; Ch² = 11.17, df = 6 (P = 0.08); I² = 46%  
Test for overall effect: Z = 1.88 (P = 0.06)  

**Total (95% CI)** 1190  
**Heterogeneity:** Tau² = 0.08; Ch² = 30.43, df = 18 (P = 0.03); I² = 41%  
Test for overall effect: Z = 4.74 (P < 0.00001)  
Test for subgroup differences: Ch² = 1.70, df = 1 (P = 0.19), I² = 41.1%  

Favours oral iron  
Favours parenteral iron
IV iron Preoperatively

Impact of treating Iron Deficiency Anemia Before Major Abdominal Surgery

Decreased Need for Blood Transfusions
31% → 12% (percent of patients)

Shorter Hospital Length of Stay
9.7 → 7.0 (days)

Recovery of Hemoglobin (Hb) post-discharge
+0.9 → +1.9 (Hb change at 4 weeks)

Preop Oral Iron?  
That’s what NICE says!

- **Cheap & Easy**

- **IVICA trial**: PWE-290 An open-label, randomised controlled trial comparing the efficacy of intravenous and oral iron in the preoperative management of colorectal cancer anaemia:

<table>
<thead>
<tr>
<th>116 anaemic patients</th>
<th>IVIron V</th>
<th>Oral</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 days prior Colorectal Surgery</td>
<td>0.47u</td>
<td>0.63u</td>
</tr>
<tr>
<td></td>
<td>(CI 0.1–0.84)</td>
<td>(CI 0.26–1)</td>
</tr>
<tr>
<td>number of patients transfused</td>
<td>( P = 0.33 )</td>
<td></td>
</tr>
<tr>
<td>mean units transfused</td>
<td>( P = 0.54 )</td>
<td></td>
</tr>
</tbody>
</table>

PREVENTT
Preoperative intravenous iron to treat anaemia in major surgery

Patient planned for major surgery?

CHECK [Hb]

Think PREVENTT

Patient benefits

Cost to the NHS

Corrects Hb levels

1/3 Anaemic

Increased blood transfusion

Increased hospital stays

Patient complications

Patient inclusion criteria:

At least 10 days before operation

Undergoing major open abdominal surgery

With anaemia (Hb <13 Men, <12 Women)

“Please tell your patient they can help with this research”

Contact information

This project was funded by the National Institute for Health Research Health Technology Assessment (NIHR HTA) Programme (project number 10/57/67); www.preventt.bstm.ac.uk
### Patients on any antiplatelet therapy

<table>
<thead>
<tr>
<th>INR Result before Surgery</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤1.0</td>
<td>49</td>
</tr>
<tr>
<td>1.1-1.4</td>
<td>164</td>
</tr>
<tr>
<td>1.5-1.9</td>
<td>50</td>
</tr>
<tr>
<td>2.0-2.4</td>
<td>17</td>
</tr>
<tr>
<td>2.5-2.9</td>
<td>6</td>
</tr>
<tr>
<td>3.0-3.4</td>
<td>7</td>
</tr>
<tr>
<td>3.5-4.4</td>
<td>8</td>
</tr>
<tr>
<td>4.5-5.9</td>
<td>2</td>
</tr>
<tr>
<td>6.0-7.9</td>
<td>-</td>
</tr>
<tr>
<td>≥8.0</td>
<td>2</td>
</tr>
</tbody>
</table>

### WARFARIN

- Patients on Warfarin pre-operatively: 8.3% (318/3813)

- Stopped therapy: 77% (279/363)
- Stopped at least 5 days pre-op: 57% (149/261)

