I. INTRODUCTION

Anemia, defined by the World Health Organization as a hemoglobin level <13 g/dl for adult males and <12 g/dl for non-pregnant adult females, is common in critically ill patients (1-6). In the Anemia and Blood Transfusion in Critically Ill Patients trial the mean hemoglobin concentration on intensive care unit (ICU) admission was 11.6 g/dl with 63% of patients having a hemoglobin concentration of <12 g/dl and 29% of patients having a hemoglobin level of <10 g/dl (1). The etiology of anemia during critical illness is often multifactorial and may include bleeding, phlebotomy, increased hemolysis, and sequestration (6). Additionally, with critical illness there is a decrease in erythropoiesis as a result of a blunted erythropoietic response to low hemoglobin, the impact of inflammatory mediators such as interleukins (II-1 and II-6) and Tumor Necrosis Factor, an alteration in the utilization of iron due to increased hepcidin and nutritional deficiencies, and perhaps due pre-existing chronic kidney disease and other comorbid conditions (1, 4, 6-9).

In recent years transfusion requirements have increased as a result of the increased burden of chronic disease, improvements in life support technology, increased incidence of blood-intensive surgical procedures, and this increase has occurred concurrently with changes in blood donation practices leading to an overall reduced blood supply (10, 11). However, the incidence of red blood cell (RBC) transfusion in the ICU continues to be substantial (4). Numerous studies have documented the prevalent use of RBC transfusion in critically ill patients and found that approximately 40% of ICU patients receive at least one RBC transfusion for average pre-transfusion hemoglobin of 8.5 g/dl (1, 2, 12-17). Among ICU patients those who are older and those with a longer ICU length of stay are more likely to be transfused (1). Nationally, the transfusion of RBC often occurs without evidenced based indications and this significantly impacts an already scarce and costly resource (1, 4, 11, 13, 18).

The benefits, in the correct clinical context, of RBC transfusion include increasing arterial oxygen content and subsequently oxygen delivery, increasing cell mass and blood volume during or following active hemorrhage, alleviating the symptoms of anemia, and reducing the impact of severe anemia with critical oxygen delivery on myocardial oxygen consumption(4).

II. PURPOSE

Blood transfusions in and of themselves are not benign interventions and have the potential to cause serious morbidity, and potentially even fatal events (1, 13). Like many therapies blood transfusion does not act as a singular treatment but rather it is associated with transfusion related
immunomodulation (TRIM) and increased rates of infection, organ dysfunction, ICU length of stay, and mortality (19-21). The potential risks associated with blood transfusions are numerous and include the transmission of infectious diseases, transfusion associated circulatory overload (TACO), transfusion associated acute lung injury (TRALI), transfusion associated leukocyte microchimerism, hemolytic reactions, hypothermia, dilutional coagulopathy, and human error in delivering the wrong blood product (22-25). Additionally, research has shown that ex vivo storage of packed RBC leads to further risks stemming from reduced RBC deformability, altered adhesiveness and aggregability, and by way of reduced levels of 2,3-DPG and ATP (26).

Several studies have demonstrated that the implementation of an evidence-based transfusion guideline, when applied to the appropriate patient cohort, reduces the number of RBC units infused without a subsequent increase in mortality (27, 28). With this in mind, this clinical practice guideline provides a framework for establishing target hemoglobin levels in specific subsets of patients, appropriate transfusion triggers, and alternatives or adjuncts to blood transfusions after the acute resuscitation phase is completed. The transfusion threshold is defined as the equilibrated Hgb level under which most patients might benefit from RBC transfusion.

### III. INTERVENTIONS

A. RBC transfusion is indicated for patients with evidence of active hemorrhagic shock (4)

B. The use of a transfusion threshold in isolation should be avoided. Rather the decision for RBC transfusion should be based on (4):

1. Volume status
2. Evidence of shock
3. Duration and extent of anemia
4. Presence of mitigating circumstances such as active myocardial ischemia

C. Ensure normovolemia

D. Identify reasons for anemia in the Surgical Critical Care Units, such as the following:

1. Active hemorrhage
   a. Gastrointestinal bleeding
   b. Surgical bleeding
   c. Trauma related bleeding
2. Phlebotomy and iatrogenic loss
3. Chronic disease
4. Inflammatory response
5. Impaired erythropoietic response
6. Nutritional deficiency
7. Hemodilution
8. Decreased RBC survival / hemolysis
9. Altered iron metabolism

E. Assess hemodynamic stability and signs of adequate organ perfusion:
   1. Normotension and/or normal heart rate
   2. Urinary output (uo) > .5 cc/kg
   3. Mental status / level of consciousness
   4. Skin perfusion
   5. Invasive hemodynamic parameters such as SVO₂ ≥65% and SV > .7 cc/kg if a pulmonary catheter or other monitor is in place

F. Assure normal coagulation profile and status.

G. The transfusion threshold for Surgical Critical Care patients who have evidence of an acute coronary syndrome (ST-elevation MI, Non ST-Elevation MI, or unstable angina) or acute cerebrovascular syndrome is < 10 g/dl.

