Perioperative Transfusion Stewardship

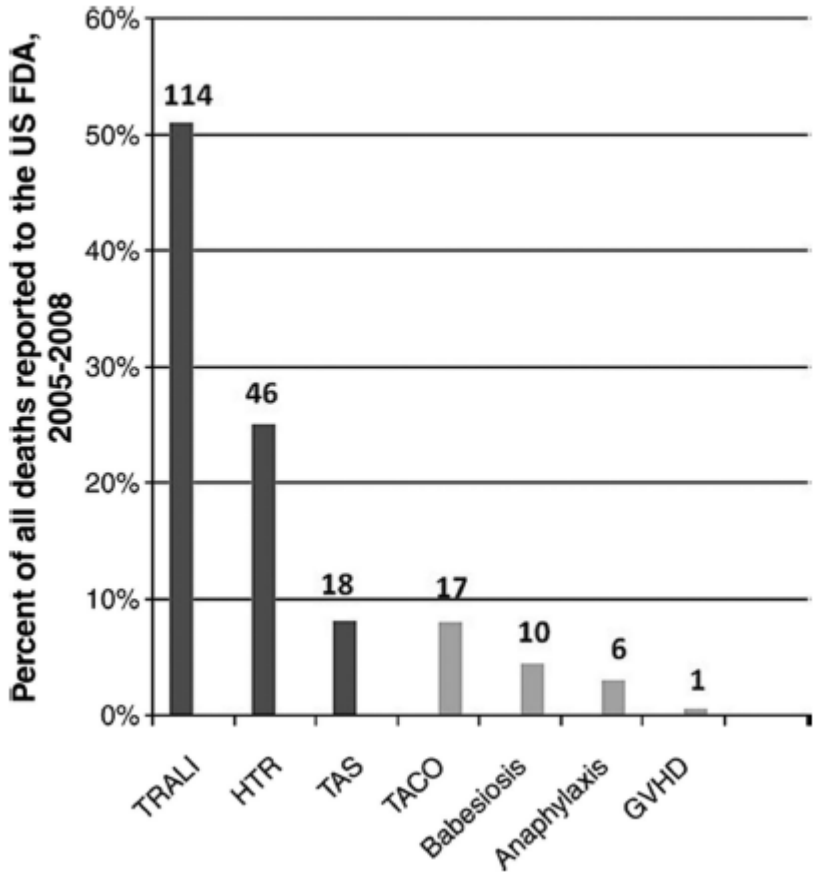
MPOG
MULTICENTER PERIOPERATIVE OUTCOMES GROUP

Objectives

- Discuss risks and outcomes associated with transfusion
- Describe ASPIRE transfusion measures
- Provide general recommendations based on American Society of Anesthesiologists (ASA) Transfusion Guidelines (2015)
- Share procedure-specific considerations presented in the literature for orthopedic, cardiac, oncologic, and general surgery
- Review best practices when transfusion cannot be avoided:
  - Massive Transfusion Protocols
  - Obstetric Hemorrhage Protocols (ACOG Recommendations)
- Summarize ASPIRE recommendations based on literature presented

Risks Associated with Transfusion

- Anaphylaxis
- Hemolytic transfusion reaction (HTR)
- Transfusion-associated sepsis (TAS)
- Transfusion-related acute lung injury (TRALI)
- Transfusion-associated circulatory overload (TACO)
- Transfusion-associated graft-versus-host disease (TA-GVHD). (ASA Task Force, 2015)



(Goodnough LT, 2012)

Approximate Risk Per-Unit Transfusion of RBCs

Table 1. Approximate Risk Per-Unit Transfusion of Red Blood Cells (RBCs)

Adverse Event	Approximate Risk Per-Unit Transfusion of RBCs
Febrile reaction[11]	1:60[a]
Transfusion-associated circulatory overload[12,13]	1:100[b]
Allergic reaction[14]	1:250
Transfusion-related acute lung injury[15]	1:12 000
Hepatitis C virus infection[16]	1:1 149 000
Hepatitis B virus infection[17]	1:1 208 000 to 1:843 000[c]
Human immunodeficiency virus infection[16]	1:1 467 000
Fatal hemolysis[18]	1:1 972 000

[a] Estimated to be 1:91 with prestorage leukoreduction and 1:46 with poststorage leukoreduction.

[b] Indicates the estimated risk per recipient rather than unit.

[c] The estimate is variable depending on the length of the infectious period.

(Carson, 2016)

Risks of Transfusion for Noncardiac Surgery

Table 3. Impact of Intraoperative Transfusion on 30-Day Mortality and 30-Day Complications

Outcome	Transfusion Group, Outcome Rate (%)	No Transfusion Group, Outcome Rate (%)	Unadj OR Txf *vs.* No Txf (95% CI)	Adj OR Txf *vs.* No Txf (95% CI)	Adj OR Txf *vs.* No Txf (PS Method) (95% CI)
Mortality	6.44	4.26	1.55 (1.24, 1.90)	1.29 (1.03, 1.62)	1.21 (0.96, 1.52)
Cardiac complications	2.08	1.40	1.50 (1.06, 2.12)	1.40 (0.97, 2.03)	1.31 (0.88, 1.95)
Pulmonary complications	12.6	6.03	2.24 (1.92, 2.63)	1.76 (1.48, 2.09)	1.75 (1.47, 2.08)
Renal complications	2.69	1.85	1.46 (1.08, 1.99)	1.32 (0.93, 1.88)	1.29 (0.91, 1.84)
CNS complications	0.69	0.58	1.20 (0.67, 2.15)	0.84 (0.43, 1.64)	0.68 (0.34, 1.38)
Sepsis complications	16.4	9.81	1.81 (1.58, 2.07)	1.43 (1.21, 1.68)	1.46 (1.24, 1.72)
Wound complications	9.17	4.65	2.07 (1.73, 2.48)	1.87 (1.47, 2.37)	1.89 (1.49, 2.41)
Thromboembolic complicatioins	4.07	1.89	2.20 (1.69, 2.88)	1.77 (1.32, 2.38)	1.81 (1.34, 2.45)

Adj = adjusted; CI = confidence interval; CNS = central nervous system; OR = odds ratio; PS method = propensity score method; Txf = transfusion; Unadj = unadjusted.

(Glance, 2011)

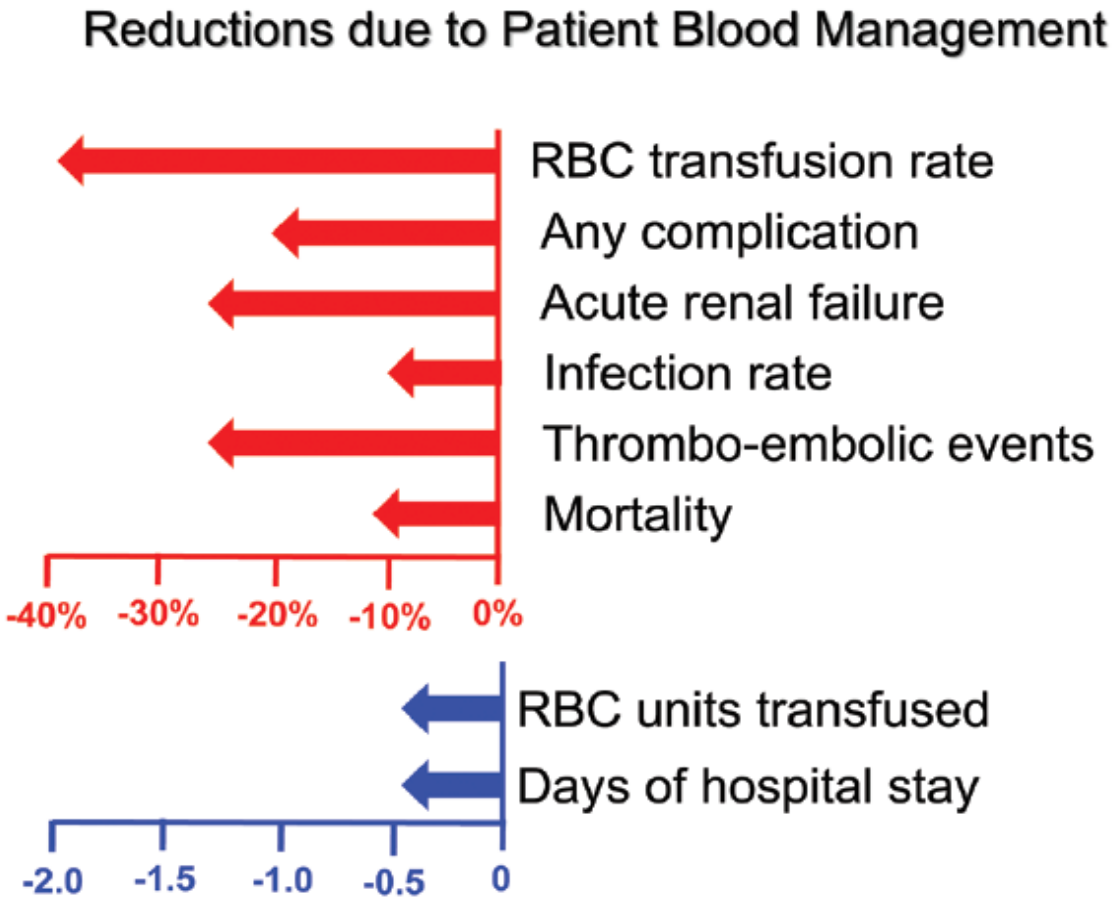
Outcomes Associated with Perioperative Blood Transfusion

- More than 1 in 10 patients undergoing hepatic, pancreatic, or colorectal resection were transfused under a liberal trigger, which was associated with worse patient outcomes and increased institutional cost compared with the restrictive trigger group. (Ejaz, 2015)
- Patients who received one or two units of erythrocytes had a 29% increased odds of death and a 40-90% increased odds of pulmonary, sepsis, wound, and thromboembolic. (Glance, 2011)
- 30-day mortality rate for patients who were transfused was 6.44% versus 4.26% for patients who were not transfused. (Glance, 2011)
- Restricting blood transfusions using a restrictive trigger of ≤ 7 g/dL results in a significant reduction in total mortality, acute coronary syndrome, pulmonary edema, re-bleeding, and bacterial infection compared with more liberal transfusion strategy. (Salpeter, 2014)

Financial Impact: Total cost of a single unit of PRBCs

- Actual institutional acquisition costs approximately $220 per unit
- Estimated mean activity-based cost of transfusion: $760 per unit ($522-$1183) takes into account acquiring, delivering, administering, and monitoring each transfusion. (Ejaz, 2015)

Implementing Patient blood management measures has shown to reduce transfusion of blood products and improve patient outcomes



(Spahn, 2020)

How do we measure transfusion management quality in ASPIRE?

- TRAN 01 – measuring hematocrit (or hemoglobin) before every unit transfused
- TRAN 02 – monitoring over-transfusion by ensuring that post transfusion hematocrit (or hemoglobin) is less than 30%

Why did we choose these measures?

