IMPLEMENTATION OF AN EVIDENCE-BASED BLOOD TRANSFUSION EDUCATION PROGRAM IN THE INTENSIVE CARE UNIT: EVALUATING NURSING KNOWLEDGE

by

Melissa M. Zaccheo

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__________________________________________________________
Signature Faculty Reader Date

__________________________________________________________
Signature Program Director Date
Implementation of an Evidence-Based Blood Transfusion Education Program in the Intensive Care Unit: Evaluating Nursing Knowledge

Melissa M. Zaccheo

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Chapter I: Introduction and Overview of the Problem of Interest

The trend in health care to implement evidence-based care is widely accepted by institutions. Organizations commonly integrate practice standards that reflect current best practice to achieve improved patient outcomes and decrease hospital cost. Although data supporting a more conservative red blood cell (RBC) transfusion trigger suggests better outcomes and lower morbidity and mortality, to date, many clinicians have not readily incorporated these recommendations into their practice and few institutions have adopted standardized policies. It is important to the profession of nursing as well as to the critically ill patient population to evaluate nursing knowledge on current RBC transfusion recommendations and adverse events. Nursing professionals should be empowered with the current evidence supporting blood transfusion practice in the intensive care unit (ICU). Empowering nurses with up-to-date knowledge regarding transfusion triggers and inherent risks associated with transfusion of blood products may lead to expedited diagnosis, rapid implementation of treatment modalities when adverse events occur, and advocacy for integration of literature supported care delivery. Unfortunately, there is limited nursing literature reviewing the current trends and contemporary adverse events associated with RBC transfusion practice.

The purpose of this evidence-based practice change project was to implement an evidence-based education program on the topic of blood transfusion practice to ICU nurses. The goal of this project was to educate ICU nurses on blood transfusion indications, adverse events, and blood conservation interventions that can be implemented to decrease patient blood loss in an ICU setting. An outcome indicator of nursing knowledge of current evidence-based blood transfusion practice in the intensive care unit has been established. Nursing knowledge was evaluated prior to and following an education program, to assess the efficacy of the education
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program. Improving knowledge of professional nurses on the evidence-based topic of RBC transfusion in the ICU may improve patient outcomes through best practice actions.

Background

In the United States, a paradigm shift to evidence-based practice is occurring (Melnyk & Fineout-Overholt, 2005). RBC transfusion practice in the acute care setting has attracted much medical professional attention. Up to 45% of ICU patients receive blood transfusions (Marik & Corwin, 2008) at a hospital cost of $213.94 per unit of RBC’s (Department of Health & Human Services, 2008). Additionally, from 2004 to 2006, RBC transfusions had increased by 3.3% (Department of Health & Human Services, 2008). In 2006, 14.7 million units of RBCs were transfused in the United States (Department of Health & Human Services). These statistics combined with the potential morbidity and mortality associated with RBC transfusions, has resulted in published recommendations to support current evidence and trends in transfusion practice. The adverse events of transfusion-associated circulatory overload and transfusion-related acute lung injury can carry a mortality rate of approximately 5% to 15% (Gajic, Gropper, & Hubmayr, 2006). Although data supporting a more conservative RBC transfusion trigger suggests better outcomes and lower morbidity and mortality, to date, many clinicians have not readily incorporated these recommendations into their practice and few institutions have adopted standardized protocols (Hebert et al., 1999).

