Red Blood Cell Conservation
A Surgeon’s Journey

Goya V. Raikar MD FACS, FCCP
Oklahoma Heart Hospital
Red Blood Cell Conservation

- Clinical impetus
- Evidence based learning
- Program development
- Industry partnerships
- Continued surveillance
Sternotomy to Robotic

Median Stenotomy
20-25 cm
Sternum Divided

Total Endoscopic
1-3.5 cm
Between Ribs
Instrument installed but not ready for surgeon control.
Move Instrument past cannula tip for surgeon control.
Da Vinci systems
Red Cell conservation

- Minimally invasive operations
  - Decrease inflammatory response?
  - Mini-circuits
  - Need for blood and blood products
  - Whole hospital program
September 22, 2006

Regions heart surgeons among first in the nation to use new compact circulatory support system September 22, 2006.

St. Paul, Minn., – Heart surgeons at Regions Hospital are among the first in the nation to use an innovative system for supporting a patient’s circulatory and respiratory functions while the patient is undergoing surgery on an arrested - or stopped - heart.
RBC: Critical Elements

Guidelines

Education

Technology

Metrics

Culture

Variability In Clinical Practice

Care Continuum

Our Vision
Developed in collaboration with Medtronic Structural Heart, this program will allow you to:
- Rethink the approaches for cardiac teams and integrate intervention in blood transfusion
- Teach and train care teams for faculty with evidence-based practices

Gabriel S. Adler, MD
Dr. Adler is a University of Washington Professor of Surgery in the Division of Cardiovascular Surgery and section chief for adult cardiac surgery. He specializes in minimally invasive heart surgery, valve replacement, repair, cardiothoracic bypass and surgery for aortic aneurysm. He joined the UVa faculty in 1995 after eight years as a faculty member at Boston University. He earned his medical degree from Columbia University, completed a residency in cardiovascular surgery in New York City and was a fellow at the University of California, San Francisco, Cardiovascular Research Institute. He maintains an active research program focused on improving methods and techniques for cardio surgery and on evaluating quality, cost and outcomes.

Dr. Adler’s research interests include coronary sinus retroperfusion, neurological/neuropsychological response to cardiopulmonary bypass, limiting inflammatory response to cardiopulmonary bypass, biomarker cardiopulmonary bypass, alternative to heparin anticoagulation, blood conservation in cardio surgery and quality assessment and outcomes in cardio surgery.

Robert W. Emery, Jr., MD
Dr. Emery graduated from Penn State University College of Medicine. His internship and residency were at the University of Minnesota, as well as 5 years as a research assistant in the Department of Physiology at the University of Minnesota. Cardiovascular and Thoracic training was at the Brigham and Women’s Hospital and Boston Children’s Hospital affiliation program. From 1987 to 1995 he was Associate Professor at the University of Arizona, and then moved back to Minnesota to complete his career in private practice in the Twin Cities area. He has published more than 250 peer Reviewed papers and book chapters. In addition, he has authored 5 books and delivered over 500 oral presentations.

James J. Klein, MD
Dr. Klein is the director of the cardiothoracic surgery program at Elmhurst Hospital and Medical Center, and is currently chief of Cardiothoracic Surgery at the institution. He received his undergraduate and medical school education at the prestigious Sophie Davis School of Biomedical Education, which is a combined seven-year MD program at the City University of New York. He obtained his medical degree from the State University of New York at Stony Brook. Dr. Klein completed his residency in General Surgery at the State University of New York at Brooklyn, and his residency in Cardiothoracic Surgery at the Mount Sinai Medical Center in New York City. Dr. Klein’s practice encompasses the full spectrum of required cardiac and general thoracic surgery. His ongoing clinical and academic interests are in blood conservation during cardiac surgery. He has one of the lowest transfusion ratios in the nation, while having one of the highest survival rates for coronary artery bypass grafting in New York.

Pierre Thié, MD
Dr. Thié is a cardiac and thoracic surgeon at Carolinas Medical Center in Charlotte, North Carolina of Medical Center of Southeastern Louisiana. He has over 20 years of experience in the field of cardiothoracic surgery with 18 years of experience in heart blood transfusion. He has presented extensively and internationally on all aspects of blood management, especially as it pertains to cardiothoracic surgery. He has spoken on hundreds of "no blood" surgeries with excellent results. Past president of Asia A2, Co-Chairman Education Comm. SABMA, "Top Doc" in AZ "Phoenix Magazine" for the past 10 years.
Objectives

- A clear case for blood conservation
- The Impact of a blood conservation program
- Strategies for achieving goals
A Clear Case for Blood Conservation

• **Patient Outcomes**
  • Blood transfusion introduces patient risk
    “Patients transfused during CABG surgery are 5.6 times more likely to die in the first 100 days following surgery than those not transfused.”