- Apply to most cases where transfusions were administered
- Relatively straightforward to understand
- Data in widely contained in EHR

Transfusion Recommendations & Guidelines

ASA

M·TQIP

ACOG
The American College of Obstetricians and Gynecologists

THE SOCIETY OF THORACIC SURGEONS
Established 1964

MARCQI
MICHIGAN ARTHROPLASTY REGISTRY
COLLABORATIVE QUALITY INITIATIVE

THE MICHIGAN SOCIETY OF THORACIC & CARDIOVASCULAR SURGEONS
MCMLXV

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ASA Practice Guidelines for Perioperative Blood Management

- Preoperative Evaluation
- Preadmission Patient Preparation
- Pre-procedure Preparation
- Intraoperative and Postoperative Management of Blood Loss. (ASA Task Force, 2015).

Preoperative Evaluation

Perform several days to weeks in advance, if possible.

- Review Previous Medical Records & conduct a Patient/Family Interview
  - ✓ Previous blood transfusion?
  - ✓ History of drug-induced coagulopathy?
  - ✓ Presence of congenital coagulopathy?
  - ✓ Risk factors for organ ischemia?
  - ✓ History of thrombotic events?
- Review existing lab results (hemoglobin, hematocrit, coagulation profiles)
- Order additional lab tests based on patient's condition (anemia, coagulopathy)
- Conduct physical exam (ecchymosis, petechiae, pallor)

Prior to surgery, inform patient of potential risks vs. benefit of blood transfusion and identify patient preferences.

(ASA Task Force, 2015).

Preadmission Patient Prep Recommendations

(ASA Task Force on Perioperative Blood Management, 2015)

- **Prevention or reduction of perioperative anemia**
  - Administration of erythropoietin can reduce need for RBC transfusions in patients with perioperative hemoglobin 10-13 g/dL who are at high risk for perioperative blood loss from elective, noncardiac, nonvascular surgery. (Pfizer Medical Information)
  - Iron (IV infusion or daily oral administration)
- **Discontinue anticoagulants/antithrombotic agents** (*Consider patient condition and risk factors)*
  - Warfarin: 5 days before surgery; check PT/INR day of surgery.
  - Clopidogrel or other thienopyridines: Discontinue 5 days before surgery.
  - Aspirin: Discontinue 7-10 days before surgery.
- **Preadmission autologous blood donation (PAD)**
  - Though autologous blood donation can reduce the use of allogenic blood transfusion by 40-52%, PAD is not found to be cost-effective as compared to other blood sparing strategies. (Birkmeyer, 1993)

Pre-procedure Preparation Recommendations

Adopt Blood Management Protocols. (ASA Task Force, 2015)

- Multimodal protocol or algorithm
- Restrictive vs liberal transfusion protocol
- Non-transfusion protocol (bloodless surgery)
- Massive transfusion protocol
- Maximum surgical blood ordering schedule for elective procedures

Reversal of anticoagulants

- Vitamin K
- Prothrombin Complex Concentrates

Antifibrinolytics for prophylaxis of excessive blood loss

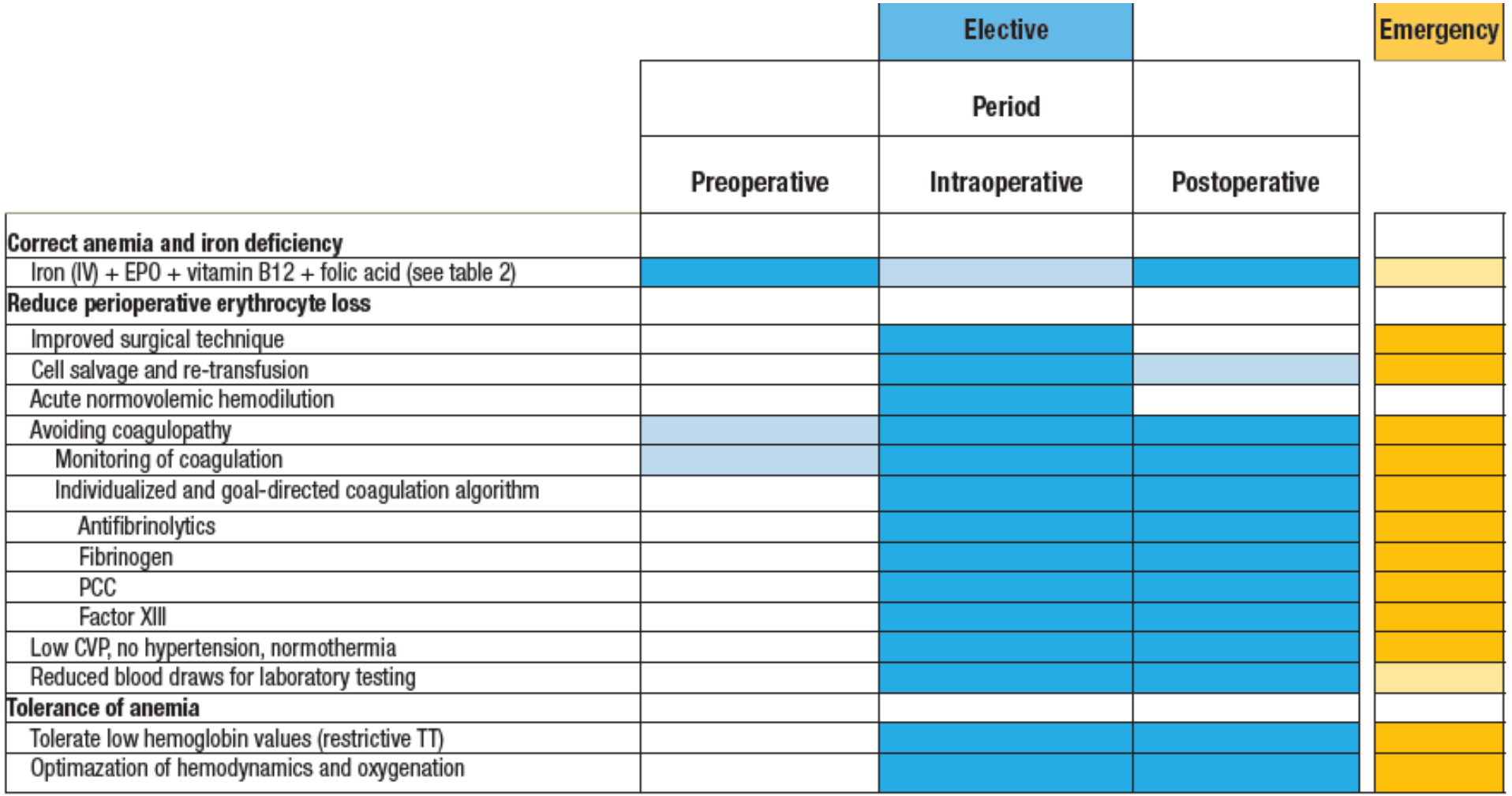
- Aminocaproic acid
- Tranexamic acid

Acute Normovolemic Hemodilution: Consider for cardiac and ortho procedures. (Shander, 2004)

Intraoperative and Postoperative Management of Blood Loss

- Allogenic Red Blood Cell Transfusion
  - Age of Stored Blood (controversial- no conclusion)
  - Leukocyte reduction: reduces complications associated with transfusion
- Reinfusion of recovered red blood cell transfusion (cell saver administration supported)
- **Intraoperative and postoperative patient monitoring**
  - Monitor blood loss
  - Perfusion of vital organs
  - Anemia
  - Coagulopathy
  - Adverse effects of transfusion
- Treatment of excessive bleeding. (ASA Task Force, 2015)

Suggested Perioperative Blood Management



	Elective		Emergency
	Period		
	Preoperative	Intraoperative	Postoperative	
Correct anemia and iron deficiency				
Iron (IV) + EPO + vitamin B12 + folic acid (see table 2)				
Reduce perioperative erythrocyte loss				
Improved surgical technique				
Cell salvage and re-transfusion				
Acute normovolemic hemodilution				
Avoiding coagulopathy				
Monitoring of coagulation				
Individualized and goal-directed coagulation algorithm				
Antifibrinolytics				
Fibrinogen				
PCC				
Factor XIII				
Low CVP, no hypertension, normothermia				
Reduced blood draws for laboratory testing				
Tolerance of anemia				
Tolerate low hemoglobin values (restrictive TT)				
Optimazation of hemodynamics and oxygenation				

(Spahn, 2020)

Treatment of Excessive Bleeding

- ASA Practice Guidelines for Perioperative Blood Management
  - Transfusion of Platelets: Obtain platelet count before transfusion
  - Transfusion of FFP: Obtain coagulation tests (INR or PT and aPTT) before transfusing FFP
  - Transfusion of Cryoprecipitate: Assess fibrinogen levels before giving cryo
  - Pharmacologic Treatment of bleeding
    - Desmopressin
    - Antifibrinolytics (tranexamic acid, aminocaproic acid)
    - Topical hemostatics (fibrin glue, thrombin gel)
    - PCCs
    - Coagulation factor concentrates (recombinant factor VIIa)
    - Treatments for hypofibrinogenemia (cryoprecipitate, fibrinogen). (ASA Task Force, 2015)

Transfusion Triggers: Literature Review

Clinical Practice Guidelines from AABB (American Association of Blood Banks)

- *Recommendation #1*: Transfusion is not indicated until hemoglobin level is 7 g/dL for hospitalized adult patients who are hemodynamically stable, including critically ill patients.*
- *Recommendation #2*: Transfusion threshold of 7-8 g/dL is indicated for patients undergoing orthopedic or cardiac surgery, and those with preexisting cardiovascular disease.*
- *Recommendation #3*: Patients, including neonates, should receive RBC units selected at any point within their licensed dating period rather than limiting patients to transfusion of only fresh (≤10 days) RBC units.