### PBM 5

anticoagulation

anti-plts

WARFARIN

Asprin & Clopidogrel
Aspirin in Patients Undergoing Noncardiac Surgery

- N = 10,010
- + Aspirin
- Placebo (stop aspirin)
- Death + MI

Hazard ratio, 0.99 (95% CI, 0.86–1.15); P = 0.92

<table>
<thead>
<tr>
<th>No. at Risk</th>
<th>Placebo</th>
<th>Aspirin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5012</td>
<td>4998</td>
</tr>
<tr>
<td></td>
<td>4724</td>
<td>4713</td>
</tr>
<tr>
<td></td>
<td>4696</td>
<td>4678</td>
</tr>
<tr>
<td></td>
<td>4680</td>
<td>4665</td>
</tr>
<tr>
<td></td>
<td>4669</td>
<td>4660</td>
</tr>
<tr>
<td></td>
<td>4662</td>
<td>4653</td>
</tr>
<tr>
<td></td>
<td>4652</td>
<td>4643</td>
</tr>
</tbody>
</table>
Aspirin in Patients Undergoing Noncardiac Surgery

- N = 10,010
- + Aspirin
- Placebo
- Death + MI

Supplemental Figure 2: Kaplan-Meier estimates of major bleed

HR (95%CI) = 1.23 (1.01-1.49), P = 0.04

<table>
<thead>
<tr>
<th>Days from randomization</th>
<th>No. at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Placebo</td>
</tr>
<tr>
<td>0</td>
<td>5012</td>
</tr>
<tr>
<td>5</td>
<td>4842</td>
</tr>
<tr>
<td>10</td>
<td>4817</td>
</tr>
<tr>
<td>15</td>
<td>4798</td>
</tr>
<tr>
<td>20</td>
<td>4782</td>
</tr>
<tr>
<td>25</td>
<td>4773</td>
</tr>
<tr>
<td>30</td>
<td>4766</td>
</tr>
</tbody>
</table>
Stopping vs. Continuing Aspirin before Coronary Artery Surgery

Paul S. Myles, M.P.H., M.D., Julian A. Smith, F.R.A.C.S., Andrew Forbes, Ph.D.,

DOI: 10.1056/NEJMo1507688
Copyright © 2016 Massachusetts Medical Society.

Figure 1. Enrollment, Randomization, and Assessment.
Table 2. Outcomes.

<table>
<thead>
<tr>
<th>Event</th>
<th>Aspirin (N=1047)</th>
<th>Placebo (N=1053)</th>
<th>Risk Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome: death, myocardial infarction, stroke, renal failure, pulmonary embolism, or bowel infarction — no./total no. (%)</td>
<td>202/1046 (19.3)</td>
<td>215/1052 (20.4)</td>
<td>0.94 (0.80–1.12)</td>
<td>0.55</td>
</tr>
<tr>
<td>Death</td>
<td>14 (1.3)</td>
<td>9 (0.9)</td>
<td>1.56 (0.68–3.60)</td>
<td>0.30</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>144 (13.8)</td>
<td>166 (15.8)</td>
<td>0.87 (0.71–1.07)</td>
<td>0.20</td>
</tr>
<tr>
<td>Stroke</td>
<td>14 (1.3)</td>
<td>12 (1.1)</td>
<td>1.17 (0.55–2.52)</td>
<td>0.70</td>
</tr>
<tr>
<td>Renal failure</td>
<td>49 (4.7)</td>
<td>41 (3.9)</td>
<td>1.20 (0.80–1.80)</td>
<td>0.39</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>8 (0.8)</td>
<td>10 (1.0)</td>
<td>0.81 (0.32–2.03)</td>
<td>0.81</td>
</tr>
<tr>
<td>Bowel infarction</td>
<td>0</td>
<td>2 (0.2)</td>
<td>—</td>
<td>0.50</td>
</tr>
<tr>
<td>Reoperation for hemorrhage — no. (%)</td>
<td>19 (1.8)</td>
<td>22 (2.1)</td>
<td>0.87 (0.47–1.60)</td>
<td>0.75</td>
</tr>
<tr>
<td>Cardiac tamponade — no. (%)</td>
<td>11 (1.1)</td>
<td>4 (0.4)</td>
<td>2.77 (0.88–8.66)</td>
<td>0.08</td>
</tr>
<tr>
<td>ICU stay — hr</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.61</td>
</tr>
<tr>
<td>Initial admission</td>
<td></td>
<td></td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interquartile range</td>
<td>22–64</td>
<td>21–64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total stay, including readmission</td>
<td></td>
<td></td>
<td>—</td>
<td>0.37</td>
</tr>
<tr>
<td>Median</td>
<td>36</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interquartile range</td>
<td>22–69</td>
<td>22–67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of mechanical ventilation — hr</td>
<td></td>
<td></td>
<td>—</td>
<td>0.58</td>
</tr>
<tr>
<td>Median</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interquartile range</td>
<td>6–16</td>
<td>6–16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reintubation during hospital stay — no. (%)</td>
<td>30 (3.5)</td>
<td>28 (3.3)</td>
<td>1.08 (0.65–1.78)</td>
<td>0.79</td>
</tr>
<tr>
<td>New episode of peptic ulceration — no. (%)</td>
<td>13 (1.2)</td>
<td>11 (1.0)</td>
<td>1.19 (0.53–2.64)</td>
<td>0.69</td>
</tr>
<tr>
<td>Hospital stay — days</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.32</td>
</tr>
<tr>
<td>Median</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interquartile range</td>
<td>6–12</td>
<td>6–11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Plus–minus values are means ±SD. ICU denotes intensive care unit.
PBM 5