• **Cost**
  • Blood transfusion costs far exceeds blood acquisition cost
    • Cost of blood processing and transfusion
    • Cost of complications

• **Evidence Based Guidelines**
  • Increasing society and country level focus
    • STS/SCA, ISMICS, JCAHO, Australia Patient Blood Management Guidelines and more....
Patient Outcomes: Blood Transfusion Introduces Patient Risk

Blood transfusions during cardiovascular procedures lead to:

- Longer recovery times
- Longer hospital stays
- Increased morbidity

References:
- Koch et al. Critical Care Medicine. 2006;34(6)
- Murphy et al. Circulation. 2007;116
Patient Outcomes: Increased Morbidity

Morbidity is associated with:

- Respiratory distress syndrome (ARDS)
- Infections
- Atrial Fibrillation (AF)
- Kidney and liver function complications

References:
- Rawn J. Current Opinion in Anesthesiology. 2008;21(5)
Patient Outcomes: Scientific Findings

Conclusion:

"Perioperative red blood cell transfusion is the single factor most reliably associated with increased risk of postoperative morbid events after CABG."

Morbid events include:
- Renal morbidity
- Prolonged ventilation time
- Serious post-op infection

Study Design: Mortality and measures of morbidity were compared between patients transfused and those not transfused

Patients: 11,963 patients who had isolated CABG Jan 1995 – Jul 2002

References: Koch et al. Critical Care Medicine. 2006;34(6)
Each unit of PRBC’s was associated with:

- > 100% increased odds for renal morbidity
- 79% increased odds for prolonged ventilation
- 76% increased odds for serious infection
- 55% increased odds for cardiac morbidity
- 37% increased odds for neurologic morbidity
- 73% increased odds for overall morbidity
Costs: Blood Transfusion Costs Far Exceed Blood Acquisition Costs

- Activity-based costing models estimate that:
  Total per unit blood costs are between 3.2 and 4.8 fold that of product acquisition costs

- Activity-based costing includes:
  - Product acquisition cost
  - Hospital blood bank supply management
  - Pre-transfusion and patient blood testing processes
  - Issuing and delivering components from blood bank to transfusion site
  - Administering and monitoring transfusions + transfusion specific consent
  - Managing acute transfusion reactions and hemovigilance
  - Post-transfusion logistics
  - Direct and indirect overhead

Reference: Shander et al. *Transfusion* 2010;50
## Costs: Blood Costs Across 4 Hospitals Worldwide

<table>
<thead>
<tr>
<th>HOSPITALS</th>
<th>ENGLEWOOD HOSPITAL MEDICAL CENTER, UNITED STATES</th>
<th>RHODE ISLAND HOSPITAL, UNITED STATES</th>
<th>CENTRE HOSPITALIER UNIVERSITAIRE VAUDOIS, SWITZERLAND</th>
<th>GENERAL HOSPITAL LINZ, AUSTRIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total RBC units transfused in surgical patients</td>
<td>1,368</td>
<td>8,306</td>
<td>5,833</td>
<td>6,107</td>
</tr>
<tr>
<td>Blood acquisition costs per unit</td>
<td>$248</td>
<td>$203</td>
<td>$194</td>
<td>$154</td>
</tr>
<tr>
<td>Total blood acquisition cost</td>
<td>$338,509</td>
<td>$1,689,995</td>
<td>$1,129,854</td>
<td>$938,796</td>
</tr>
<tr>
<td>Total cost/unit including activity-based costs*</td>
<td><strong>$1,183</strong></td>
<td><strong>$726</strong></td>
<td><strong>$611</strong></td>
<td><strong>$522</strong></td>
</tr>
<tr>
<td>Total cost</td>
<td><strong>$1,618,780</strong></td>
<td><strong>$6,030,589</strong></td>
<td><strong>$3,566,551</strong></td>
<td><strong>$3,190,604</strong></td>
</tr>
</tbody>
</table>
Costs: The cost of complications

- **Conclusion:**
  Patients experiencing complications consumed significantly more hospital resources and had a longer length of stay.
  - Incremental cost*: +$15,468/hospitalization
  - Incremental length of hospital stay*: +5.3 days
  - Total incremental hospital resources: $241 million

- **Study Design:** Retrospective study reviewing the frequency of seven complications and estimating associated incremental costs (cost and length of stay)

- **Patients:** 114,233 Medicare beneficiaries undergoing CABG in 2005

*Adjusted for patient demographics and comorbid conditions

Quality improvement efforts to reduce these complications could have significant financial benefits for US hospitals.