*Recommendations do not apply to patients with Acute Coronary Syndrome, severe thrombocytopenia, and chronic transfusion-dependent anemia. (Carson, 2016; Mueller, 2019)

Transfusion Triggers: Literature Review

Red Cross Transfusion Guidelines:

- RBCs should be administered based on signs and symptoms, Hgb level, and hematologic results
- In the absence of acute hemorrhage, RBCs should be administered as single units, followed by appropriate evaluation to justify additional units.
- Complete administration of a single unit within 4 hours

Post-transfusion Considerations:

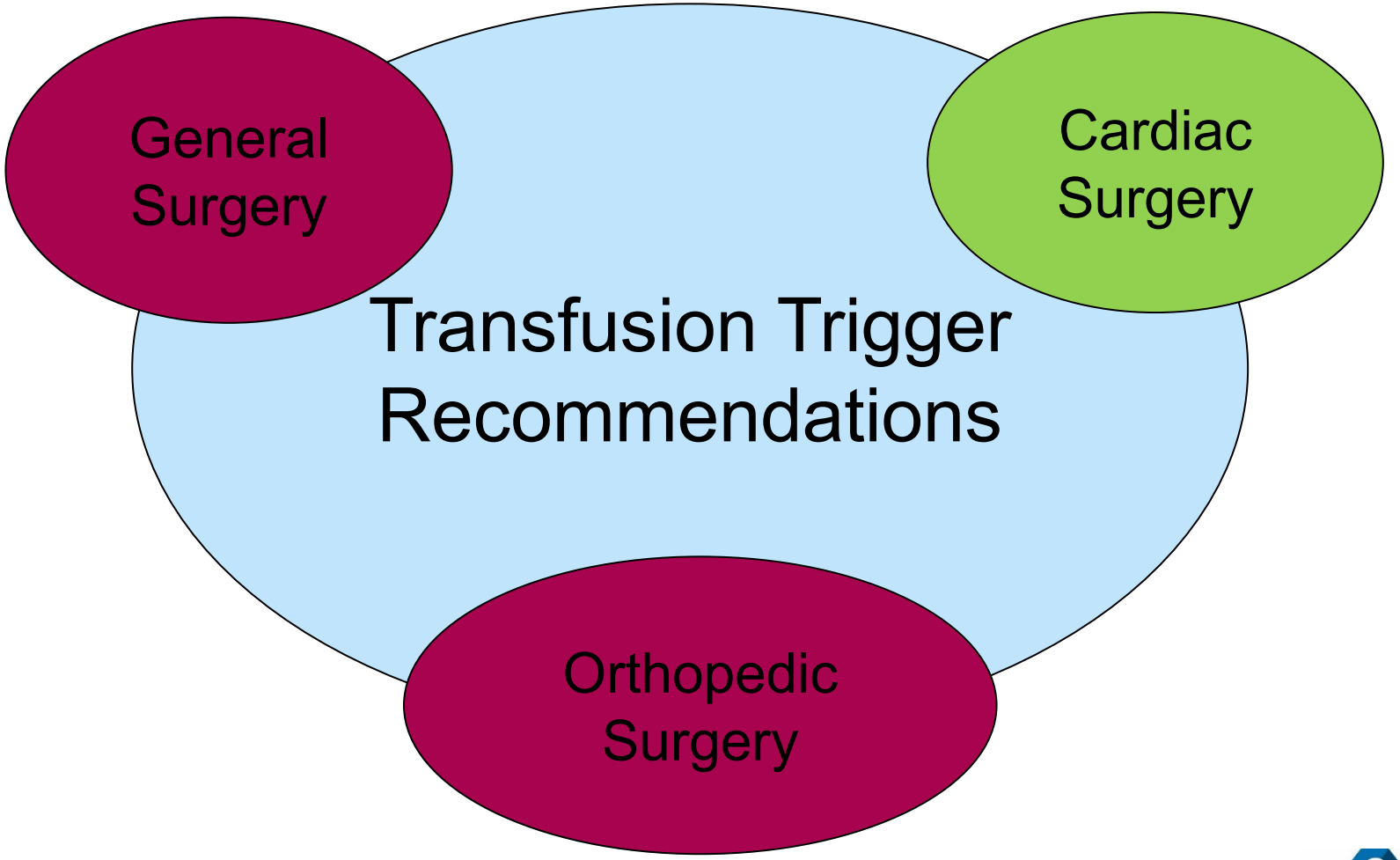
- In a non-bleeding, non-hemolyzing adult, the hemoglobin should equilibrate within 15 minutes after transfusion of RBCs.
- It is estimated that one RBC unit should increase Hgb by approximately 1g/dL or Hct by 3%. (American Red Cross, 2017)

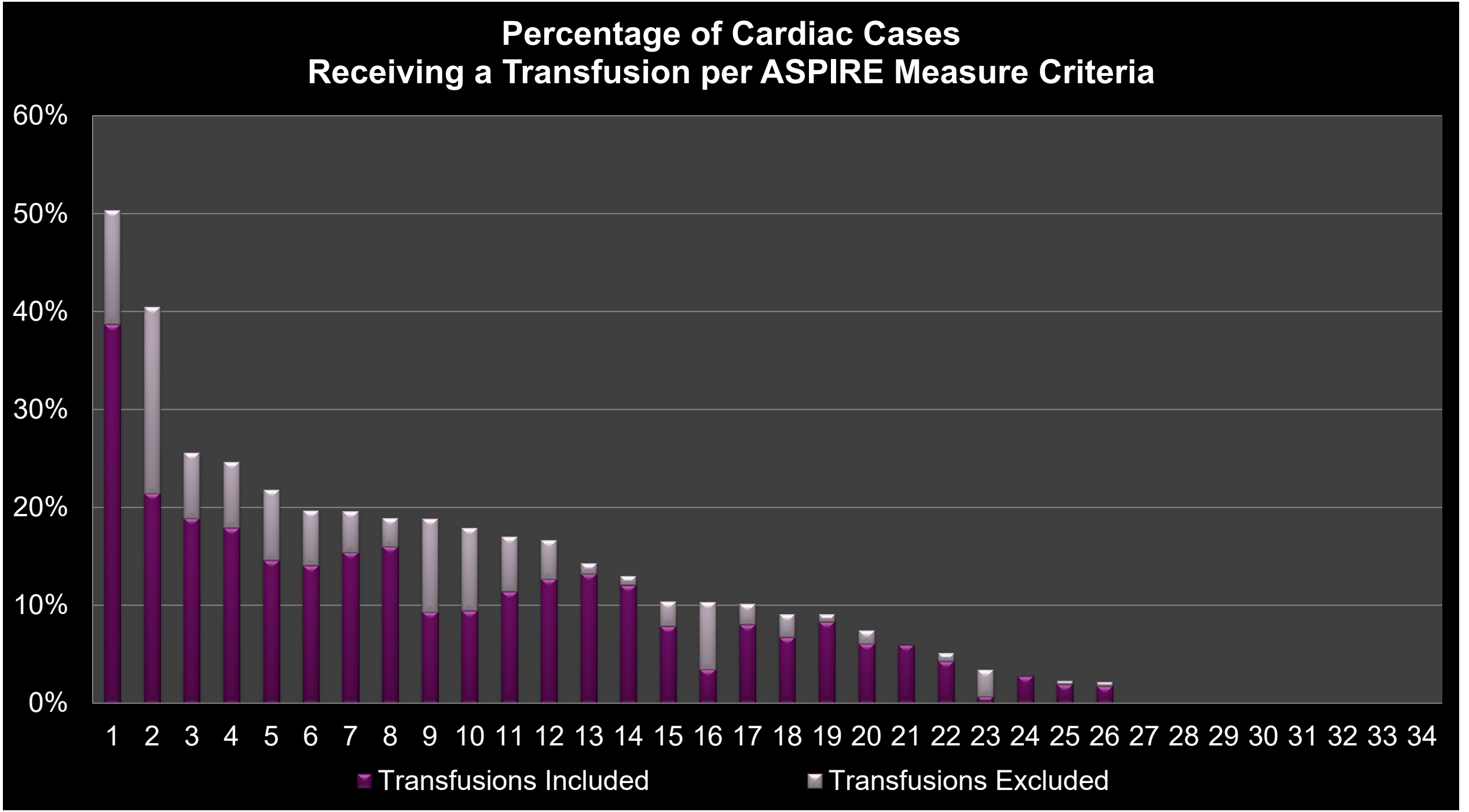
Transfusion Triggers: Literature Review

National Institute for Health and Care Excellence (NICE) Guidelines:

- Use Restrictive RBC Hgb Thresholds (7 g/dL) for patients who need RBC transfusions but do not have:
  - Major hemorrhage
  - Acute Coronary Syndrome
  - A need for regular blood transfusions for chronic anemia
- Post-transfusion Hgb target (goal) for restrictive therapy: 7-9 g/dL
- In patients with acute coronary syndrome, consider transfusion threshold of Hgb: 8 g/dL and target of 8-10 g/dL
- Set individual thresholds and targets for patients with chronic anemia
- Consider single unit red blood cell transfusions for adults who do not have active bleeding
- After each single unit of RBC transfusion, clinically reassess and check Hgb levels before administering additional units. (National Clinical Guideline Centre, 2015; Mueller, 2019)

Transfusion Trigger Considerations by Surgical Specialty



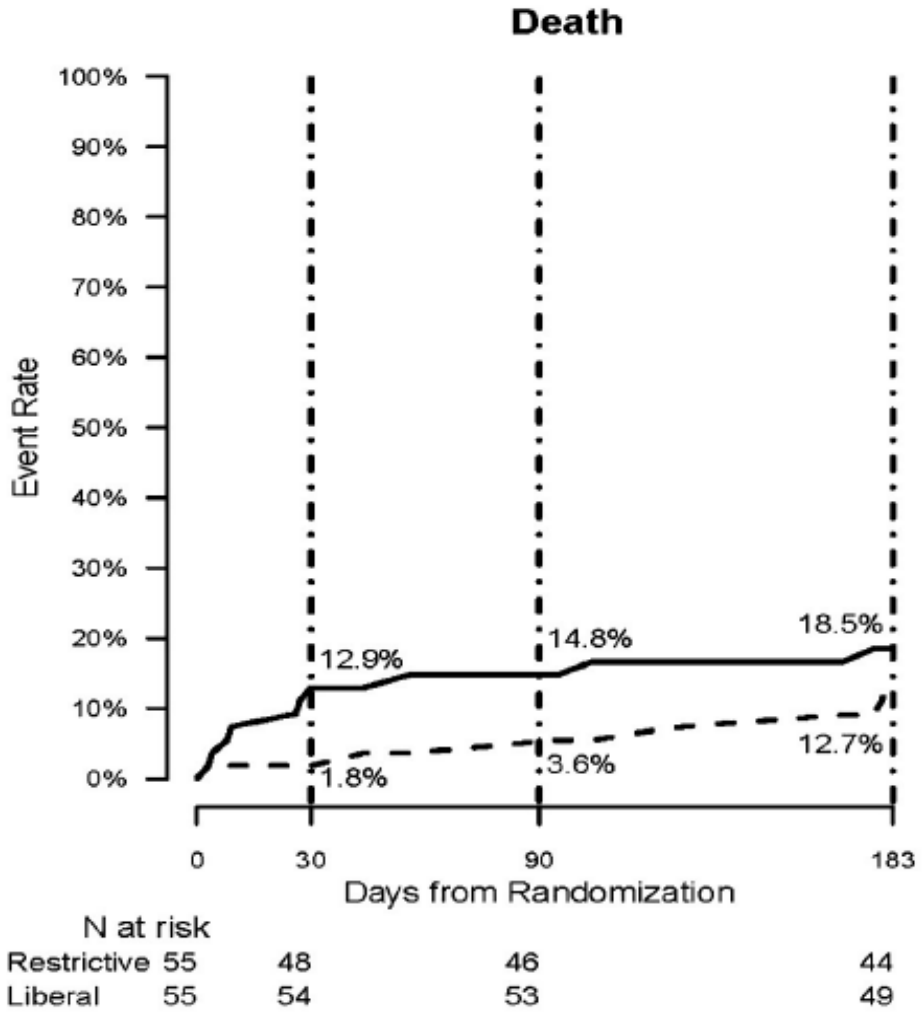

Percentage of Cardiac Cases
Receiving a Transfusion per ASPIRE Measure Criteria
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
Transfusions Included
Transfusions Excluded

Transfusion Literature: Cardiac Surgery

Conflicting definitions of restrictive transfusion presented in the literature:

- In a review article by Curley et al., there was no significant increase in rates of myocardial infarction, stroke, acute renal failure, or mortality using restrictive transfusion thresholds (Hgb: 7-9 g/dL) in patients undergoing cardiovascular surgery. (Curley, 2014)
- Low Hgb (<7) values are associated with increased operative mortality, increased likelihood of prolonged intensive care stay and greater likelihood of postoperative hospitalization of 9 or more days. (Habib, 2003)
- Restrictive transfusion thresholds (Hgb: 7-8 g/dL) associated with higher rates of acute coronary syndrome in anemic patients compared with more liberal transfusion thresholds (9-10 g/dL). (Docherty, 2016)

Liberal vs. Restrictive Transfusion Strategy in Cardiac Patients



- 110 Patients
- Restrictive: <8 g/dL
- Liberal: <10 g/dL
- Restrictive transfusion strategy resulted in increased rate of death (18.5% vs. 12.7%).