- N=541
- 30% Longer LOS
- P<0.0005 [1.16-1.51]
Patient Blood Management

PILLAR 1
• Anaemia
• Anticoag / antiplt

PILLAR 2
• Cell Salvage
• Anti-fibrinolytics
• Adjuncts
• POC

PreOP

IntraOP
Cell salvage for minimising perioperative allogeneic blood transfusion (Review)

Carless PA, Henry DA, Moxey AJ, O’Connell D, Brown T, Fergusson DA
Cell Salvage

• 75 trials (n=6025)

• Overall
  • Reduction BT
    – ARR 21%
    – NNT 4.8
  • Allogenic Tx saving
    – Ortho 54%
    – Cardiac 23%

  0.62  (0.55-0.70)
Surgical Tips and Tricks

1 L N/saline
5000u Heparin
Should intraoperative cell-salvaged blood be used in patients with suspected or known malignancy?
Les cellules sanguines épargnées en peropératoire doivent-elles être réutilisées chez des patients ayant des processus malins connus ou suspectés?

Jacqueline D. Trudeau, MD, PhD · Terrence Waters, MD · Kate Chipperfield, MD

Conclusion  Transfusion of autologous blood harvested via ICS should be considered a viable option for reduction or avoidance of allogeneic product during many oncologic surgeries and may be a lifesaving option for those patients who refuse allogeneic blood products.
PBM 6: IOCS

- Overall Reduced BT
  OR 0.58 p <0.0005, C.I. [0.47-0.71]

- Overall Reduced LOS
  9.8%, p= 0.005, C.I. [3% - 16.2%]

- THR Reduction 18.9%
  P= 0.047, 95% C.I. [0% - 34.1%]
Tranexamic acid
a lysine binding analogue

Empirical Formula: C₈H₁₅NO₂
Molecular Weight: 157.2
Effect of tranexamic acid on surgical bleeding: systematic review and cumulative meta-analysis

Katharine Ker research fellow, Phil Edwards senior lecturer, Pablo Perel clinical senior lecturer, Haleema Shakur senior lecturer, Ian Roberts professor of epidemiology