There is limited nursing literature on the evidence-based practice of blood transfusion in the ICU and the nursing interventions that can integrate best practice. With the common incidence of anemia and blood transfusion in the ICU, coupled with the hospital cost and adverse event occurrence with RBC transfusions, nursing professionals should be educated on current best practice and contemporary adverse events to impact patient care outcomes.
Significance

It is important to the profession of nursing, as well as to the critically ill patient population, to ensure that care delivery is evidence-based. Nursing professionals should be equipped with the current evidence supporting blood transfusion practice in the acute care environment. Empowering clinicians with an evidence-based education program regarding RBC transfusion practice and inherent risks associated with transfusion of blood products may lead to expedited diagnosis, rapid implementation of treatment modalities when adverse events occur, and advocacy for integration of literature supported care delivery. RBC transfusions have benefits, well known and less recognized risks, and a tremendous economic impact on our healthcare system. The risks of blood transfusions are researched and documented, however, the practice of a more restrictive transfusion trigger and blood conservation practices are not widely accepted or instituted by the clinicians in the acute hospital setting (Corwin et al., 2004).

Literature suggests that patients who receive evidence-based care from well-designed studies experience 28% better outcomes (Melnyk and Fineout-Overholt, 2005). Furthermore, there is some evidence that providers who use an evidence-based approach to healthcare delivery have higher levels of professional satisfaction. The use and teaching of evidence-based practice may be an opportunity to not only improve patient morbidity, mortality, and hospital cost, but also may decrease the attrition rate of nurses and improve their professional satisfaction. An institutional nursing trend is implementation of evidence-based care to improve patient health outcome and assist clinicians in gaining a better understanding of practices so that they can deliver more sensitive clinical care. The project outcome may not only be used to evaluate the level of evidence based nursing knowledge prior to and following an education program, but also
provide data to champion in-service evidence based practice education programs to enhance the nurses’ knowledge and skill.

*Question Guiding Inquiry (PICO)*

Integration of a clinical question into a format that will yield the most relevant and best evidence is the first step of evidence-based practice (Melynyk & Fineout-Overholt, 2005). Using the PICO format to generate a comprehensive clinical question that includes: (a) patient population, (b) intervention of interest, (c) comparison intervention or status, and (d) outcome, will result in an effective and time-efficient search of the literature (Melynk & Fineout-Overholt).

1. Does educating adult intensive care unit registered nurses improve their knowledge about current evidence based practice on blood transfusion triggers and adverse events in adult critically ill patients?

**Population (P):**
- The target population is a diverse sample of registered nurses who practice in an adult ICU in an acute care hospital clinical environment.
- The accessible population will be chosen from a Level II trauma center in western Pennsylvania.

**Intervention (I):**
- Develop an evidence-based education program.
- Power point education presentation during the scheduled unit-based monthly meeting.

**Comparison (C):**
- Adult ICU registered nurses following voluntary participation in the evidence-based education program.

**Outcome (O):**
- Nursing knowledge is the project’s outcome measurement indicator.
Conclusion

With up to 45% of ICU patients receiving blood transfusions, it is important for ICU nurses to have the information on best practice for this common nursing intervention. There is information in nursing literature about the technical aspect of administering blood transfusions, as well as the more commonly discussed immunologic adverse events associated with this common practice. However, nursing literature is deficient in the current trends on transfusion triggers and more contemporary adverse events. Furthermore, the morbidity, mortality, and cost associated with this common practice demands that all care providers are current with their knowledge and clinical practice.
Chapter II: Review of the Literature

The practice of RBC transfusions in the ICU has literature to support and advocate for care delivery that is evidence-based. ICU nurses should be provided with information to improve their knowledge to ultimately provide care delivery that is based on relevant literature. In chapter two, the process of searching for the best evidence and the results of that process will be revealed.

Methodology

To achieve a comprehensive and validated review of the literature, the process was consistent and systematic. A search of databases was completed, initially in the nursing literature and subsequently in the medical literature. Databases that were utilized included the Cochrane Library, MEDLINE, CINAHL, EMBASE, Sigma Theta Tau International’s Registry of Nursing Research, and PubMed. The database search process integrated citation inclusion goals including language, peer reviewed literature, and study design. Subsequently, the bibliographies of critiqued relevant literature were referenced to discover additional studies, systematic reviews, evidence-based clinical practice guidelines, and/or meta-analyses. A search of the nursing literature did not yield the quantity or quality of publications needed for a comprehensive written literature review, or current evidence-based nursing knowledge. Therefore, the search was expanded and subsequently fulfilled with medical literature.