<table>
<thead>
<tr>
<th>Complication</th>
<th>Incremental $s*</th>
<th>Incremental LOS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any complication</td>
<td>$15,469</td>
<td>5.3 days</td>
</tr>
<tr>
<td>Septicemia</td>
<td>$49,849</td>
<td>18.1 days</td>
</tr>
<tr>
<td>Infection</td>
<td>$30,100</td>
<td>13.5 days</td>
</tr>
<tr>
<td>Stroke</td>
<td>$14,349</td>
<td>5.4 days</td>
</tr>
<tr>
<td>Hemodialysis</td>
<td>$11,715</td>
<td>4.9 days</td>
</tr>
<tr>
<td>ARDS</td>
<td>$16,297</td>
<td>5.5 days</td>
</tr>
<tr>
<td>Re-operation</td>
<td>$15,358</td>
<td>3.1 days</td>
</tr>
</tbody>
</table>

*Adjusted for patient demographics and comorbid conditions
Evidence Based Guidelines Emerge Globally

In addition to the foundational 2007 STS/SCA Blood Conservation Guidelines:

- **CANADA:**
  - The Ontario Transfusion Coordinators (OttTrac) Pilot Program in academic teaching hospitals
  - Canadian Society for Transfusion Medicine

- **EUROPE:**
  - The European Union Optimal Blood Use Project
  - Wildebad Kreuz Initiative

- **UNITED STATES:**
  - Joint Commission Patient Blood Management Performance Measures
  - American Red Cross: A Compendium of Transfusion Practice Guidelines

- **BELGIUM:**
  - Local Bureau of Health has mandated that autologous transfusions make up at least 20% of all hospital transfusions

- **AUSTRALIA:**
  - Western Australia Patient Blood Management Program (PBM)

- **WORLD:**
  - AABB Perioperative Blood Management: A Physician's Handbook
  - International Society of Minimally Invasive Cardiac Surgeons (ISMICS) Blood Management Consensus Statement
Collaborated to assist physicians in clinical decision making regarding approaches to blood conservation for cardiac surgery patients

Multi-modality approach:

- **Drugs** that increase pre-operative blood volume or decrease post-operative bleeding

- **Technologies** that conserve blood

- **Techniques** that protect the patient’s own blood from the stress of operation
## STS/SCA Guideline Summary

### 2007 – Foundational Guidelines

- Evidence based guidelines
- Patients at risk
  - Age; low pre-op Hct; small body size; pre-op drugs; complex cases; emergent; co-morbidities
- Transfusion triggers
  - Hgb, 7g/dl
- Transfusion-based indicators
  - oxygenation/bleeding
- Drug therapy
  - amicar; tranexamic acid
- Techniques and Technologies
  - Pump type
  - Heparin management
  - Heparin coated circuits
  - Cell washers
  - Low prime circuits
  - Minimized circuits (RAP prime)
  - Hemofiltration

### 2011 – Update

- Blood Salvage Interventions
  - Expanded use of blood salvage (using centrifugation) to include patients with malignancy
  - Pump salvage of residual blood in CPB circuit
  - Centrifugation of pump blood vs direct reinfusion
- Perfusion Interventions
  - Microplegia to reduce hemodilution
  - Mini-circuits to reduce hemodilution
  - Biocompatible CPB circuits to limit hemostatic activation and lime inflammatory response
  - Modified ultrafiltration
  - Conventional or zero-balance ultrafiltration during CPB
  - Leukocyte filters used in CPB circuit *(NOT RECOMMENDED)*

Endorsed by the International Consortium of Evidence-based Perfusion (2011)
Evidence Based Guidelines:
The Joint Commission Patient Blood Management Measures

- **Background**
  - Pilot study was developed based on a strong interest to include blood management as a performance measure
  - Seven measures were recommended for consideration of National Quality Forum (NQF) endorsement
  - Patient Blood Management Measures (PBM)
    - PBM-01 Transfusion Consent
    - PBM-02 RBC Transfusion Indication
    - PBM-03 Plasma Transfusion Indication
    - PBM-04 PLT Transfusion Indication
    - PBM-05 Blood Administration Documentation
    - PBM-06 Preoperative Anemia Screening
    - PBM-07 Preoperative Blood Type Screening and Antibody Testing

- **Results**
  - Although strong support and “high importance”, it was determined that additional information is necessary

  “We anticipate that as a result of this project, the focus on patient blood management will rise on the national agenda.”

