Blood Utilization Management

10th Annual Transfusion Medicine Education Education Symposium
April 15, 2015

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Ontario Regional Blood Coordinating Network
Physician Clinical Project Coordinator
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Faculty/Presenter Disclosure

• Faculty: Allison Collins

• Relationships with commercial interests: None
Objectives

Through attending this session, participants will be able to:

• Demonstrate understanding of the indications and thresholds for blood transfusions using a restrictive vs. liberal strategy to minimize the use of blood components and adverse events

• Demonstrate understanding of when to transfuse the right component at the right time to the right patient e.g. limiting the use of O neg RBC to non-O neg patients
Concepts in Patient Blood Management

1. Limiting loss through phlebotomy for testing
2. Optimizing patient Hb levels before surgery
3. Using autologous donations and red cell recovery techniques
4. Minimizing perioperative blood loss
5. Making evidence-based hemotherapy decisions

Getting Started in Patient Blood Management aaBB 2011
Red Cells

- Evidence
- Ontario practice
<table>
<thead>
<tr>
<th>Trial</th>
<th>N</th>
<th>Res/Lib Hb/Hct</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRICC (ICU)</td>
<td>838</td>
<td>70/100</td>
<td>30d mortality same</td>
</tr>
<tr>
<td>TRACS (cardiac surgery)</td>
<td>502</td>
<td>.24/.30</td>
<td>30d mortality and serious morbidity same</td>
</tr>
<tr>
<td>FOCUS (hip #)</td>
<td>1999</td>
<td>80/100</td>
<td>60d mortality same</td>
</tr>
<tr>
<td>UGIB</td>
<td>889</td>
<td>70/90</td>
<td>45d mortality ↓ in Res group</td>
</tr>
<tr>
<td>TRISS (sep. shock)</td>
<td>998</td>
<td>70/90</td>
<td>90d mortality same</td>
</tr>
</tbody>
</table>
## Randomised Trials of RBC Transfusion

<table>
<thead>
<tr>
<th>Trial</th>
<th>N (year)</th>
<th>Res/Lib Hb/Hct</th>
<th>Result</th>
<th>↓ RBC use</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRICC (ICU)</td>
<td>838 (1999)</td>
<td>70/100</td>
<td>30d mortality same</td>
<td>54%</td>
</tr>
<tr>
<td>TRACS (cardiac surgery)</td>
<td>502 (2010)</td>
<td>.24/.30</td>
<td>30d mortality and serious morbidity same</td>
<td>58%</td>
</tr>
<tr>
<td>FOCUS (hip #)</td>
<td>1999 (2011)</td>
<td>80/100</td>
<td>60d mortality same</td>
<td>65%</td>
</tr>
<tr>
<td>UGIB</td>
<td>889 (2013)</td>
<td>70/90</td>
<td>45d mortality ↓ in Res group</td>
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</tr>
<tr>
<td>TRISS (sep. shock)</td>
<td>998 (2014)</td>
<td>70/90</td>
<td>90d mortality same</td>
<td>50%</td>
</tr>
</tbody>
</table>
### Updated 30-Day Mortality

Carson JL, Carless P, Hebert PC. Cochrane Database of Systematic Reviews 2012 Updated 10-13
Guidelines for RBC Transfusion

1. Adhere to a restrictive strategy in hospitalised stable patients (Hb 70-80 g/L)
2. Consider transfusion in hospitalised patients with pre-existing cardiovascular disease if symptomatic or Hb ≤ 80 g/L, otherwise use a restrictive strategy
3. Cannot recommend against restrictive or liberal strategy in stable hospitalised patients with acute coronary syndrome
4. Transfusion decisions should be based on symptoms as well as Hb

Guidelines for RBC Transfusion

1. Adhere to a restrictive strategy in hospitalised stable patients (Hb 70-80 g/L)

2. Consider transfusion in hospitalised patients with pre-existing cardiovascular disease if symptomatic or Hb ≤ 80 g/L, otherwise use a restrictive strategy