After gathering the literature, the information was critically appraised, systematically, to evaluate validity, reliability, and applicability. This process generated confidence for inclusion in the final integrative review of the literature.
Findings

Anemia is one of the most commonly encountered abnormal laboratory value found in critically ill patients. Up to 45% of ICU patients receive blood transfusions during their admission (Marik & Corwin, 2008). RBC transfusions in the critically ill adult population have obvious clinical benefits, and are often life saving. However, RBC transfusion practice has come under increased scrutiny since the 1980s. Historically, the main concerns surrounding blood transfusion have been associated with transfusion related infections and serious transfusion reactions. With modern blood banking technology, these complications are exceedingly rare. More recent literature has offered that blood transfusions are not as benign as once thought. Furthermore, there are other important, but less clinically recognized risks associated with transfusion of blood products in the critically ill. More recent literature suggests that immunomodulating effects occur in recipient’s of RBC transfusions. These effects may increase a recipients’ risk of developing clinical non-infectious complications such as: transfusion related acute lung injury (TRALI), transfusion associated circulatory overload (TACO), the development of nosocomial infections, as well as a possible link to autoimmune disease later in life.

Transfusion requirements will continue to increase because of the increasing burden of chronic disease in an aging population, improvement in life support technology, and blood intensive surgeries (Marik & Corwin, 2008). From 2004 to 2006, the total RBC transfusions increased by 3.3% (Department of Health & Human Services, 2008). Given data supporting a more conservative transfusion trigger suggesting lower morbidity and mortality, healthcare professionals must recognize that implementation of this widely applied practice demands professional awareness and individual attention to the risks and benefits.
Anemia and Critical Illness

Anemia of critical illness is common in the ICU. The prospective, multiple-center, observational cohort CRIT study in the United States reported that 70% of intensive care unit patients had a hemoglobin concentration <12 g/dL (Corwin et al., 2004). Anemia is defined as a reduced absolute number of circulating red blood cells, which clinically manifests as a reduction in hemoglobin (Hgb) concentration, hematocrit (Hct) and/or red blood cell count. In females, anemia is defined as a Hgb <12 g/dL or Hct <36%, and in males, a Hgb <13.5 g/dL or Hct <41% (Silvergleid, 2008). However, subtle variations in these numbers are organization dependent.

The etiology of anemia in critically ill patients is multifactorial. Blood loss via trauma, surgery, gastrointestinal bleeding are overtly recognized causes of anemia. However, phlebotomy and minor procedures have also been recognized as contributing to anemia in the critically ill. Vincent, Baron, Reinhart, Gattinoni, et al. (2002) found that the average total volume of blood drawn in a 24 hour period, per patient, was 41.1 mL. An additional etiology for anemia in the critically ill population is decreased RBC production via decreased erythropoietin synthesis, resistance to erythropoietin, or iron deficiency. Red blood cell production in critically ill patients is physiologically abnormal. Critically ill patients have an inappropriately low erythropoietin concentration, irrespective of the presence of renal failure (Raghavan, 2005). There is suppression of erythropoietin production by erythropoietin gene inhibition and erythropoietin resistance is attributed to a variety of inflammatory mediators (Raghavan, 2005). Increased hemolysis as well as decreased RBC lifespan also plays an important role.

Symptoms related to anemia are a result of decreased oxygen delivery to the tissues and hypovolemia. Anemia causes a decrease in the oxygen carrying capacity of blood leading to an increased cardiac output, shift of the oxyhemoglobin dissociation curve and increased oxygen
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Transfusions of RBC’s have been used clinically to increase tissue oxygen delivery in the setting of anemia. Clinical symptoms of anemia include dyspnea, fatigue, bounding pulses, palpitations, dizziness, chest pain, myocardial infarction, arrhythmia, syncope, hypotension, shock, and death.