Reference: Gammon et al. *Transfusion* 2011;51
Patients must be evaluated individually to determine the proper transfusion therapy, with care taken to avoid over- or under-transfusion.

Impact of Blood Conservation Program: Improved Outcomes

- 32,449 isolated CABG patients 2000-2004 from 17 institutions in New Jersey
- 586 patients from Englewood Hospital propensity score-matched with 586 from other institutions with common blood management practices

“Blood conservation emerges as the sole difference responsible for the improved outcomes at EH.”

Impact of Blood Conservation Program: Improved Outcomes

Additional evidence finds similar transfusion reductions across various hospital settings:

• 41% reduction in total blood product usage\(^1\)

• Red blood cells transfused decreased from 35% to 16% after implementing an extensive blood conservation program\(^2\)

• Decreased allogeneic red blood cell transfusion in a community hospital setting from 43% to 18%\(^3\)

• 23% overall reduction in blood use in CABG\(^4\)

Reference:
2. DeAnda et al. Am Jnl Medical Quality 2006;21
4. Freedman et al. Transfusion Asph Science 2005;33
Impact of Blood Conservation Program:
Cost Savings Potential

POTENTIAL COST SAVINGS BASED ON POSSIBLE BLOOD USAGE DECREASES OF 10% AND 20% TO THE ACTUAL BLOOD USAGE OF FOUR HOSPITALS:*

<table>
<thead>
<tr>
<th>Hospital Name</th>
<th>Original Cost</th>
<th>10% Decrease in Transfusions</th>
<th>20% Decrease in Transfusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Englewood Hospital Medical Center,</td>
<td>$1,618,780</td>
<td>$161,878</td>
<td>$323,756</td>
</tr>
<tr>
<td>United States</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhode Island Hospital, United States</td>
<td>$6,030,589</td>
<td>$603,059</td>
<td>$1,206,118</td>
</tr>
<tr>
<td>Centre Hospitalier Universitaire</td>
<td>$3,566,551</td>
<td>$356,655</td>
<td>$713,310</td>
</tr>
<tr>
<td>Vaudois, Switzerland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Hospital Linz, Austria</td>
<td>$3,190,604</td>
<td>$319,060</td>
<td>$638,120</td>
</tr>
</tbody>
</table>

Reference: Shander et al. Transfusion 2010:50
Blood Product Conservation Is Associated with Improved Outcomes and Reduced Costs Following Cardiac Surgery

Objective(s): Efforts to reduce blood product utilization have the potential to avoid transfusion related complications and to reduce health care costs. The purpose of this investigation was to determine whether a multi-institutional effort to reduce blood product use through the implementation of transfusion guidelines impacts postoperative events following cardiac operations and to determine the influence of intraoperative and postoperative product transfusion on risk-adjusted outcomes.

Methods: A total of 14,259 patients (2006-2010) undergoing non-emergent, primary, isolated coronary artery bypass grafting operations at 17 different statewide cardiac centers were stratified according to transfusion guideline era: pre-guideline (n=7,059, age=63.7 ± 10.6 yr) vs. post-guideline (n=7,200, age=63.7 ± 10.5 yr). Primary outcomes of interest were observed differences in postoperative events and mortality risk-adjusted associations as estimated by multiple regression analysis.

Results: Overall intraoperative (18% [n=1274] vs. 24% [n=1697], p<0.001) and postoperative (33% [n=2363] vs. 39% [n=2761], p<0.001) blood product transfusion was significantly reduced in the post-guideline era. As a result, post-guideline patients demonstrated reduced morbidity with decreased pneumonia (p=0.01), prolonged ventilation (p=0.05), renal failure (p=0.03), new onset hemodialysis (p=0.004) and composite incidence of major complications (p=0.001, Table). Operative mortality (1.0% [n=71], vs. 1.8% [n=135], p<0.001) and postoperative ventilation time (22h vs. 26h, p<0.001) were similarly reduced in the post-guideline era. Importantly, after mortality risk-adjustment, operations performed in the post-guideline era were associated with a 47% reduction in the odds of death (AOR=0.57, p<0.001), while the risk of major complications and mortality were significantly increased following intraoperative (AOR=1.86 and 1.25, both p<0.001) and postoperative (AOR=4.61 and 4.50, both p<0.001) transfusion.