P value: 0.032

(Carson, 2013)

Transfusion Recommendations: Cardiac Surgery

Cell Saver

- Transfusion through cell saver is safe and results in a significant reduction in homologous transfusion while not causing a clinically significant coagulopathy. Pts who receive intraoperative cell saver transfusion (ICT) also have decreased mediastinal drainage 12 hours postoperatively. (Cote, 2016)
- Hgb levels fell significantly in patients on day 1 post-op however 24 hour postop Hgb was significantly higher in the auto-transfusion group. (Niranjan, 2006)
- Major concerns regarding the use of cell saver include:
  - ✓ Possible increase in the systemic inflammatory response. (Sandoval, 2001; Amand, 2002)
  - ✓ Coagulopathy postoperatively. (Daane, 2003)
  - ✓ An increased risk of fat and air emboli. (Engelhardt, 1991)
  - ✓Organ Failure. (Casey, 1993; Reents, 1999)

Michigan Society of Thoracic and Cardiovascular Surgeons (MSTCVS) & Society of Thoracic Surgeons (STS): Transfusion Considerations

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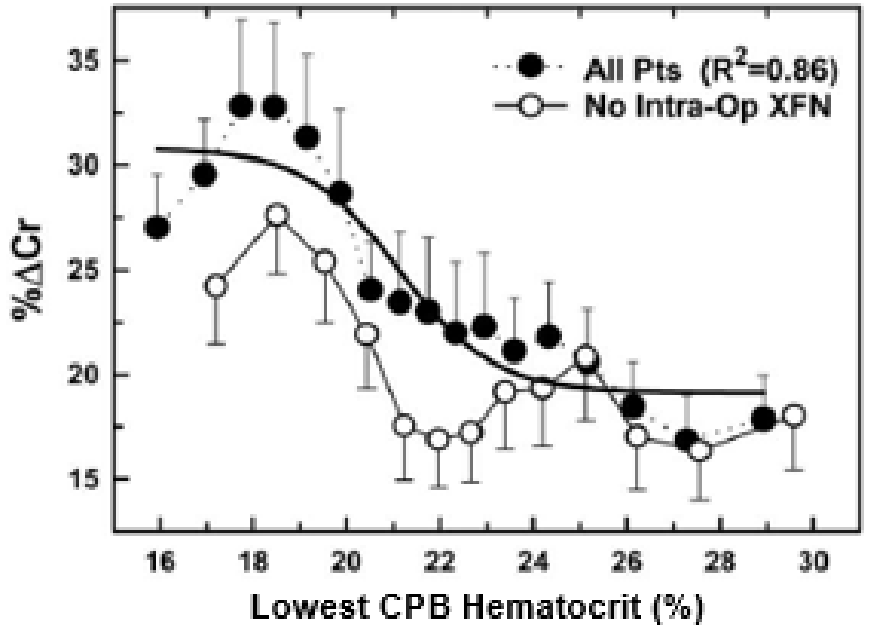
Optimizing Perfusion: Anemia Tolerance & Transfusion

- Transfusion Trigger during CPB was 22%
- %△Cr = The peak postoperative change in serum creatinine level relative to pre-CPB values.
- Acute renal injury and failure (ARF) after cardiopulmonary bypass (CPB) has been linked to low on-pump hematocrit.



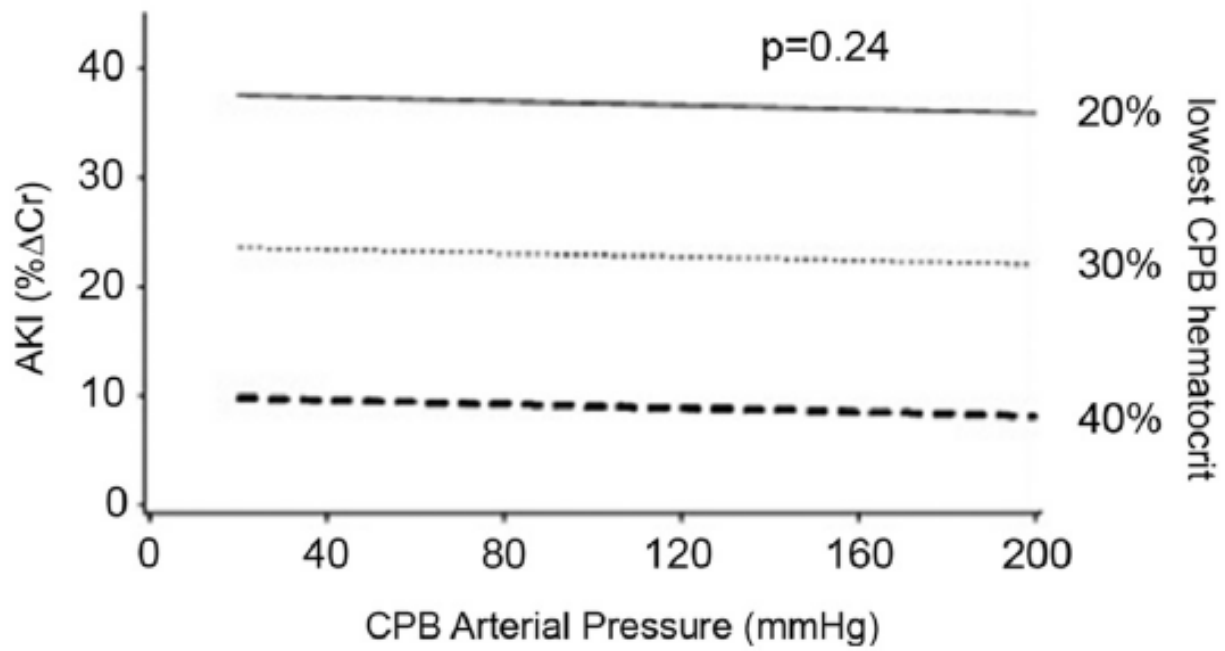
(Habib, 2005)

Increasing rates of AKI are seen as the HCT dips below 20-21% during CPB. Occurs whether the patient is transfused or not. Transfusion itself does increase the risk of AKI.

Anemia and Hypotension: Co-Occurrence during CPB

- The likelihood of acute kidney injury with CPB anemia does not change with different blood pressure values as measured at the time when the lowest CPB hematocrit occurred.

Hypotension, Anemia Tolerance during CPB and Postoperative Acute Kidney Injury



(Haase, 2012; Sickeler, 2014)

Hemodilution and Transfusion

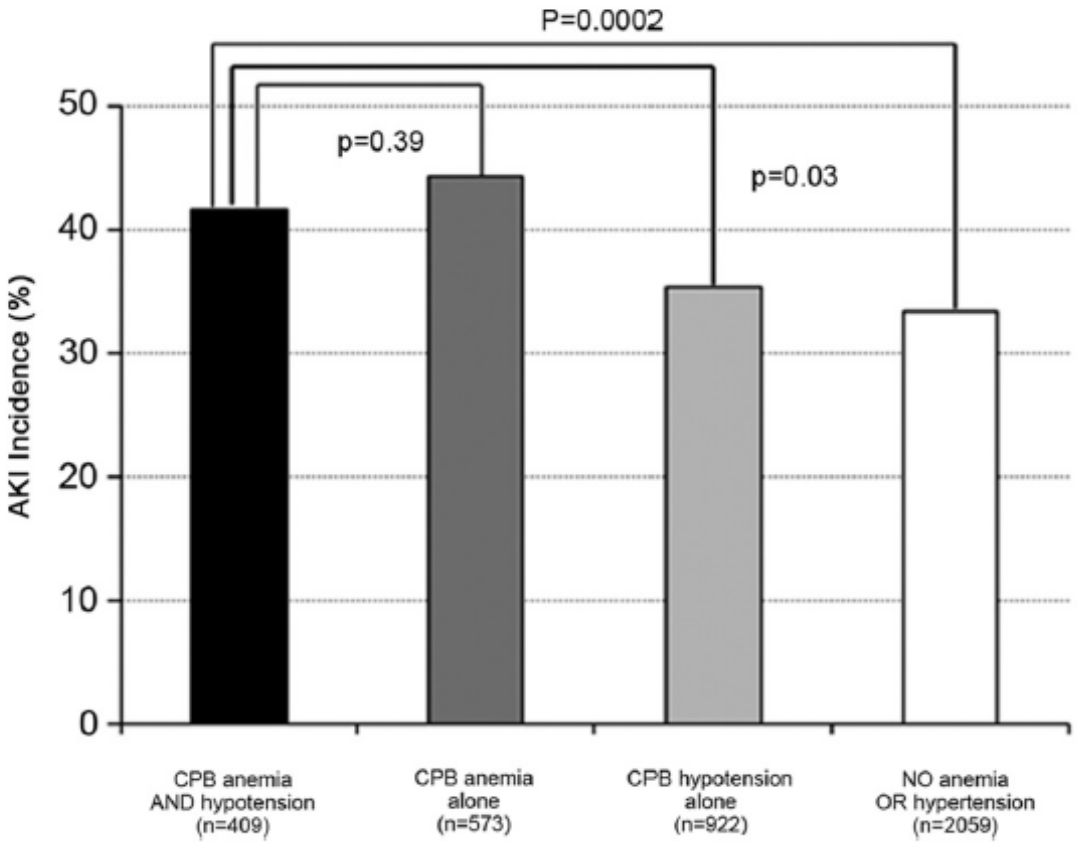
Minimizing hemodilution and avoiding unnecessary transfusion is best practice.