3. **Cannot recommend against restrictive or liberal strategy in stable hospitalised patients with acute coronary syndrome**

4. Transfusion decisions should be based on symptoms as well as Hb

Transfusion Thresholds Today

• Patient’s signs and symptoms PLUS:
  – Hb 70 g/L for stable in-patients
  – Hb 80 g/L for patients with cardiac risk factors or cardiac symptoms
  – acute coronary syndromes? (no large RCT evidence yet)

• Cardiac symptoms:
  – dyspnea, syncope, chest pain, tachycardia, orthostatic hypotension, heart failure
  – not fatigue alone
Choosing Wisely Canada

3. Don’t transfuse red blood cells for arbitrary hemoglobin or hematocrit thresholds in the absence of symptoms, active coronary disease, heart failure or stroke.

1. Don’t transfuse blood if other non-transfusion therapies or observation would be just as effective.

Also: Canadian Hematology Society, Canadian Society of Palliative Care Physicians
## Randomised Trials of RBC Transfusion

<table>
<thead>
<tr>
<th>Trial</th>
<th>N (year)</th>
<th>Res/Lib Hb/Hct</th>
<th>Target Hb/Hct Range</th>
<th>1 unit at a time?</th>
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</thead>
<tbody>
<tr>
<td>TRICC (ICU)</td>
<td>838 (1999)</td>
<td>70/100</td>
<td>Res: 70 – 90</td>
<td>Yes</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Lib: 100-120</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lib: ≥ .30</td>
<td></td>
</tr>
<tr>
<td>FOCUS (hip #)</td>
<td>1999 (2011)</td>
<td>80/100</td>
<td>Res: ≥ 80</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lib: ≥ 100</td>
<td></td>
</tr>
<tr>
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<td>889 (2013)</td>
<td>70/90</td>
<td>Res: 70 - 90</td>
<td>Yes</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Lib: 90 - 110</td>
<td></td>
</tr>
<tr>
<td>TRISS (sep. shock)</td>
<td>998 (2014)</td>
<td>70/90</td>
<td>Res: &gt; 70</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lib: &gt; 90</td>
<td></td>
</tr>
</tbody>
</table>
2 Don’t transfuse more than one Red cell unit at a time when transfusion is required in stable, non-bleeding patients.

1U RBC raises the Hb by about 10 g/L in the non-bleeding average-sized patient and more than that in smaller patients.
### ORBCoN RBC Audit 2013
5 Ontario Community Hospitals plus SHSC

<table>
<thead>
<tr>
<th>Site</th>
<th>Number of RBC transfusion orders</th>
<th>Number of RBC units ordered</th>
<th>Number of RBC units transfused</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>44</td>
<td>100</td>
<td>99</td>
<td>44</td>
</tr>
<tr>
<td>B</td>
<td>60</td>
<td>146</td>
<td>120</td>
<td>60</td>
</tr>
<tr>
<td>C</td>
<td>120</td>
<td>265</td>
<td>225</td>
<td>90</td>
</tr>
<tr>
<td>D</td>
<td>106</td>
<td>229</td>
<td>212</td>
<td>81</td>
</tr>
<tr>
<td>E</td>
<td>125</td>
<td>273</td>
<td>200</td>
<td>109</td>
</tr>
<tr>
<td>Total</td>
<td>455</td>
<td>1013</td>
<td><strong>856</strong></td>
<td>384</td>
</tr>
</tbody>
</table>

Total RBC units transfused per hospital in 2012 ranged from 2613 to 6062
Pre-transfusion Hb < 80 g/L
(excluding outpatients 20-25%)

Percentage of Transfusions

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>50</td>
<td>61</td>
<td>79</td>
<td>75</td>
<td>77</td>
<td>84</td>
</tr>
</tbody>
</table>

Slide credit: Yulia Lin

www.transfusionontario.org
Ontario RBC Audit 2013
Single Unit Transfusions
(excluding outpatients 20-25%)