Intraoperative and postoperative transfusions were also associated with increased adjusted additive total costs ($4,408 and $10,479, respectively).

Conclusions: Implementation of a blood utilization initiative significantly improves postoperative morbidity, mortality and resource utilization. Limiting intraoperative and postoperative blood product transfusion decreases adverse postoperative events and reduces health care costs. Blood conservation efforts are bolstered by collaboration and guideline development.

Source:
AATS Annual Conference Program 2012
Impact of Blood Conservation Program: Cost Savings Potential

One hospital’s experience:

Reducing average per patient blood use by only one unit could realize:

- $480,000 to $720,000 per year of cost savings
  - Program performing 300 cases per year (similar to that studied)
  - Includes costs associated with complications

RBC Conservation

- OHH transfusion rate between 40-50% for cardiac surgical patients
  - Approximately 1200-1300 cases/yr
Initiating an RBC program

- Identification of key components and providers
  - Pre-operative
  - Intraoperative
  - Post-operative
Oklahoma Heart and Medtronic

- **Goal:** Through a multi-modality approach, decrease the transfusion rate associated with cardiac surgery to improve patient outcomes and reduce the costs of blood product utilization and blood use-related complications

- **Accelerate and sustain** the education, technology and clinical practice activities that are impacting the decreasing transfusion rates, improved patient care and reduced costs
Initiating an RBC program

- Personell
  - Surgeon
  - Anesthesiology
  - Perfusion
  - Head of nursing, ICU, OR
  - Lead intensivist

- Site visit
Initiating an RBC program

- Medical executive committee meetings
- Sharing evidence based studies
- Protocols
  - Moving away from transfusion triggers
  - Education of staff
Initiating an RBC program

- Technology
  - Intraoperative
  - Perioperative
Initiating an RBC program

• Intraoperative
  • Design and build of a custom “mini-circuit”
    • Original OHH circuit
      • Non-coated
      • No cell saver
      • Prime volume approximate 1800 cc crystalloid
  • Visit to Medtronic PRL site
    • Lab with different circuits
      • VARD system
      • Open Medtronic mini-circuit
      • Terumo Fx 15 and Fx 25
Initiating an RBC program

- Our mini circuit design
  - Coated circuit
  - Minimizing perfusion lines
  - Fx 15 Fx 25 Terumo
  - RAP prime
  - Used circuit design for all cases including complex valve cases and circulatory arrest
Initiating an RBC program

- Intraoperative
  - Anesthesiology
    - Hemodilution
    - RAP (Retrograde autologous prime)
    - Prime = approximately 500cc or less of crystalloid
  - TEG analysis
    - Pre-operative
    - Intraoperative
    - ICU
Initiating an RBC program

- Data analysis
- Internal OHH review
- ARMUS
Keyboard shortcuts and field definitions are always available without any extra keystrokes.
D. Preoperative Data

Pre-op blood products transfused to the patient:  ○ Yes  ○ No

Ordered Blood Products:  ○ Surgeon  ○ Preop Nurse  ○ Anesthesiologist  ○ PA or NP  ○ Other  ○ Other:

RBC: __________  Platelets: __________  FFP: __________

Pre-Op HCT: __________

Platelets: __________  Platelet Function Test:  ○ Yes  ○ No  Platelet Function Test Type: __________

Preop ACT: __________  Arrhythmia - Aflib/Aflutter:  ○ Yes  ○ No

COPD:  ○ Yes  ○ No  Diabetes:  ○ Yes  ○ No  Control:  ○ None  ○ Diet  ○ Oral  ○ Insulin  ○ Other

HTN:  ○ Yes  ○ No  Ejection Fraction: __________

Anti Platelet Agents:  ○ Yes  ○ No  Discontinued>5 days prior:  ○ Yes  ○ No

POC Device used to measure ACT:

○ HMS System
○ ACT Plus
○ Hemocon
○ Hemocon Jr
○ POC not used sample processed in the lab
○ Other:
  If Other, Specify: __________