STS Guideline Recommendations

- Multidisciplinary and multi modality:
  - Mini-circuits
  - Microplegia
  - Modified ultrafiltration
  - Blood salvage

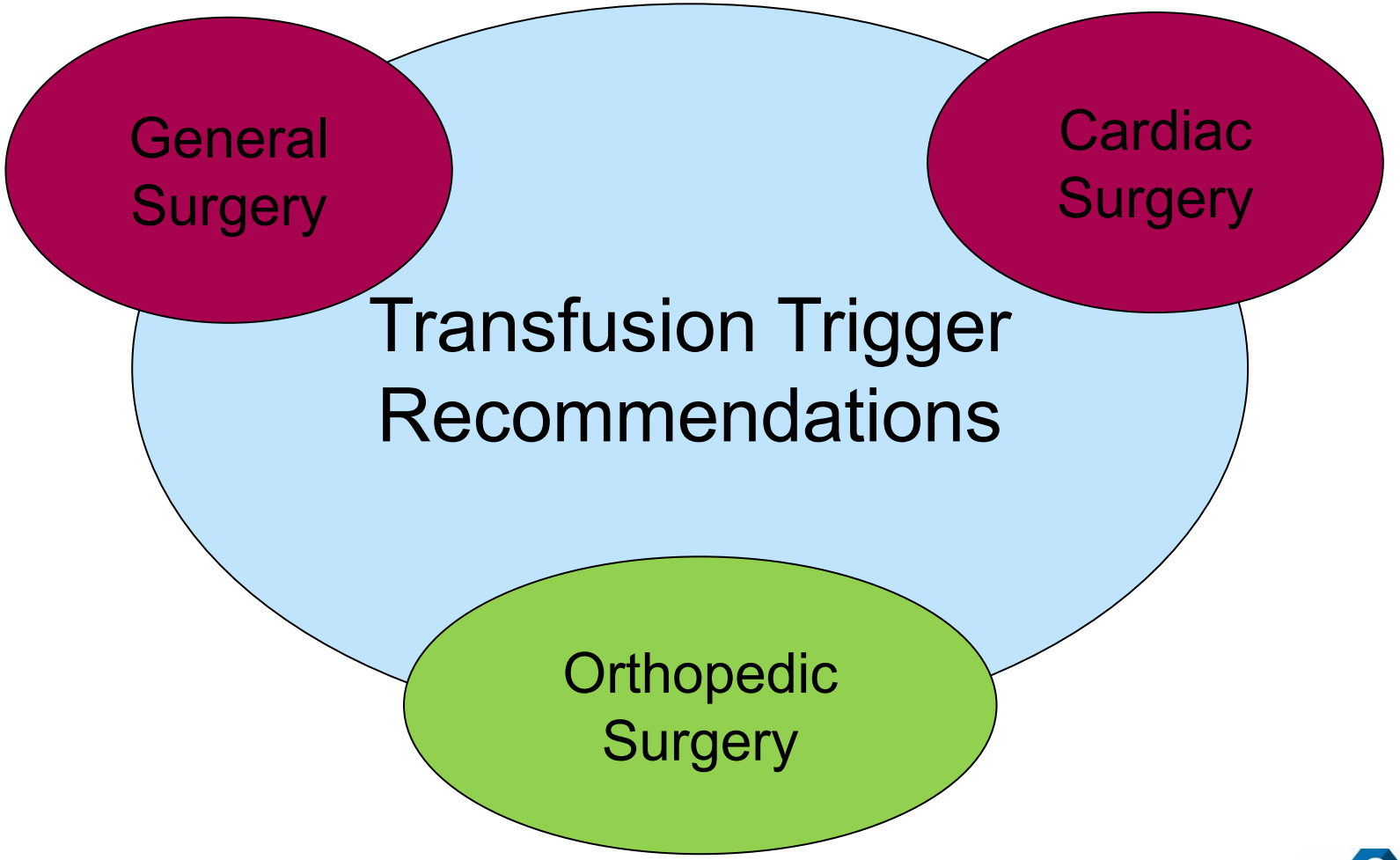
(Society of Thoracic Surgeons Blood Conservation Guideline Task Force, 2011)

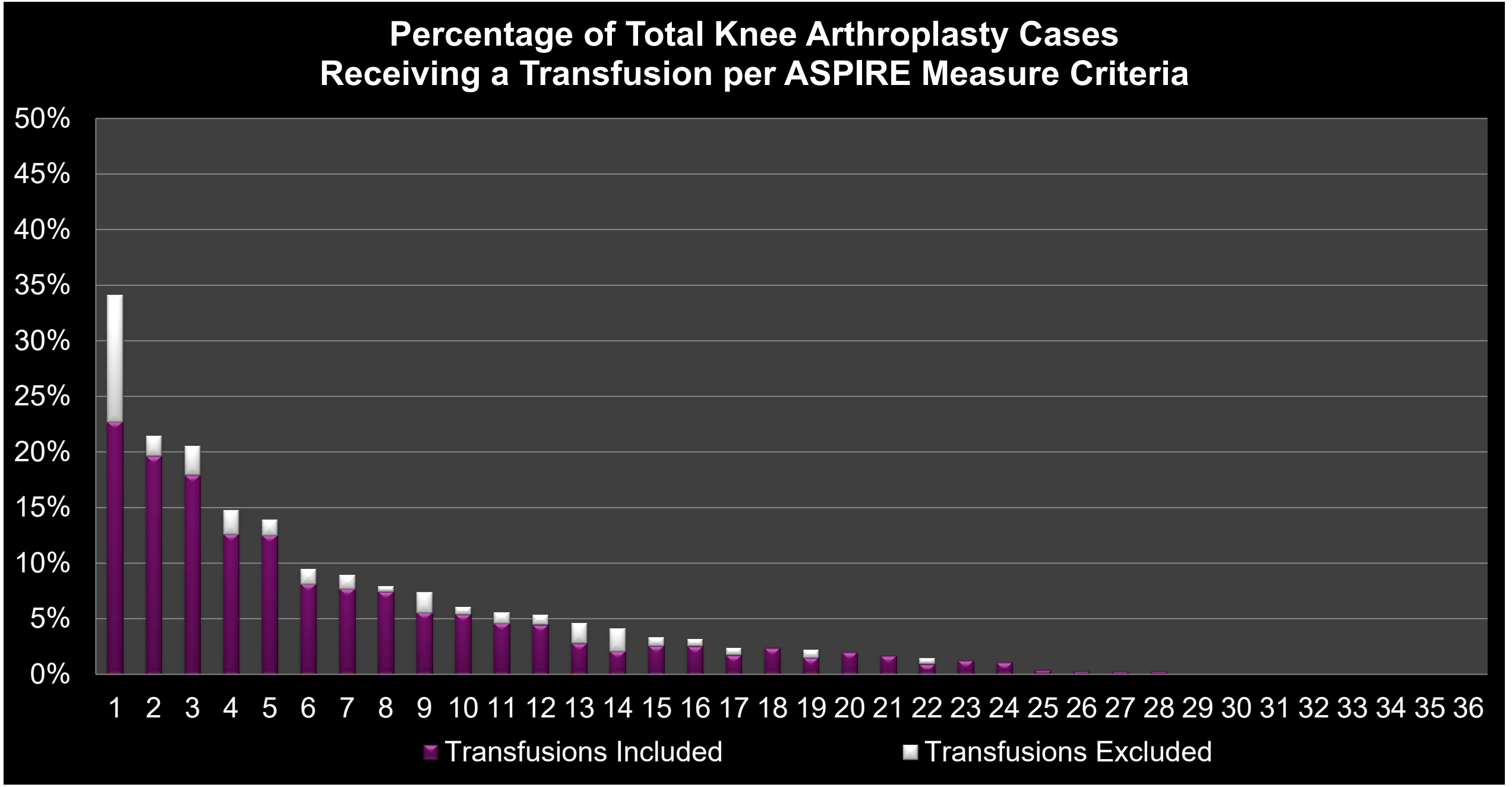
Cardiopulmonary Bypass: Anemia, Hypotension, and AKI



Patients with both anemia and hypotension during CPB did not differ in rates of AKI with those of anemia alone but did differ from patients with hypotension alone and patients with neither anemia or hypotension. (Sickeler, 2014)

Transfusion Trigger Considerations by Surgical Specialty

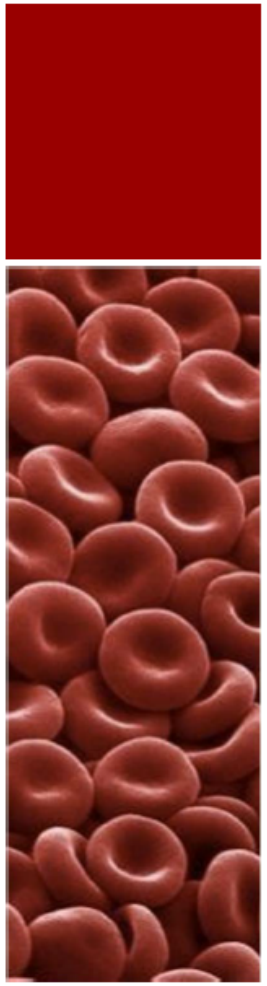



Percentage of Total Knee Arthroplasty Cases
Receiving a Transfusion per ASPIRE Measure Criteria
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
Transfusions Included
Transfusions Excluded

Literature Review: Orthopedic Surgery

- Total Knee Replacement: Restrictive <8 g/dl and Liberal <10 g/dl
  - Randomized trial looked at patients with a history of cardiovascular disease whose Hgb level was <10 after hip fracture surgery. Randomly assigned 2016 patients to restrictive (<8) vs liberal (<10). A liberal strategy did NOT reduce rates of death or inability to walk independently on 60 day follow up or reduce in hospital morbidity in elderly pts at high cardiovascular risk
  - No evidence found that maintaining the Hgb above 10 is superior to maintaining level of 8 with respect to primary outcomes (death or inability to walk across the room without assistance. [1]
  - Restrictive group received 65% fewer units than liberal group. Also did not find increased rates of MI or CHF in the liberal group.
- Hip Fracture: Restrictive: 7.3 g/dL and Liberal: 8.6 g/dL
  - Liberal group was associated with a statistically significantly faster TUG (Timed Up and Go test) after hip revision surgery compared to restrictive. The clinical importance is questionable and the groups did not differ in Hgb at the time of testing. (Carson, 2011)

MARQCI Transfusion Recommendations



MARCQI Sites: Transfusion Guidelines

- Wide range of transfusion triggers
- Some have no protocol
- Asymptomatic patient
  - Hgb < 7 g/dL to Hgb < 9 g/dL
- Symptomatic patients
  - Hgb < 7 g/dL to Hgb < 11 g/dL