Percentage of Transfusions

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<th></th>
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<tbody>
<tr>
<td></td>
<td>25</td>
<td>37</td>
<td>35</td>
<td>33</td>
<td>32</td>
<td>78</td>
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Slide credit: Yulia Lin

www.transfusionontario.org
### Risks of Transfusion

or...one of the reasons restrictive strategies are better

<table>
<thead>
<tr>
<th>Risk of Event</th>
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<tbody>
<tr>
<td>1 in 100</td>
<td>Hives</td>
</tr>
<tr>
<td>1 in 300</td>
<td>Fever</td>
</tr>
<tr>
<td>1 in 700</td>
<td>TACO</td>
</tr>
<tr>
<td>1 in 7,000</td>
<td>TRALI</td>
</tr>
<tr>
<td>1 in 12,000</td>
<td>SEPSIS</td>
</tr>
<tr>
<td>1 in 10,000</td>
<td>Sepsis per unit of red blood cells</td>
</tr>
<tr>
<td>1 in 1,700,000</td>
<td>Hepatitis B virus infection</td>
</tr>
<tr>
<td>1 in 250,000</td>
<td>Symptomatic bacterial sepsis per unit of red blood cells</td>
</tr>
<tr>
<td>1 in 500,000</td>
<td>Death from bacterial sepsis, per unit of red blood cells</td>
</tr>
<tr>
<td>&lt; 1 in 1,000,000</td>
<td>West Nile virus infection</td>
</tr>
<tr>
<td>1 in 6,700,000</td>
<td>Hepatitis C virus infection</td>
</tr>
<tr>
<td>1 in 8,000,000</td>
<td>Human Immunodeficiency Virus (HIV) infection</td>
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Blood Easy 3 ; 2011
Vox Sang 2012;103:83
Blood 2012;119:1757
Slide credit: Yulia Lin
## Risks of Transfusion

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<td>1 in 700</td>
<td>TACO</td>
</tr>
<tr>
<td>1 in 7,000</td>
<td>Delayed hemolysis</td>
</tr>
<tr>
<td>1 in 12,000</td>
<td>TRALI</td>
</tr>
<tr>
<td>1 in 10,000</td>
<td>Symptomatic bacterial sepsis</td>
</tr>
<tr>
<td>1 in 40,000</td>
<td>Getting the wrong (ABO) blood type</td>
</tr>
<tr>
<td>1 in 40,000</td>
<td>Anaphylaxis</td>
</tr>
<tr>
<td>1 in 60,000</td>
<td>Death from bacterial sepsis</td>
</tr>
<tr>
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Most common causes of death from transfusion:

- TACO
- TRALI
- SEPSIS
- WRONG BLOOD
- ANAPHYLAXIS

References:
- Bloody Easy 3; 2011
- Vox Sang 2012;103:83
- Blood 2012;119:1757

Slide credit: Yulia Lin
Transfusion-related fatalities US and Canada

FDA to 2013

PHAC to 2012

TACO
Transfusion-related Deaths (n=41)
PHAC TTISS 2006-2012

13 TACO (32%)

PHAC: Public Health Agency of Canada
TTISS: Transfusion Transmitted Injuries Surveillance System
Transfusion Associated Circulatory Overload (TACO)

Within 6 hours of transfusion:
1. Acute respiratory distress
2. Tachycardia
3. Increased blood pressure
4. Acute or worsening pulmonary edema
5. Evidence of positive fluid balance

Mortality rate 5-15%

Incidence: 1:68 (Narick) 1:33 (Clifford)

Under-reported!
- 3 of 176 cases reported to the TM service (Clifford)

Narick. Transfusion 2012;52:160
Clifford. Anesthesiology 2015;122:21
TACO – Patients at risk

- Older patients (>70 yrs)
- Renal insufficiency
- Cardiac dysfunction
- Positive fluid balance
  - crackles, ↑ JVP, peripheral edema
- Infusion of large volumes
- Faster infusion rates

TACO – Patients at risk

- Older patients (>70 yrs)
- Renal insufficiency
- Cardiac dysfunction
- Positive fluid balance
  - crackles, ↑ JVP, peripheral edema
- Infusion of large volumes
- Faster infusion rates