Operative

Arterial Pump Type:  ○ roller Head Pump  ○ Centrifugal Pump

Centrifugal Pump Type:  ○ Affinity CP  ○ BP 50  ○ BPX 80  ○ Revolution  ○ Codaex  ○ ROTA Flow

CPB Circuit Used:  ○ Open  ○ Closed  ○ Reservoir Less
Oklahoma Heart:
Risk Factors, June 2013 - March 2014

- Advanced Age: 39.2%
- Low Hgb: 0.0%
- AntiPlatelets: 10.0%
- Reoperation: 6.4%
- Emergent: 3.6%
- Non-cardiac comorbidities: 55.6%

Mean Body Surface Area (m²): 2.0
Oklahoma Heart: Patient Outcomes by Transfusion Group, June 2013-March 2014

- Average OR Time (Hours)
  - Blood Transfused: 7.1
  - No Blood Transfused: 5.7

- Average ICU Days
  - Blood Transfused: 2.5
  - No Blood Transfused: 1.5

- Average Length of Stay Surgery to Discharge
  - Blood Transfused: 4.7
  - No Blood Transfused: 3.9
Oklahoma Heart: Cost of Care by Transfusion Group, June 2013 - March 2014

Note: Dollar values are Registry averages.
Oklahoma Heart:
Mean Units Per Transfused Patient, June 2013 - March 2014

<table>
<thead>
<tr>
<th></th>
<th>Preop</th>
<th>Operative</th>
<th>Postop</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBC</td>
<td>0.0</td>
<td>2.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Platelet</td>
<td>0.0</td>
<td>1.7</td>
<td>2.0</td>
</tr>
<tr>
<td>FFP</td>
<td>0.0</td>
<td>3.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Cryo</td>
<td>1.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Oklahoma Heart:
Mean Cost Per Transfused Patient, June 2013 - March 2014

NOTE: Dollar values are Registry averages

Mean Cost of Blood per Transfused Patient

- RBC: $271
- Platelet: $879
- FFP: $115
- Cryo: $353

Preop, Operative, Postop categories are indicated by different colors.
Percentage of Operative Blood Products Ordered by Health Care Professional
June 2013 - March 2014

Anesthesiology

- 5.6% ordered

Surgeon

- 94.4% ordered

Mean Cost per Transfused Patient

- $0

- $500

- $1,000

- $1,500

- $2,000

Percentage of Blood Ordered

- 0%

- 20%

- 40%

- 60%

- 80%

- 100%

Oklahoma Heart:

- Advanced Age
- Low Hgb
- AntiPlatelets
- Reoperation
- Emergent
- Non-cardiac comorbidities

Mean Body Surface Area

Body Surface Area (m²)
Percentage of Postop Blood Products Ordered by Health Care Professionals
June 2013 - March 2014

![Graph showing the percentage of blood ordered by different health care professionals.]

- Anesthesioloist: 16.7%
- PA or NP: 16.7%
- Surgeon: 66.7%

Mean Cost per Transfused Patient:
- $0
- $500
- $1,000
- $1,500
- $2,000
Oklahoma Heart:
Overall Transfusion Rates, June 2013 - March 2014

Total Complete Patient Cases = 103

Periop Blood Given
Pre- or Post-op Only

Periop = 2.1%
Pre-Post Op = 14.3%
Total = 16.4%
RBC CONSERVATION

- Champions
  - Surgeon
  - Anesthesiology
  - ICU
  - Critical care
  - Nursing
Discussion
Medtronic Empowers Hospitals Throughout the Process

GUIDELINE AWARENESS

EDUCATION & TRAINING

SUITE OF TOOLS & TECHNOLOGIES
Rethinking Blood Conservation (RBC) Initiative
Objective: Improve patient outcomes and the financial health of hospitals through better blood management and practices

**Account Engagement**

**Plan**
Evaluation of existing practices and impact assessment with multi-disciplinary team

**Implement**
Consultative approach toward blood management communication, evaluation and education

**Measure**
Tools for tracking and measuring impact

**Multi-Product Procedural Impact**

**Mini-circuits**

**Biocompatible Circuits**

**Cell Salvage**

**Hemostasis Management**

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RBC® Initiative: Supporting Tools

- **RBC® Challenge**
  - 50 patient cases with RBC protocol vs. 25 control cases
  - Cost neutral evaluation

- **RBC® Registry**
  - Customized Perfusion based tracking tool
  - Available to account during implementation of RBC technologies

- **Quarterly Business Reviews**
  - Help you measure progress, celebrate success, and determine next steps