H. In patients with stable cardiac disease, without evidence of active of recent ischemia, the transfusion threshold is <7 g/dl.

I. For the “stable”, based on the above parameters, Surgical Critical Care patient with anemia a restrictive transfusion threshold of <7g/dl is recommended when the patient does not exhibit one or more of the following:
   1. Evidence of impaired O₂ delivery
   2. Shock
   3. Ongoing blood loss

J. Wait three (3) hours after transfusion before drawing Hgb/Hct to allow equilibration unless patient is clinically unstable or has ongoing blood loss.

K. Monitor the patient being transfused carefully since as many as 20% of patients receiving PRBC’s have an adverse reaction
   1. If a patient is suspected as having a possible transfusion reaction then:
      a. Stop the infusion immediately
      b. Evaluate the patient
         i. Current and pre-transfusion vital signs
         ii. Skin for hives
         iii. Presence of adventitious breath sounds
         iv. Urine for change in color
      c. Mild allergic reaction (isolated rash/pruritis only) or simple febrile reaction (isolated fever thought not likely due to transfusion) then the transfusion may be restarted.
d. If there is reasonable likelihood for a transfusion reaction then terminative the transfusion.
   a. Initiate a transfusion reaction work-up in conjunction with blood bank pathologist

L. The initiation of recombinant human erythropoietin or erythropoietin stimulating agent
   (ESA) in the anemic critically ill surgical patient is not recommended (29, 30)
   1. Consider continuation of recombinant human erythropoietin or ESA (dosed at
      40,000 units per week along with iron supplementation) for those patients on pre-
      existing regimen secondary to chronic kidney disease
      a. Ensure concurrent and clinically appropriate venous thromboembolism
         prophylaxis

M. When the anemic patient is able, enteraly add FeSO₄ 325 mg TID to the medication
   regimen in all anemic patients.

N. Whenever possible attempts should be made to reduce RBC transfusion by limiting blood
   loss through judicious ordering of laboratory studies and by way of using blood
   conservation devices on arterial lines

O. Optimize nutrition.

P. Monitor continuously for signs of under perfusion in anemic patients (mental status, uo,
   HR)

IV. BIBLIOGRAPHY


   clinical trial of transfusion requirements in critical care. transfusion requirements in critical care investigators, canadian critical


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<th>CLINICAL PRACTICE GUIDELINE MANUAL</th>
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Developed by: Corinna Sicoutris CRNP / Vicente H. Gracias, MD  09/2004

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Approved by: Surgical Critical Care faculty

Last Review:  02/2013

Clinical Practice Guidelines (CPG) are meant to standardize and optimize care and decrease variability in practice. They are intended to be used as framework for the delivery of patient care in the surgical critical care units. CPG’s are a combination of evidence-based medicine and accepted practices in critical care medicine. CPG’s are intended to provide decision support for the management of the majority of patients, and are not proposed as directives, rules, or policies. They are not substitutes for clinical judgement. Deviations from the CPG’s are expected when deemed medically necessary; all exceptions should be documented in the medical record and require discussion between the Surgical Critical Care attending and the attending of the primary or consulting service.

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12/15/13
Date

12/15/13
Date
Last Revised: 07/01/2011

Check CBC

Ensure normovolemia

Identify reasons for anemia

Chronic renal failure and prior ESA regimen?

No

Epogen and FeSO₄

Yes

History or evidence of ischemic cardiac disease?

No

Signs of hemodynamic instability or impaired tissue perfusion?

Yes

Hgb ≤ 10 g/dl

Ongoing bleeding?

Yes

Go to Resuscitation of Shock CPG

No

Hgb ≤ 7 g/dl

No transfusion indicated

Transfuse to goal range 7 - 9 g/dl

Transfuse PRBC's

Transfuse to goal range 10 - 12 g/dl

Recheck Hgb in 3 hours