MARCQI
MICHIGAN ARTHROPLASTY REGISTRY
COLLABORATIVE QUALITY INITIATIVE

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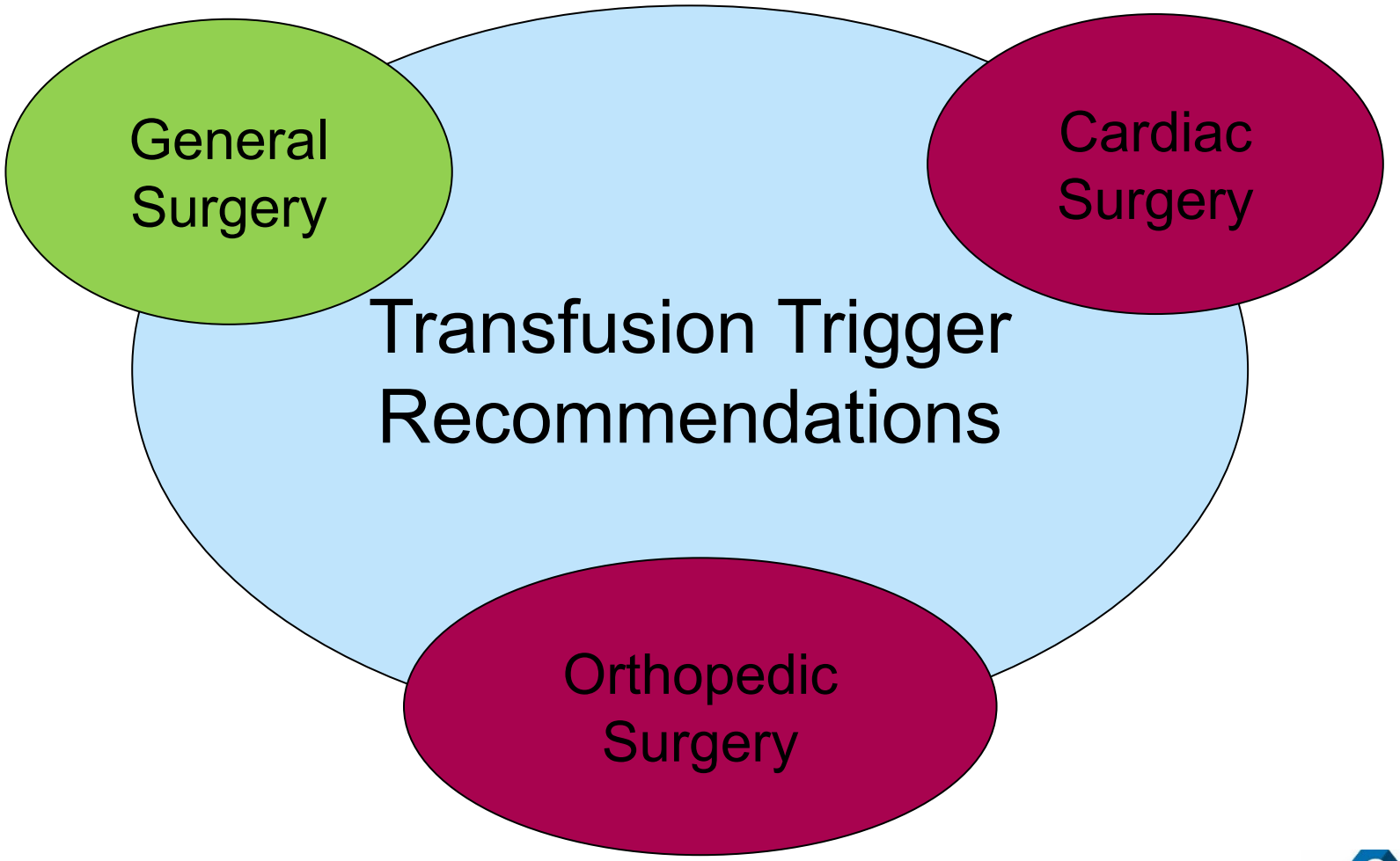
Literature Review: Orthopedic Surgery-Spine

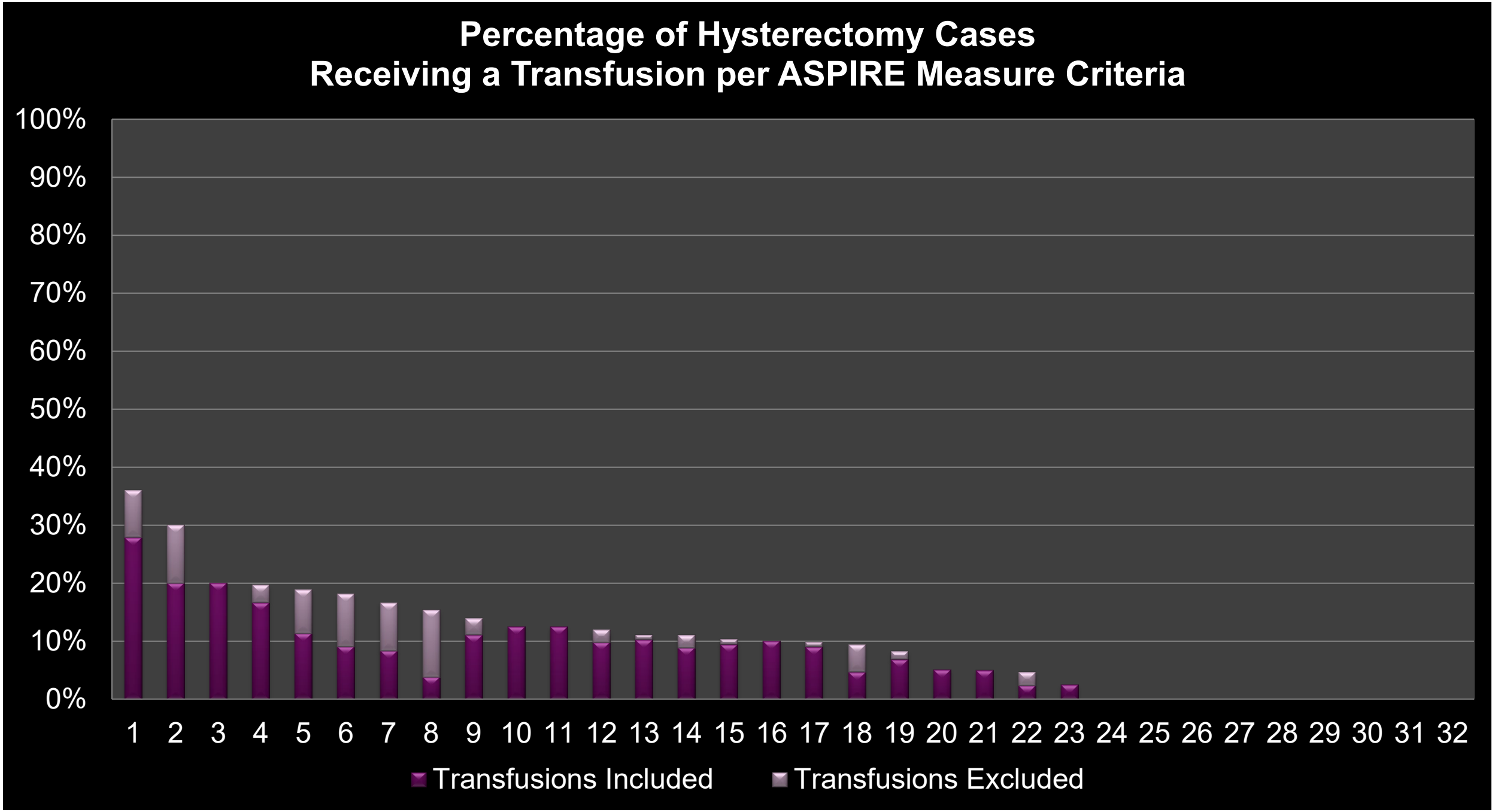
- Purvis et al. examined 1204 patients receiving at least 1 unit of PRBCs during spine surgery. Perioperative complications occurred in 234 patients. (Purvis, 2018)
  - Findings suggest the percentage change of Hgb is independently associated with a higher risk of developing any perioperative complication and hospital related infection.
  - An Hgb decline of 50% or more was associated with an increased risk of ischemic complications and hospital related infections.
- An additional study by Purvis et al. investigated the effects of liberal blood transfusion on clinical outcomes of 2,374 spine surgical patients receiving transfusions. (Purvis, 2017)
  - Transfusion using a liberal trigger is associated with increased morbidity, even after controlling for possible confounders. **Morbidity rates were doubled when liberal transfusions were given.**
    - Liberal intraop trigger: ≥10 g/dL
    - Liberal postop trigger: ≥8 g/dL
  - Length of stay was longer in patients transfused compared to no transfusion (5-10 days vs. 2-5 days).

Transfusion Trigger Considerations by Surgical Specialty



Literature Review: General Surgery

- Patients with a nadir Hgb of 8-10 undergoing colorectal, pancreatic or liver resection who underwent a PRBC transfusion had a significantly higher LOS and overall in hospital morbidity than those patients who were not transfused. (Ejaz, 2015)
- Among patients undergoing gastrointestinal surgery, a percentage change Hgb of 50% or more was associated with a higher risk of postop adverse events and in particular ischemic complications. This was true even in patients whose nadir Hgb did not drop to a restrictive trigger concentration. (Spolverato, 2015)
- Incidence of death was significantly lower in patients receiving restrictive transfusion compared to those receiving liberal transfusion for GI Bleed. (Villanueva, 2013; Blair, 1986)


Percentage of Hysterectomy Cases
Receiving a Transfusion per ASPIRE Measure Criteria
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Transfusions Included
Transfusions Excluded

Literature Review: Oncology

- Periop transfusions are administered in up to 85% of patients with colorectal cancer and have been shown to increase perioperative and postoperative morbidity and mortality. (Jakobsen, 1990)
- Preoperative anemia has been identified as an independent risk factor of poorer prognosis after colon surgery. (Leichtle, 2011)
- de Almeida et al. studied 198 surgical oncology patients and found that 30-day mortality was decreased in the liberal strategy group compared to the restrictive transfusion group (8.2% vs. 22.8%). (de Almeida, 2015)
- Wehry et al. examined 415 patients undergoing surgery for abdominal malignancy and found that a restrictive transfusion protocol resulted in reduction of percentage of patients transfused with no change in outcomes (mortality, infection, hemorrhage, LOS). (Wehry, 2015)

ASPIRE Measure: TRAN 01

Inclusions: All surgical patients receiving anesthetics who receive a transfusion of red blood cells.

Success: Documentation of hemoglobin and/or hematocrit prior to blood transfusion

- For the first unit of transfusion, a hemoglobin or hematocrit of any value should be checked in a time period of 0 to 90 minutes before the transfusion, or the most recent documented hemoglobin or hematocrit of less than 8/24 should be within 36 hours of the transfusion
- If the last hemoglobin or hematocrit drawn before the first transfusion is ≤ 5/16, a second unit could be administered without rechecking hemoglobin/hematocrit
- If multiple units are administered, documentation of a hemoglobin or hematocrit value must be present within 90 minutes before each administration
- **For pediatric cases (patients < 12 years old):** Pre-transfusion hemoglobin/hematocrit required before the first unit and an additional recheck after 15cc/kg of PRBCs have been administered
- **For cardiopulmonary bypass cases,** all transfusions administered between cardiopulmonary bypass start and end will not be included for determining measure results for the case

Responsible Provider: Provider(s) who administered blood product

ASPIRE Measure: TRAN 01

Exclusions:

- Massive Transfusion: Transfusion of 4 or more units of blood.
- EBL ≥ 2000 ml
- Patients < 2 years of age
- Patients <12 years old undergoing a cardiac procedure
- Patients <12 years old where either transfused PRBC or EBL was greater than 30cc/kg
- Burn cases
- ASA 5 & 6
- Labor Epidurals
- Cesarean sections with an EBL > 1500cc.
- Cesarean sections with a HR>110, SBP<85, DBP<45, or O2Sat <95%
- Postpartum hemorrhage cases

ASPIRE Measure: TRAN 02

Inclusions: Any patient that receives a red blood cell transfusion. Transfusion is defined as packed red blood cells or whole blood

Success: Hematocrit value documented as less than or equal to 30% and/or hemoglobin value documented as less than or equal 10 g/dL

- All hemoglobin/hematocrit lab values drawn after the last transfusion and before anesthesia end will be evaluated. If the lowest of these values is ≤10g/dL or ≤30%, the case will pass
- If no hemoglobin or hematocrit is drawn after the last transfusion and before anesthesia end, then the **first** hemoglobin/hematocrit after anesthesia end will be evaluated. If this value is ≤10/30, the case will pass. This measure will only examine lab values up to 6 hours after anesthesia end to identify a hemoglobin or hematocrit value. Once the first hemoglobin or hematocrit value is identified after anesthesia end, additional values will not be considered
- No hematocrit or hemoglobin checked within 6 hours of anesthesia end

Responsible Provider: Individual who administered the transfusion

ASPIRE Measure: TRAN 02

Exclusions:

- Patients < 2 years of age
- Patients <12 years old undergoing a cardiac procedure
- Pediatric cases (<12 years old) where either the transfused PRBC or EBL was greater than 30cc/kg
- ASA 5 & 6
- EBL ≥ 2000ml
- Massive Transfusion: Transfusion of 4 or more units of blood
- Labor Epidurals
- Cesarean sections with an EBL > 1500cc
- Cesarean sections with a HR>110, SBP<85, DBP<45, or O2Sat <95%
- Postpartum hemorrhage cases

MTQIP Transfusion Measure

M·TQIP

#6	10	**Red Blood Cell to Plasma Ratio (Weighted Mean Points) of Patients Transfused ≥5 Units in 1st 4 Hours (18 Mo's: 1/1/17-6/30/18)** 10 pts: Tier 1: ≤ 1.5 10 pts: Tier 2: 1.6-2.0 5 pts: Tier 3: 2.1-2.5 0 pts: Tier 4: >2.5	0-10

For more information, visit MTQIP.