<table>
<thead>
<tr>
<th>Type of surgery</th>
<th>No of events (tranexamic acid/control)</th>
<th>Pooled risk ratio (95% CI)</th>
<th>P value*</th>
<th>Heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>622/835</td>
<td>0.65 (0.60 to 0.70)</td>
<td>&lt;0.001</td>
<td>60</td>
</tr>
<tr>
<td>Orthopaedic</td>
<td>298/462</td>
<td>0.55 (0.49 to 0.61)</td>
<td>&lt;0.001</td>
<td>83</td>
</tr>
<tr>
<td>Hepatic</td>
<td>29/54</td>
<td>0.52 (0.49 to 0.68)</td>
<td>&lt;0.001</td>
<td>93</td>
</tr>
<tr>
<td>Urological</td>
<td>40/60</td>
<td>0.66 (0.58 to 0.91)</td>
<td>0.01</td>
<td>2</td>
</tr>
<tr>
<td>Vascular</td>
<td>11/19</td>
<td>0.58 (0.44 to 0.99)</td>
<td>0.05</td>
<td>—</td>
</tr>
<tr>
<td>Gynaecological</td>
<td>17/50</td>
<td>0.86 (0.78 to 1.54)</td>
<td>0.61</td>
<td>65</td>
</tr>
<tr>
<td>Cranial and orthognathic</td>
<td>52/76</td>
<td>0.63 (0.45 to 0.86)</td>
<td>0.004</td>
<td>46</td>
</tr>
</tbody>
</table>

*Test for effect.
Tranexamic Acid in Patients Undergoing Coronary-Artery Surgery

N= 4662

P – Cardiac Surgery

I - TXA 100mg / kg

C - Placebo

O - Death / thrombotic AE

TXA – 16.7%

Control – 18.1%

(CI 0.81- 1.05)

MI

TXA – 0.84 (CI 0.7- 1.0)

Bleeding

TXA 4331 BT

Control 7994 BT

p < 0.001

(tamponade, reoperation)
Surgical Tips and Tricks
Point-of-Care Testing

A Prospective, Randomized Clinical Trial of Efficacy in Coagulopathic Cardiac Surgery Patients

Christian Friedrich Weber, Dr. med.,* Klaus Görlinger, Dr. med.,† Dirk Meininger, P.D. Dr. med.,‡ Eva Herrmann, Prof. Dr. rer. nat.,§ Tobias Bingold, Dr. med.,‡ Anton Moritz, Prof. Dr. med.,|| Lawrence H. Cohn, M.D., Ph.D.,# Kai Zacharowski, Prof. Dr. med., Ph.D., F.R.C.A.**

P Cardiac Surgery (n= 100)

I POC – TEG / Plt aggregometry

C Normal care

O BT (Hb>8g/dl)
**WHAT IS THE INTERVENTION??**

**TIME – POC reduced time to intervention**

---

### Table 6. Cumulative Costs of Transfused Allogenic Blood Products, Hemostatic Therapy (Including Coagulation Factor Concentrates), and Costs of Performed POC Analyses

<table>
<thead>
<tr>
<th></th>
<th>Conventional Group</th>
<th>POC Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allogenic blood products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packed erythrocytes</td>
<td>18,648</td>
<td>13,176</td>
</tr>
<tr>
<td>[72 €/U]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFP [0.162 €/g]</td>
<td>13,530</td>
<td>4,665</td>
</tr>
<tr>
<td>PC [231 €/U]</td>
<td>28,755</td>
<td>15,123</td>
</tr>
<tr>
<td>Other hemostatic therapy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desmopressin [3.3 €/μg]</td>
<td>3,128</td>
<td>3,412</td>
</tr>
<tr>
<td>Fibrinogen [233 €/g]</td>
<td>35,882</td>
<td>27,727</td>
</tr>
<tr>
<td>PCC [114 €/600 IU]</td>
<td>10,944</td>
<td>6,726</td>
</tr>
<tr>
<td>rVIIa [2,784 €/240 kIU]</td>
<td>44,544</td>
<td>5,568</td>
</tr>
<tr>
<td>Total blood products and hemostatic therapy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expendable materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POC Diagnostics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROTEM®</td>
<td></td>
<td>4,093</td>
</tr>
<tr>
<td>Multiplate®</td>
<td></td>
<td>2,427</td>
</tr>
<tr>
<td>Cumulative [€]</td>
<td>135,431</td>
<td>82,918</td>
</tr>
<tr>
<td>Mean costs per patient [€]</td>
<td>3,109</td>
<td>1,658</td>
</tr>
</tbody>
</table>

The data are presented in Euro [€]. Manufacturers of ROTEM® and Multiplate® were Tem International GmbH, Munich, Germany, and Verum Diagnostica GmbH, Munich, Germany, respectively.