*Risks of Transfusion*

With the high incidence of anemia in the critically ill, many patients will receive RBC transfusions as part of their treatment plan. The results of the 2007 National Blood Collection and Utilization Survey Report state that 14.7 million units of red blood cells were transfused in 2006 at a hospital cost of $213.94 per unit of RBC’s (Department of Health & Human Services, 2008). Blood transfusions are given with the aim of improving oxygen delivery and hence limiting tissue hypoxia and damage at the cellular level. With up to 45% of ICU patients receiving RBC transfusions, the risk to benefit ratio must be evaluated individually. As a result of concerns over adverse events associated with blood transfusion, and several studies suggesting better outcomes and lower morbidity and mortality with lower transfusion triggers, there has been a general decrease in the transfusion threshold. The previous arbitrary transfusion trigger of 10g/dL hemoglobin concentration used in the past has been subjected to further investigation and scrutiny.

*Transfusion transmitted infections.* In 2006, infectious disease testing of blood products for transfusion in the United States included routine use of serologic tests for antigens and/or antibodies to human immunodeficiency virus (HIV), type 1 and type 2; hepatitis B virus (HBV); hepatitis C virus (HCV); human T-cell lymphotropic viruses, type I and type II; and syphilis (Stramer, 2007). Nucleic acid amplification testing (NAT) has also been used for HIV-1 and HCV detection and by some blood centers for HBV deoxyribonucleic acid (DNA) detection and
by virtually all facilities for West Nile virus RNA detection. NAT was implemented for all donations in the United States in 1998 to 2000 to reduce the residual risk of HIV and HCV transmission by all components (Stramer). The progression of testing technology has significantly reduced the risk of transfusion-transmitted infections (TTI). The reported risk from test-negative blood components in the United States is an estimated 1 in 2 million for HIV and HCV and 1 in 200,000 to 500,000 for HBV (Stramer). Although there has been immense progress and a downward trend in TTI’s, there are other important risks associated with blood transfusions.

Transfusion-related acute lung injury. TRALI is a potentially life-threatening complication of blood transfusion. Mortality rates are estimated at 6-10%. TRALI is largely a clinical diagnosis resulting in respiratory distress symptoms requiring oxygen support within the first 2 to 6 hours from the initiation of the relevant blood transfusion (Moore, 2006). Additional signs and/or symptoms include hypoxemia, hypotension, cyanosis, bilateral pulmonary infiltrates, absence of signs of circulatory overload, and fever. Less commonly, hypertension may be seen. The absolute pathophysiology of TRALI ultimately remains unclear. However, Moore has proposed the current theory regarding a possible mechanism: passively transferred donor blood cells containing anti-leukocyte antibodies and blood storage lipids, directed against recipient leukocytes, cause pulmonary sequestration, complement activation, and lung injury resulting in pulmonary edema secondary to increased permeability. The treatment of TRALI surrounds making the correct diagnosis. To date, no formally structured prospective trials of different treatments have been reported. Supportive care with oxygen, mechanical ventilation (approximately 72% of patients will require intubation), low tidal volume ventilation, as well as fluids and vasopressors for hypotension are indicated.
Transfusion-associated circulatory overload. Pulmonary edema is a potentially serious complication of blood transfusions. It is associated with the accumulation of extravascular lung water due to an imbalance of fluid filtration and resorption (Gajic, Gropper, & Hubmayr, 2006). When pulmonary edema and hypoxemia occur within 6 hours of a blood transfusion, the differential between TACO and TRALI must be made. The incidence of TACO is relatively unknown. Estimates have suggested that TACO may occur in up to 11% of patients undergoing blood transfusions with an estimated morality rate of 5-15% (Gajic, et al.). Clinically, TACO presents with dyspnea, tachypnea, jugular venous distention, and an elevated systolic blood pressure. Treatment of TRALI and TACO vary considerably, thus prompt recognition and initiation of appropriate management is imperative. A history of heart disease, positive fluid balance, absence of acute lung injury risk factors, and signs consistent with systemic and/or pulmonary venous hypertension establish a diagnosis in favor of TACO (Gajic, et al.). Management of TACO is employed by volume reduction with diuretics.