MPOG

Massive Transfusion Protocols

Develop with multi-disciplinary committee that includes:

- Transfusion service/blood bank
- Emergency department
- Anesthesia
- Trauma Service

Massive Transfusion Protocol should address:

- Triggers for initiating massive transfusion in trauma
- Resuscitation in the trauma bay
  - MTP Product Availability
  - MTP Product Delivery
  - MTP Blood Product Transfusion
- Continuing MTP in OR, Angiography suite, ICU
- Transfusion service processes for delivery of blood products
- Transfusion targets
- Use of adjuncts for massive transfusion patients
- Termination of MTP
- Performance Improvement Monitoring

For more information: American College of Surgeons

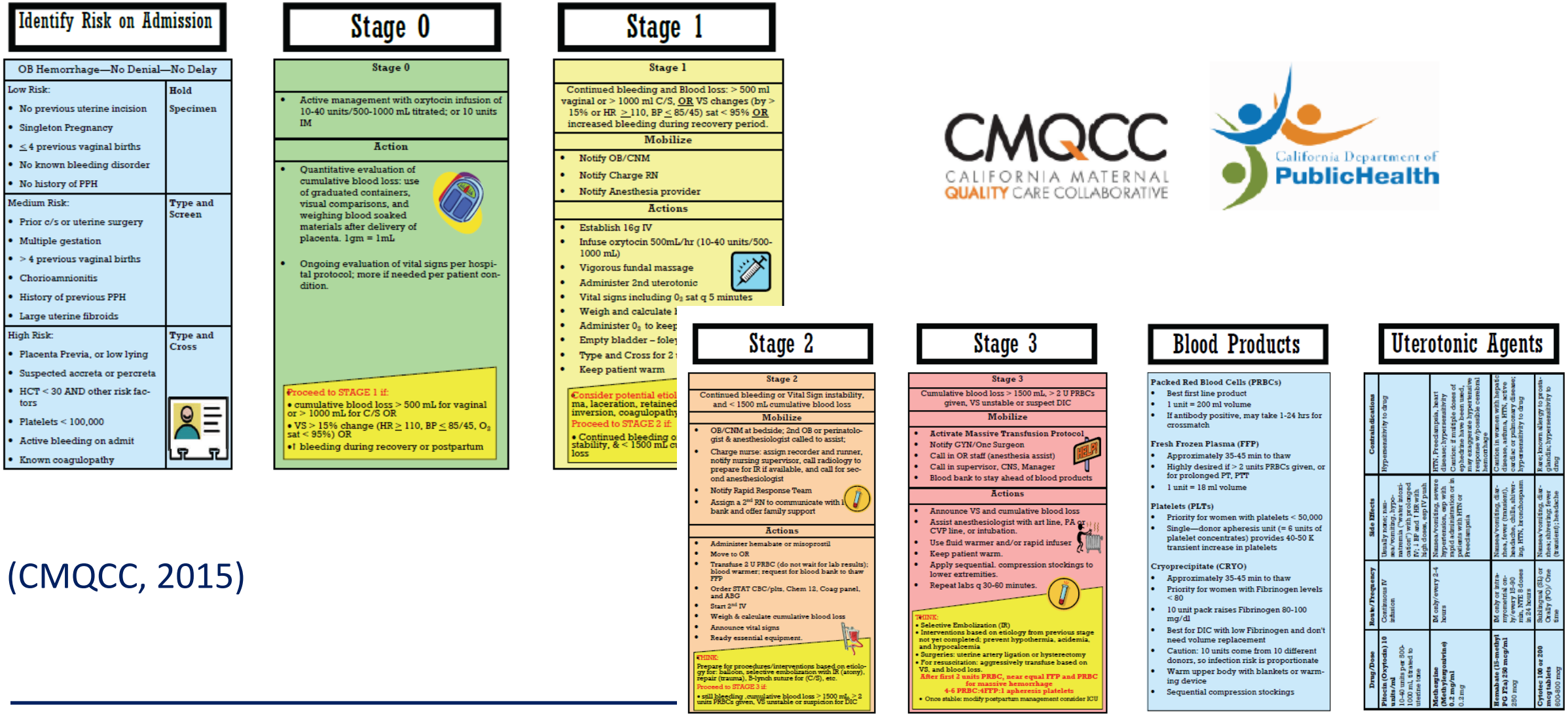
Obstetric Hemorrhage Protocol

American College of Obstetrics and Gynecology (ACOG) released the Safe Motherhood Initiative in 2013.

- Blood transfusion or cross-matching should not be used as a negative quality marker and is warranted for certain obstetric events.
- In cases of severe obstetric hemorrhage, ≥4 units of blood products may be necessary to save the life of a maternity patient.
- Hospitals are encouraged to coordinate efforts with their laboratories, blood banks, and quality improvement departments to determine the appropriateness of transfusion and quantity of blood products necessary for these patients.

For more information and resources, please visit the ACOG website: ACOG Obstetric Hemorrhage Bundle

Obstetric Hemorrhage Protocol Pocket Card



Identify Risk on Admission

OB Hemorrhage—No Denial—No Delay	
Low Risk: • No previous uterine incision • Singleton Pregnancy • ≤ 4 previous vaginal births • No known bleeding disorder • No history of PPH	Hold Specimen
Medium Risk: • Prior c/s or uterine surgery • Multiple gestation • > 4 previous vaginal births • Chorioamnionitis • History of previous PPH • Large uterine fibroids	Type and Screen
High Risk: • Placenta Previa, or low lying • Suspected accreta or percreta • HCT < 30 AND other risk factors • Platelets < 100,000 • Active bleeding on admit • Known coagulopathy	Type and Cross

Stage 0

Stage 0

- Active management with oxytocin infusion of 10-40 units/500-1000 mL titrated; or 10 units IM

Action

- Quantitative evaluation of cumulative blood loss: use of graduated containers, visual comparisons, and weighing blood soaked materials after delivery of placenta. 1gm = 1mL
- Ongoing evaluation of vital signs per hospital protocol; more if needed per patient condition.

Proceed to STAGE 1 if:
- cumulative blood loss > 500 mL for vaginal or > 1000 mL for C/S OR
- VS > 15% change (HR ≥ 110, BP ≤ 85/45, O_2 sat < 95%) OR
- ↑ bleeding during recovery or postpartum

Stage 1

Stage 1

Continued bleeding and Blood loss: > 500 ml vaginal or > 1000 ml C/S, OR VS changes (by > 15% or HR ≥ 110, BP ≤ 85/45) sat < 95% OR increased bleeding during recovery period.

Mobilize

- Notify OB/CNM
- Notify Charge RN
- Notify Anesthesia provider

Actions

- Establish 16g IV
- Infuse oxytocin 500mL/hr (10-40 units/500-1000 mL)
- Vigorous fundal massage
- Administer 2nd uterotonic
- Vital signs including O_2 sat q 5 minutes
- Weigh and calculate l
- Administer O_2 to keep
- Empty bladder – foley
- Type and Cross for 2 u
- Keep patient warm

Consider potential etiol
ma, laceration, retained
inversion, coagulopathy
Proceed to STAGE 2 if:
- Continued bleeding o
stability, & < 1500 mL c
loss

Stage 2

Stage 2

Continued bleeding or Vital Sign instability, and < 1500 mL cumulative blood loss

Mobilize

- OB/CNM at bedside; 2nd OB or perinatologist & anesthesiologist called to assist;
- Charge nurse: assign recorder and runner, notify nursing supervisor, call radiology to prepare for IR if available, and call for second anesthesiologist
- Notify Rapid Response Team
- Assign a 2nd RN to communicate with l bank and offer family support

Actions

- Administer hemabate or misoprostil
- Move to OR
- Transfuse 2 U PRBC (do not wait for lab results); blood warmer; request for blood bank to thaw FFP
- Order STAT CBC/plts, Chem 12, Coag panel, and ABG
- Start 2nd IV
- Weigh & calculate cumulative blood loss
- Announce vital signs
- Ready essential equipment.

THINK:
Prepare for procedures/interventions based on etiology for: balloon, selective embolization with IR (atony), repair (trauma), B-lynch suture for (C/S), etc.
Proceed to STAGE 3 if:
- still bleeding ,cumulative blood loss > 1500 mL, > 2 units PRBCs given, VS unstable or suspicion for DIC

Stage 3

Stage 3

Cumulative blood loss > 1500 mL, > 2 U PRBCs given, VS unstable or suspect DIC

Mobilize

- Activate Massive Transfusion Protocol
- Notify GYN/Onc Surgeon
- Call in OR staff (anesthesia assist)
- Call in supervisor, CNS, Manager
- Blood bank to stay ahead of blood products

Actions

- Announce VS and cumulative blood loss
- Assist anesthesiologist with art line, PA or CVP line, or intubation.
- Use fluid warmer and/or rapid infuser
- Keep patient warm.
- Apply sequential. compression stockings to lower extremities.
- Repeat labs q 30-60 minutes.

THINK:
- Selective Embolization (IR)
- Interventions based on etiology from previous stage not yet completed: prevent hypothermia, acidemia, and hypocalcemia
- Surgeries: uterine artery ligation or hysterectomy
- For resuscitation: aggressively transfuse based on VS, and blood loss.