FFP = fresh frozen plasma; IU = international units; PC = pooled platelet concentrate; PCC = prothrombin complex concentrate; POC = point-of-care; rVIIa = recombinant activated factor VIIa concentrate.

---

![Fig. 4. Kaplan–Meier curve demonstrating survival by type of performed coagulation management during the 6-month follow-up period. POC = point-of-care.](image)
Surgical Tips and Tricks

Thanks to Prof. B. Hunt
Patient Blood Management - PILLAR 2

- Anti-fibrinolytics
- Cell Salvage
- Adjuncts
- POC

P = 0.02
Surgical BT - Preventions

Pre OP
Who?
Target pop
What?
AID ? FID ?
Protocol
Oral / IV Iron
AUDITS
Dose / response
Outcomes
KPI

Operative
POC
Cell Salvage
Tranexamic acid

Post OP
Need
Trigger
Drain salvage
Outcomes

>=4 On a given day

0
2000
4000
6000
8000
10000

-14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14

-500
0
500
1000
1500
2000
2500

-14-13-12-11-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

KPI

Outcomes

Need
Trigger
Drain salvage

Pre OP
Who?
Target pop
What?
AID ? FID ?
Protocol
Oral / IV Iron
AUDITS
Dose / response
Outcomes
KPI

Operative
POC
Cell Salvage
Tranexamic acid

Post OP
Need
Trigger
Drain salvage
Outcomes

KPI

Outcomes
I know best

HOW TO IMPLEMENT PBM???
STUDENT POWER

• Audit 1  BT in Vascular Surgery
  Oct 2014 – Mar 2015

• INTERVENTION
  • Education program
  • Student on ward round

• Audit 2  BT in Vascular Surgery
  Nov 2015 – Feb 2016
Education

• AAGBI conference

• London BT 2020

• Literature

• Talks

1. Background Reading
2. Audit current transfusion practice
3. Analyse and produce feedback
4. Establish and set standards of practice based on national guidelines
5. Implement educational change
6. Re-audit transfusion practice
Patient details:
Name…………………………………………………….
MRN……………………………………………………..
DOB……………………………………………………
Consultant………………………………………………

<table>
<thead>
<tr>
<th>Elective</th>
<th>Emergency</th>
</tr>
</thead>
</table>

Preoperative (Tick all that apply)

- Is the patient anaemic? (Male <130g/l, Female <120g/l):
  - HB:
- Has anaemia been investigated? (Iron studies/B12/Folate)
- If iron deficient, has this been treated? (IV iron Cosmofer 20mg/kg)
- Is the patient on anticoagulants and has appropriateness been reviewed
- Is the patient on antiplatelet agents and has appropriateness been reviewed
- Transfuse one unit if Hb <70g/L, with a Hb target of 70—90g/L after transfusion OR <80g/L in unstable IHD with a Hb target of 80 -100g/L after transfusion.
- Single Unit Transfusion Policy (recheck Hb after each unit)

Intraoperative (Tick all that apply)

- Tranexamic Acid (1g)
- Cell salvage
- Swab Washing
- Single Unit Transfusion Policy (check Hb after each unit unless active haemorrhage)
- Point of care testing:
  - ACT
  - TEG

Postoperative (Tick all that apply)

- Restrictive blood samples (no ‘routine’ samples)
- Transfuse one unit if Hb <70g/L, with a Hb target of 70—90g/L after transfusion OR <80g/L in unstable IHD with a Hb target of 80 -100g/L after transfusion.
- Single Unit Transfusion Policy (recheck Hb after each unit)
- If iron deficient, has this been treated? (IV iron Cosmofer 20mg/kg)
- Use of IV iron where appropriate in patients likely to be in hospital > 1 week
I know best

WHY?
## Demographics (CLI)