Transfusion-related immunomodulation. Transfusion-related immunomodulation (TRIM) has been suggested to result from infusion of large amounts of foreign antigens and blood storage proteins. These mediators have been shown to down regulate the recipients’ immune system, thus contributing to the development of immunosuppression and increasing the incidence of nosocomial infections (Vamvakas, 2006). This syndrome, the mechanisms and clinical relevance, requires additional trials and studies to fully understand its’ impact on treatment and outcomes in blood transfusions.

Blood Storage

Vincent and Piagnerelli (2006) state that “although oxygen delivery is improved, there is not necessarily a concomitant increase in tissue oxygenation or oxygen utilization” (p.S97). This
is due to various morphological and functional changes associated with blood storage. Blood storage systems approved by the United States Food and Drug Administration allow red cell units in the United States to be stored for up to 42 days. The mean calculated age of stored red blood cells, in the United States, was 19.5 days at transfusion (Department of Health & Human Services, 2008). Some studies have suggested that post transfusion complications increase when the blood has been stored for longer periods. Koch, Li, Sessler, Figueroa, et al. (2008) enrolled over 6000 patients in an observational cohort study comparing patients undergoing cardiac surgery who received transfusion of blood stored for more than 2 weeks with the outcomes among patients receiving blood stored for 2 weeks or less. They concluded that transfusion of red cells that had been stored for more than 2 weeks was associated with a significantly higher risk of postoperative complications including prolonged intubation, renal failure, sepsis, and multi-organ failure as well as overall reduced survival after cardiac surgery. The mechanism linking adverse outcomes to duration of RBC storage is unclear. However, the depletion of 2,3-diphosphoglycerate (2,3-DPG), which shifts the oxyhemoglobin dissociation curve to the left reducing oxygen delivery, is suggested as a contributing factor. Additionally, stored red blood cells change shape secondary to decreased adenosine triphosphate (ATP) levels, thereby causing decrease deformability, thus impeding microvascular flow.

**Immunologic Blood Transfusion Reactions**

In addition to the less recognized risks associated with blood transfusions, there are the well documented and understood immunologic reactions as well as a number of chemical complications directly associated with blood transfusions. Unfortunately, one of the most frequent and avoidable causes of life threatening events from blood transfusions results from human error in which a patient receives an ABO mismatched unit of blood. This results in an
acute hemolytic reaction, which is a medical emergency resulting from the rapid destruction of donor erythrocytes by pre-formed recipient antibodies. The result is intravascular hemolysis, which may lead to disseminated intravascular coagulation (DIC), shock, and acute kidney injury from acute tubular necrosis. Patient’s present with fever, chills, flank pain and rarely brown urine. Immediate cessation of the transfusion, infusion of intravenous normal saline solution, and supportive care must be initiated emergently. The blood bank should be alerted immediately, the bag of RBC’s returned, and hospital policy followed.

Febrile nonhemolytic reactions are the most common transfusion reaction (Silvergleid, 2008). This often results in fever, chills, mild dyspnea and usually responds to discontinuing the transfusion and administration of antipyretics. It is important to confirm that an acute hemolytic reaction is not occurring.

Anaphylactic reactions are a life threatening reaction to a blood transfusion. It results from the presence of class-specific IgG, anti-IgA antibodies in patients who are IgA deficient (Silvergleid, 2008). It usually has rapid onset, manifested by shock, hypotension, angioedema, and respiratory distress and demands immediate intervention with epinephrine, airway maintenance, oxygenation, volume resuscitation, vasopressors, and immediate cessation of the blood transfusion.