After first 2 units PRBC, near equal FFP and PRBC for massive hemorrhage
4-6 PRBC:4FFP:1 apheresis platelets
- Once stable: modify postpartum management consider ICU

Blood Products

Packed Red Blood Cells (PRBCs)
- Best first line product
- 1 unit = 200 ml volume
- If antibody positive, may take 1-24 hrs for crossmatch

Fresh Frozen Plasma (FFP)
- Approximately 35-45 min to thaw
- Highly desired if > 2 units PRBCs given, or for prolonged PT, PTT
- 1 unit = 18 ml volume

Platelets (PLTs)
- Priority for women with platelets < 50,000
- Single—donor apheresis unit (= 6 units of platelet concentrates) provides 40-50 K transient increase in platelets

Cryoprecipitate (CRYO)
- Approximately 35-45 min to thaw
- Priority for women with Fibrinogen levels < 80
- 10 unit pack raises Fibrinogen 80-100 mg/dl
- Best for DIC with low Fibrinogen and don't need volume replacement
- Caution: 10 units come from 10 different donors, so infection risk is proportionate
- Warm upper body with blankets or warming device
- Sequential compression stockings

Uterotonic Agents

Drug/Dose	Route/Frequency	Side Effects	Contraindications
Pitocin (Oxytocin) 10 units/ml 10-40 units per 500-1000 mL titrated to uterine tone	Continuous IV infusion	Usually none; transient hypotension, tachycardia, hyponatremia ("water intoxication") with prolonged IV; ↓ BP and ↑ HR with high dose, esp IV push	Hypersensitivity to drug
Methergine (Methylergonavine) 0.2 mg/ml 0.2 mg	IM only/every 2-4 hours	Nausea/vomiting, severe hypertension, esp with rapid administration or in patients with HTN or Preeclampsia	HTN, Preeclampsia, heart disease; hypersensitivity Caution: if multiple doses of ephedrine have been used, may exaggerate hypertensive response w/possible cerebral hemorrhage
Hemabate (15-methyl PG F2a) 250 mcg/ml 250 mcg	IM only or intramyometrial only; avoid IV; MAX 8 doses in 24 hours	Nausea/vomiting, diarrhea, fever (transient), headache, chills, shivering, bronchospasm	Caution in women with hepatic disease, asthma, HTN, active cardiac or pulmonary disease; hypersensitivity to drug
Cytotec 100 or 200 mcg tabs 800-1000 mcg	Sublingual (SL) or Orally (PO)/ One time	Nausea/vomiting, diarrhea; abdominal pain (transient); headache	Rare; known allergy to prostaglandin; hypersensitivity to drug

(CMQCC, 2015)

ASPIRE Recommendations

- Use the literature to develop evidence-based institution transfusion protocols and guidelines
- Restrictive transfusion protocols should be considered for asymptomatic patients
- There is rarely an indication to transfuse any patient with a Hgb >10g/dL
- Decision to transfuse should be based on objective assessment of the patient, including Hgb/Hct
- In the absence of acute hemorrhage, transfuse one unit at a time
- Reassess post-transfusion to determine if additional units are required

Additional Transfusion Resources

ASPIRE Transfusion Toolkit

American College of Obstetrics and Gynecology: Maternal Safety Bundle for Obstetric Hemorrhage

American College of Surgeons: Massive Transfusion Protocol

MARCQI: Blood Transfusion Project- Reducing Transfusion in the MARCQI Population

MTQIP: Proposal for monitoring site performance for massive transfusions (MT)

Blood Conservation in Thoracic Surgery: STS Clinical Guidelines

STS Renal Failure After Cardiac Surgery: Webinar, May 2018

References

Amand T, Pincemail J, Blaffart F, et al. (2002). Levels of inflammatory markers in the blood processed by autotransfusion devices during cardiac surgery associated with cardiopulmonary bypass circuit. Perfusion. 17(2):117-23.

American Red Cross. (2017). A Compendium of Transfusion Practice Guidelines Third Edition 2017. https://www.laboratoryalliance.com/assets/Uploads/Transfusion-Services/TransfusionPractices-Compendium-3rdEdition.pdf

ASA Task Force on Perioperative Blood Management. (2015). Practice guidelines for perioperative blood management: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Blood Management*. Anesthesiology. 122(2):241-75.

Birkmeyer JD, Goodnough LT, AuBuchon JP, et al. (1993). The cost-effectiveness of preoperative autologous blood donation for total hip and knee replacement. Transfusion. 33(7):544-51.

Blair SD, Janvrin SB, McCollum CN, Greenhalgh RM. (1986). Effect of early blood transfusion on gastrointestinal haemorrhage. Br J Surg. 73(10):783-5.

Carson JL, Terrin ML, Noveck H, et al. (2011) Liberal or restrictive transfusion in high-risk patients after hip surgery. N Engl J Med. 365(26):2453-62.

References

Carson JL, Brooks MM, Abbott JD, et al. (2013). Liberal versus restrictive transfusion thresholds for patients with symptomatic coronary artery disease. Am Heart J. 165(6):964-971.e1.

Carson JL, Guyatt G, Heddle NM, et al. (2016). Clinical Practice Guidelines From the AABB: Red Blood Cell Transfusion Thresholds and Storage. JAMA. 15;316(19):2025-2035.

Casey LC. (1993). Role of cytokines in the pathogenesis of cardiopulmonary – induced multisystem organ failure. Ann Thorac Surg. 56(5 Suppl):S92-6.

CMQCC. (03/24/2015). Obstetric Hemorrhage Toolkit. Version 2.0. https://www.scdhhs.gov/sites/default/files/CMQCC%20OB%20Hemorrhage%20Toolkit%20Pocket%20Card.pdf

Côté CL, Yip AM, MacLeod JB, et al. (2016). Efficacy of intraoperative cell salvage in decreasing perioperative blood transfusion rates in first-time cardiac surgery patients: a retrospective study. Can J Surg. 59(5):330-6.

Curley GF, Shehata N, Mazer CD, et al. (2014). Tranfusion triggers for guiding RBC transfusion for cardiovascular surgery: a systematic review and meta-analysis*. Crit Care Med. 42(12):2611-24.

Daane CR, Golab HD, Meeder JHJ, et al. (2003). Processing and transfusion of residual cardiopulmonary bypass volume: effects on haemostasis, complement activation, postoperative blood loss and transfusion volume. Perfusion. 18(2):115-21.

References

de Almeida JP, Vincent J-L, Galas F, et al. (2015). Transfusion requirements in surgical oncology patients: a prospective, randomized controlled trial. Anesthesiology. 122(1):29-38.

Docherty AB, O'Donnell R, Brunskill S, et al. (2016). Effect of restrictive versus liberal transfusion strategies on outcomes in patients with cardiovascular disease in a non-cardiac surgery setting: systematic review and meta-analysis. BMJ. 352:i1351.

Ejaz A, Frank SM, Spolverato G, et al. (2015). Potential Economic Impact of Using a Restrictive Transfusion Trigger Among Patients Undergoing Major Abdominal Surgery. JAMA Surg. 150(7):625-30.

Engelhardt W, Blumenberg D. (1991). Risk and side effects of intraoperative autotranfusion. Beitr Infusionsther. 28:317-21

Glance LG, Dick AW, Mukamel DB, et al. (2011). Association between intraoperative blood transfusion and mortality and morbidity in patients undergoing noncardiac surgery. Anesthesiology. 11;114(2):283-92.

Goodnough LT, Shander A. (2012). Patient blood management. Anesthesiology. 116(6):1367-76.

Haase M, Bellomo R, Story D, et al. (2012). Effect of mean arterial pressure, haemoglobin and blood transfusion during cardiopulmonary bypass on post-operative acute kidney injury. Nephrol Dial Transplant. 27(1):153-60.

References

Habib R, Zacharias A, Schwann TA, et al. (2003). Adverse effects of low hematocrit during cardiopulmonary bypass in the adult: should current practice be changed? J Thorac Cadiovasc Surg. 125(6):1438-50.

Habib R, Zacharias A, Schwann, TA, Riordan CJ, et al. (2005). Role of hemodilutional anemia and transfusion during cardiopulmonary bypass in renal injury after coronary revascularization: implications on operative outcome. Crit Care Med. 33(8):1749-56.

Jakobsen EB, Eickhoff JH, Andersen J, et al. (1990). Perioperative blood transfusion and recurrence and death after resection for cancer of the colon and rectum. Scand J Gastroenterol. 25(5):435-42.

Leichtle SW, Mouawad NJ, Lampman R, et al. (2011). Does preoperative anemia adversely affect colon and rectal surgery outcomes? J Am Coll Surg. 212(2):187-94.

Mueller MM, Remoortel HV, Meybohm P, et al. (2019). Patient Blood Management: Recommendations From the 2018 Frankfurt Consensus Conference. JAMA. 321(10):983-997.

National Clinical Guideline Centre (UK). (2015). Blood Transfusion. London: National Institute for Health and Care Excellence (NICE). Nov 2015. PMID: 26632625 Bookshelf: NBK327570.

Niranjan G, Asimakopoulos G, Karagounis A, et al. (2006). Effects of cell saver autologous blood transfusion on blood loss and homologous blood transfusion requirements in patients undergoing cardiac surgery on – versus off – cardiopulmonary bypass: a randomised trial. Eur J Cardiothorac Surg. 30(2):271-7.

.

References

Pfizer Medical Information. Retacrit Indications and Usage (epoetin alfa-epbx). https://www.pfizermedicalinformation.com/en-us/retacrit/indications-usage

Purvis TE, Goodwin CR, Garza-Ramos R, et al. (2017). Effect of liberal blood transfusion on clinical outcomes and cost in spine surgery patients. Spine J. 17(9):1255-1263.

Purvis TE, Goodwin CR, Molina CA, et al. (2018). Percentage change in hemoglobin level and morbidity in spine surgery patients. J Neurosurg Spine. 28(3):345-351.

Reents W, Babib-Ebell J, Misoph MR, et al. (1999). Influence of different autotransfusion devices on the quality of salvaged blood. Ann Thorac Surg. 68(1)58-62.

Salpeter SR, Buckley JS, Chatterjee S. (2014). Impact of more restrictive blood transfusion strategies on clinical outcomes: a meta-analysis and systematic review. AM J Med. 127(2):124-131.e3.

Sandoval S, Alrawi S, Samee M, et al. (2001). A cytokine analysis of the effect of cell saver on blood in coronary bypass surgery. Heart Surg Forum. 4(2):113-7.

Shander A, Rijhwani TS. (2004). Acute normovolemic hemodilution. Transfusion. 44(12 Suppl):26S-34S.

Sickeler R, Phillips-Bute, B, Kertai MD, et al. (2014). The risk of acute kidney injury with co-occurrence of anemia and hypotension during cardiopulmonary bypass relative to anemia alone. Ann Thorac Surg. 97(3):865-71.

References

Society of Thoracic Surgeons Blood Conservation Guideline Task Force, Ferraris VA, Brown JR, et al. (2011). 2011 update to the Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists blood conservation clinical practice guidelines. Ann Thorac Surg. 91(3):944-82.

Spahn DR, Muñoz M, Klein AA, et al. (2020). Patient Blood Management: Effectiveness and Future Potential. Anesthesiology. 133(1):212-222.

Spolverato G, Kim Y, Ejaz A, et al. (2015). Effect of Relative Decrease in Blood Hemoglobin Concentrations on Postoperative Morbidity in Patients Who Undergo Major Gastrointestinal Surgery. JAMA Surg. 150(10):949-56.

Villanueva C, Colomo A, Bosch A, et al. (2013). Transfusion strategies for acute upper gastrointestinal bleeding. N Engl J Med. 368(1):11-21.

Wehry J, Agle S, Philips P, et al. (2015). Restrictive blood transfusion protocol in malignant upper gastrointestinal and pancreatic resections patients reduces blood transfusions with no increase in patient morbidity. Am J Surg. 210(6):1197-204.