<table>
<thead>
<tr>
<th></th>
<th>Audit 1 (n=127)</th>
<th>Audit 2 (n=84)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years), median (IQR)</strong></td>
<td>72 (21)</td>
<td>69.5 (15.5)</td>
<td>0.257</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>78 (61)</td>
<td>56 (67)</td>
<td>0.529</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Amputation</strong></td>
<td>52 (40.9)</td>
<td>27 (32.1)</td>
<td>0.094</td>
</tr>
<tr>
<td>• <strong>Angioplasty</strong></td>
<td>48 (37.8)</td>
<td>31 (36.9)</td>
<td></td>
</tr>
<tr>
<td>• <strong>Bypass</strong></td>
<td>15 (11.8)</td>
<td>8 (9.5)</td>
<td></td>
</tr>
<tr>
<td>• <strong>Endarterectomy</strong></td>
<td>12 (9.4)</td>
<td>18 (21.4)</td>
<td></td>
</tr>
<tr>
<td><strong>Anaemic</strong></td>
<td>90 (70.9%)</td>
<td>52 (61.9%)</td>
<td>0.181</td>
</tr>
</tbody>
</table>
## Blood Transfusion

<table>
<thead>
<tr>
<th></th>
<th>Audit 1 (n=127)</th>
<th>Audit 2 (n=84)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients transfused</td>
<td>47 (37.0%)</td>
<td>17 (20.2%)</td>
<td>0.010*</td>
</tr>
<tr>
<td>Total anaemic patients transfused</td>
<td>40 (44.4%)</td>
<td>14 (26.9%)</td>
<td>0.039*</td>
</tr>
<tr>
<td>Number of transfusion events #</td>
<td>104</td>
<td>39</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total number of units transfused</td>
<td>193</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Total Cost</td>
<td>£23,517.05</td>
<td>£10,357.25</td>
<td></td>
</tr>
<tr>
<td>Patient Cost</td>
<td>£185</td>
<td>£123</td>
<td></td>
</tr>
</tbody>
</table>
# Hb results

<table>
<thead>
<tr>
<th>Patients who received RBC transfusion:</th>
<th>Audit 1 (n=127)</th>
<th>Audit 2 (n=84)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Hb on admission (g/L) [IQR]</td>
<td>102 [94-114]</td>
<td>93 [88-108]</td>
<td>0.330</td>
</tr>
<tr>
<td>Median transfusion trigger Hb (g/L) [IQR]</td>
<td>76 [71-81]</td>
<td>72 [66-79]</td>
<td>0.051</td>
</tr>
<tr>
<td>Transfusions Hb &gt; 70g/L, n (%)</td>
<td>105 (79.8%)</td>
<td>69 (62.5%)</td>
<td>0.036</td>
</tr>
<tr>
<td>Median discharge Hb (g/L) [IQR]</td>
<td>98 [88-106]</td>
<td>88 [79-93]</td>
<td>0.037</td>
</tr>
</tbody>
</table>
## Hospital Stay

<table>
<thead>
<tr>
<th>Median LOS (days) (IQR)</th>
<th>Audit 1 (n=127)</th>
<th>Audit 2 (n=84)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All patients</strong></td>
<td>17 [8-29]</td>
<td>8 [3-23]</td>
<td>0.001*</td>
</tr>
<tr>
<td><strong>Anaemic patients</strong></td>
<td>18 [10-34]</td>
<td>9.5 [3-27.5]</td>
<td>0.008*</td>
</tr>
<tr>
<td><strong>Non-anaemic patients</strong></td>
<td>13 [6-22]</td>
<td>6 [2-22]</td>
<td>0.064</td>
</tr>
</tbody>
</table>
Pre-Op Anaemia

Audit & benchmarking
Be a Champion!

• PBM 1 Identify Anaemia (PREVENTT)
• PBM 5 Stop Anti-coag & Anti-plt
• PBM 7 Intra-OP PBM
  » TXA
  » Cell Salvage
  » POC

• THESE WORK
Preoperative intravenous iron to treat anaemia in major surgery

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