Moreover, there are also less serious reactions including delayed hemolytic transfusion reactions, urticarial transfusion reactions, citrate toxicity, hyperkalemia, hypokalemia, hypothermia, and iron overload.

*Current Evidence and Trends in Transfusion Practice*

With the significant incidence and prevalence of anemia in the critically ill, determining when to transfuse RBC’s has become a topic of much debate regarding the optimal transfusion
trigger. RBC transfusions have benefits, well known and less recognized risks, and tremendous economic impact on our healthcare system. Zilberberg and Shorr (2007) led a quantitative secondary analysis to estimate the annual reduction in transfusion attributable severe acute complications (TSACs) and costs with the adoption of a restrictive transfusion strategy. They concluded that approximately 40,000 TSACs and nearly $1 billion could potentially be avoided and saved annually in the United States.

There have been numerous studies evaluating the efficacy and safety of blood transfusions in the critically ill. Hebert et al. (1999), in the Transfusion Requirement in Critical Care (TRICC) study, is the only adequately powered randomized study that investigated the impact of blood transfusion in adult critically ill patients. In the TRICC trial, Hebert et al. randomly assigned 838 critically ill patients to either a restrictive transfusion strategy where RBC transfusions were administered to keep the Hgb 7-9 g/dL, or a liberal transfusion strategy where patients were transfused if their Hgb was <10 g/dL and maintained a Hgb of 10-12 g/dL. The results revealed an overall 30-day mortality of 19% in the restricted group and 23% in the liberal transfusion group (P = 0.11). These differences were significant in patients less acutely ill (Acute Physiology and Chronic Health Evaluation II score ≤20, 8.7 vs. 16.1%; P = 0.03) and younger (age <55 years, 5.7 vs. 13%; P = 0.02). The overall hospital mortality was significantly less in the restricted transfusion group (22 vs. 28%; P = 0.05). The previous arbitrary transfusion trigger of 10g/dL was challenged and providers were encouraged by the data to utilize a more restrictive transfusion trigger of < 7g/dL with the possible exception of patient’s with unstable angina and acute myocardial infarction. Subsequently, Vincent et al. (2002), led a multicenter prospective observational cohort study, known as the ABC study that enrolled 3534 patients to evaluate mortality and organ dysfunction association with RBC transfusion. They found a higher
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mortality in the patient’s who received RBC transfusions vs. those who had not received a transfusion (18.5 vs. 10.1%; \( P < 0.001 \)). Similarly, Corwin et al. (2004) in the CRIT study, enrolled 4892 adult patients from ICUs in a prospective observational cohort study to examine the relationship of anemia and RBC transfusion to clinical outcomes. The results concluded that the number of RBC transfusions was independently associated with longer ICU and hospital lengths of stay and an increase in mortality and complications. Additionally, they reported that although studies have found recommendations of a lower transfusion trigger of 7g/dL, this has not resulted in a major alteration in practice patterns. The studies by Vincent et al. and Corwin et al. were observational studies with a heterogeneous sample of critically ill patients, thereby confounding the interpretation of the results.

More recently, Vincent et al. (2008) led a study known as The Sepsis Occurrence in Acutely Ill Patients (SOAP) where they enrolled 3,147 patients in a multicenter, observational study to evaluate the relation of blood transfusion to mortality in European ICUs. Unlike the earlier CRIT and ABC studies, the SOAP study found that blood transfusion was not associated with increased mortality. These differing results have been attributed to varying study design. Another explanation is the increased utilization of leukocyte-depleted blood since the ABC study was conducted.