1. Consider pre-transfusion furosemide in at-risk patients.
2. Specify the infusion rate (max 4 hrs).
3. Transfuse on day shift if possible for safety (monitoring).
Order the Infusion Rate

Bedside Audit 2011

- infusion rate was specified in fewer than 50% of transfusion orders
- Infusion of RBC must be completed within 4 hours
- Infusion rate is a significant factor in TACO
Transfusion Related Acute Lung Injury (TRALI)

- Sudden onset of acute lung injury occurring 1-2 hours post transfusion, may be delayed up to 6 hours
- Hypoxemia: $\text{PaO}_2/\text{FiO}_2 \leq 300$, $\text{SpO}_2 < 90\%$ on room air
- dyspnea, fever, hypotension
- CXR shows bilateral interstitial and alveolar infiltrates
- No other cause for ALI, no TACO
Transfusion-related fatalities US and Canada

FDA to 2013

PHAC to 2012

(TRALI + possible TRALI)
Transfusion-related Deaths (n=41)
TTISS 2006-2012

5 TRALI
11 Possible TRALI
39%

PHAC: Public Health Agency of Canada
TTISS: Transfusion Transmitted Injuries Surveillance System

www.phac-aspc.gc.ca
www.transfusionontario.org
<table>
<thead>
<tr>
<th>Classification</th>
<th>Priming required?</th>
<th>Etiologic agent</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic mechanism I</td>
<td>No</td>
<td>Donor WBC Ab</td>
<td>Recipient granulocytes</td>
</tr>
<tr>
<td>Reverse classic mechanism I</td>
<td>No</td>
<td>Recipient WBC Ab Ab</td>
<td>Donor granulocytes (?)</td>
</tr>
<tr>
<td>Classic mechanism II</td>
<td>Yes (mice)</td>
<td>Donor WBC Ab</td>
<td>Recipient monocytes</td>
</tr>
<tr>
<td>Classic mechanism III</td>
<td>No</td>
<td>Donor WBC Ab</td>
<td>Recipient endothelial cells</td>
</tr>
<tr>
<td>Alternate mechanism</td>
<td>Yes (e.g. infection, surgery)</td>
<td>Lipids released during storage</td>
<td>Recipient granulocytes</td>
</tr>
<tr>
<td>Alternate mechanism II</td>
<td>No</td>
<td>CD40L released from stored PLT</td>
<td>PMN’s CD40</td>
</tr>
<tr>
<td>Alternate mechanism IIa</td>
<td>No</td>
<td>CD40L released from stored PLT</td>
<td>Endothelial cells’ CD40</td>
</tr>
</tbody>
</table>

AuBuchon. Transfusion 2014;54:3021
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Since 2010 all CBS plasma for transfusion is from male donors only

AuBuchon. Transfusion 2014;54:3021
TRALI: Management

• Supportive care, including mechanical ventilation
• Usually resolves in 24-72 hours
• Report to the Blood Bank
• Other patients may be affected
  – a donor unit is divided into RBC, plasma and platelets
• Recipient and donor testing at CBS may be necessary, arrange with the Blood Bank
O negative Red Blood Cells

- What the standards say
- Ontario maternal age data
• When there is insufficient time to complete the ABO and Rh group of the recipient or a sample cannot be obtained, group O red cells shall be issued.

• Group O Rh negative red cells should be issued for women of childbearing age and children.
• …whole blood or red blood cells should be Rh-negative for children and women of child-bearing age

• …recipients with an undetermined ABO group shall receive group O red blood cells
• …whole blood or red blood cells should be Rh-negative for female children and women of child-bearing age or younger
• …recipients with an undetermined ABO group shall receive group O red blood cells
5.5% MTP, no ABO group on file, or only 1 ABO group on file
Ontario
FY 2007-2008 to 2011-2012 (source: CIHI)

Cumulative % of births by maternal age

98% ≤ 41
99% ≤ 42
99.5% ≤ 43
Total 662,042

Cum %

maternal age (yrs)