Marik and Corwin (2008) completed a systematic review of the literature to determine the association between RBC transfusion and morbidity and mortality in high-risk hospitalized patients. They concluded that in adult, ICU, trauma, and surgical patients, RBC transfusion are associated with increased morbidity and mortality. Current recommendations for the management of patients with severe sepsis support a transfusion trigger of \(< 7g/dL\) to a target hemoglobin of 7.0 to 9.0 g/dL in adults (Dellinger et al., 2008). They did suggest that “special
“circumstances” might require a higher hemoglobin including: myocardial ischemia, severe hypoxemia, acute hemorrhage, cyanotic heart disease, or lactic acidosis (Dellinger et al, p. 24). Furthermore, Hill et al. (2008) in the Cochrane Reviews concluded that the evidence, although limited, supports the use of restrictive transfusion triggers in patients who are free of serious cardiac disease.

Limitations

A search of the nursing literature did not reveal publications on evidence-based blood transfusion practice in the ICU. Therefore, the literature search was expanded to other health sciences to acquire information and data to generate a thorough integrative review of the literature.

Conclusion

Anemia is common in critically ill patients. The providers of care must balance the risks associated with anemia with those associated with RBC transfusions. Much has changed with regard to blood transfusion triggers since Hebert et al. (1999). Concerns regarding excess morbidity and mortality associated with liberal RBC transfusions coupled with the emerging risk associated with immunomodulation related to blood storage practices should prompt education of current evidence of transfusion practice and the risks associated with this common, often anecdotal clinical practice. The evidence, thus far, suggests that RBC transfusions are associated with increased morbidity and mortality in heterogeneous critically ill patient populations (Marik & Corwin, 2008). The transfusion trigger of 7g/dL, with the possible exception of acute myocardial infarction and unstable angina, has been supported by the current literature, although, additional randomized controlled clinical trials are needed.
Literature supports that patients who receive evidence-based care experience 28% better outcomes (Melnyk & Fineout-Overholt, 2005). There is also evidence to suggest that providers who use an evidence-based approach to care delivery experience higher levels of professional satisfaction, which may impact nurse attrition rates and healthcare cost (Melynyk & Fineout-Overholt). Nursing professionals should be aware of the benefits and risks of blood transfusions and the current evidence supporting practice. Furthermore, there is evidence that RBC transfusion is a common practice implemented by nurses. They have the ability to impact best practice for critically ill patients. Responsible phlebotomy for diagnostic testing, use of pediatric or low volume adult tubes, point-of-care microanalysis, and closed circuit sampling are modifiable ways to decrease blood loss in the ICU. The nurses ability to embrace, understand, and apply the current evidence-based literature will inherently lead to ways to minimize the risks associated with blood transfusions. Empowering the nurse with up to date knowledge regarding transfusion triggers, inherent risks associated with transfusion of blood products, and blood conservation techniques will lead to advocacy for RBC transfusion indications, an expedited diagnosis and treatment of adverse events following an RBC transfusion, and a decrease in patient blood loss. Furthermore, this knowledge will be reflected in an environment that will foster patient advocacy and nurse champions for leadership amongst colleagues, thus leading to improved clinical environments for patients and nursing professionals.
Chapter III: Conceptual Model

Studies indicate that care delivery by healthcare providers often does not actively incorporate research findings into their practice (Melnyk & Fineout-Overholt, 2005). Using a model to guide actions, for an individual or organizational practice change, provides a prescribed direction to progress from published literature to practice application. In chapter three, the Stetler model will be reviewed and will serve as a guide for the evidence-based practice change project to implement an evidence-based blood transfusion education program in the ICU.