TOTAL 662,042
## Summary of Ontario Maternal Age Data
**FY 2007-2008 to 2011-2012 (source: CIHI)**

<table>
<thead>
<tr>
<th>Cum % of all births</th>
<th>Maternal age (yr)</th>
<th>LHIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>98</td>
<td>≤ 39</td>
<td>NE, NW</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>ESC, SW, WW, HNHB, SE, NSM</td>
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<td></td>
<td>41</td>
<td>CW, MH, Cen, CE, Cham</td>
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<tr>
<td></td>
<td>42</td>
<td>Tor Cen</td>
</tr>
<tr>
<td>99</td>
<td>40</td>
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<td></td>
<td>41</td>
<td>ESC, SW, WW, SE, NSM, NW</td>
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<tr>
<td></td>
<td>42</td>
<td>HNHB, CW, MH, Cen, CE, Cham</td>
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<td>43</td>
<td>Tor Cen</td>
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<tr>
<td>99.5</td>
<td>41</td>
<td>NE</td>
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<td>ESC, SW, SE, NSM, NW</td>
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<tr>
<td></td>
<td>43</td>
<td>WW, HNHB, CW, MH, CE, Cham</td>
</tr>
<tr>
<td></td>
<td>44</td>
<td>Tor Cen, Cen</td>
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Details on ORBCoN website: [www.transfusionontario.org](http://www.transfusionontario.org)
Summary

1. Use restrictive transfusion thresholds for red cell transfusion, order 1 unit at a time in stable inpatients, specify the infusion rate.

2. Try to transfuse on the day shift whenever possible for patient safety.


4. Know the maternal age data for your institution and formulate emergency transfusion protocols for the use of group O negative red cells accordingly.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Journal &amp; Year</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Hajjar</td>
<td>JAMA 2010;304(14):1559</td>
<td></td>
</tr>
<tr>
<td>5. Holst</td>
<td>NEJM 2014;371(15):1381</td>
<td></td>
</tr>
</tbody>
</table>
Thank you

“Blood is not a resource to be taken for granted, used liberally without accountability, or wasted”.

Dr. Aryeh Shander
Immediate Past President
Society for the Advancement of Blood Management
Question 1

- 58 year old man in ICU
- Multiple trauma due to motorcycle accident
- Not bleeding, no cardiac history
- HR 85, BP 130/80, Hb 75 g/L

What is the most appropriate RBC transfusion order?
A. No RBC
B. 1 unit
C. 1 unit, then re-evaluate patient and check Hb
D. 2 units
E. 2 units, then re-evaluate patient and check Hb
Question 1

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Question 2

- 58 year old man in ICU
- Multiple trauma due to fall from a ladder
- Not bleeding, has a history of myocardial infarct
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Question 2

58 year old man in ICU
Multiple trauma due to fall from a ladder
Not bleeding, has a history of myocardial infarct
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E. 2 units, then re-evaluate patient and check Hb
It’s Saturday night and you have a family in your Emergency Department who have been involved in a motor vehicle accident. You have a limited supply of O neg RBC for emergency transfusion, enough for one patient only. To whom do you issue the O neg RBC?

A. First come, first served
B. 25 year old woman
C. 22 year old man
D. 50 year old woman
E. 52 year old man
Question 3

It’s Saturday night and you have a family in your Emergency Department who have been involved in a motor vehicle accident. You have a limited supply of O neg RBC for emergency transfusion, enough for one patient only. To whom do you issue the O neg RBC?

A. First come, first served
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Question 4

What are the most common causes of transfusion-related death in Ontario?

A. Bacterial sepsis from platelets and RBCs
B. HIV and hepatitis infection
C. Acute and delayed hemolytic reactions
D. TACO and TRALI
E. ABO-incompatible RBC and plasma transfusion
Question 4

What are the most common causes of transfusion-related death in Ontario?

A. Bacterial sepsis from platelets and RBCs
B. HIV and hepatitis infection
C. Acute and delayed hemolytic reactions
D. TACO and TRALI
E. ABO-incompatible RBC and plasma transfusion