Model

The Stetler model was chosen for this evidence-based practice change project. This model applies to all forms of practice (i.e. educational, clinical, managerial, etc.) and outlines a series of five phases to promote evidence-based practice: (1) preparation, (2) validation, (3) comparative evaluation / decision making, (4) translation / application, and (5) evaluation. The model can be used by the individual practitioner or at the organizational level, however historically it is known as a “practitioner-oriented” model (Melnyk & Fineout-Overholt, 2005, p. 188). The Stetler model promotes the use of both internal and external evidence in a fluid and dynamic process that imitates the professional’s way of thinking about evidence-based practice. These characteristics make this model ideal for the proposed capstone project. Furthermore, the Stetler model focuses on critical thinking and the use of evidence to deliver care. This correlates with the goals of the evidence-based practice change project. Integrating critical thinking through the evidence-based education program emphasizes the importance of not creating an environment that is “task-oriented, mechanistic routine that can lead to inappropriate, ineffective, and non-evidence-based-practice” (Melnyk & Fineout-Overholt, 2005, p. 188).
Models of evidence-based practice promote a clinical practice that is based on evidence, not tradition or ritual. Additionally they raise awareness about the importance of applying research findings to the practice of nursing (Melnyk & Fineout-Overholt, 2005). Lastly, the models offer guidelines for designing and implementing practice change projects.

**Conclusion**

Integration of the Stetler model as a guide for the evidence-based practice change project will benefit not only the author, but also the individual providers and organization. The model will serve as a consistent advisor to achieve the planned outcome measurements. Evaluating nursing knowledge prior to and following an evidence-based education program to ICU nurses requires project organization and a fluid, defined process where progress is dependent on the prior steps’ findings. Although dynamic in nature, the model will provide structure to achieve the desired outcomes.
Chapter IV: Project Design

In chapter four of this practice change initiative, the project design will be described. Implementation of an evidence-based blood transfusion education program to ICU nurses requires a project design involving various individuals to achieve an effective capstone project.

Project Description and Planning

The facility where the capstone project took place was a 343-bed, level II trauma center in western Pennsylvania. There are two intensive care units and one transitional care unit (TCU). One ICU is a designated Medical Intensive Care Unit (MICU) and the second is a Surgical Intensive Care Unit (SICU). The MICU has 14 patient beds, the SICU has 28 patient beds, and the TCU has 20 beds. The target population was a diverse sample of registered nurses who practice in an adult ICU in an acute care hospital clinical environment. The accessible population was chosen from a local Level II trauma center in western Pennsylvania. Pennsylvania licensed registered nurses whom currently work in a critical care practice setting were invited to participate. A number of currently employed registered nurses in the intensive care unit were obtained from the current designated nurse managers. Participation was voluntary.

The organization has several councils and committees that support and, at times, champion evidence-based practice. There is a nursing research council, a newly formed evidence-based practice nursing council, and an ICU specific performance improvement team. More recently, over the past 6 months, the organization has committed to the Magnet Recognition Program® outlined by the American Nurses Credentialing Center. The designated hospital Magnet® Coordinator, the Chief Nursing Officer, the Chief Quality Officer, and the Medical Director of the Intensivist Service support this practice change project and recognize the
importance of integrating evidence-based education to nurses to improve patient quality, safety, and outcomes, as well as nursing professional satisfaction.

The human resources required to achieve a successful evidence-based practice change project vision and plan are numerous. Administrative support to advocate evidence-based nursing practice included the Chief Nursing Officer, Chief Quality Office, Medical Director of Critical Care, and the Nursing Magnet® Coordinator. Furthermore, the questionnaire generated required time investment and expertise by three independent expert nursing and medical professionals to establish face validity. A doctorate prepared tenured nurse educator, a medical director and practicing intensivist physician, and a pathologist physician whom is the medical director of the department of laboratory medicine, were the experts used in the development of the questionnaire. Additionally, an advanced-practice nurse (APN) colleague and intensivist physician had volunteered as on-site liaisons and implementers on this project. Moreover, the buy-in by the nurse managers has been vitally important. They are the staff nurses’ direct resources for integrating and advocating change and education in the acute care environment. A hospital based research analyst provided support for the statistical analysis of the project. Lastly, the technology personnel are integrated into the project as support for required equipment supply and technology difficulties that may arise.

A PowerPoint presentation was generated as the educational program tool. The information included in the program was based on the evidence published in the literature, which was integrated in the review of the literature for this project. The significance of creating standardized materials that specifically outline the content of the education program was important so that others can replicate it and expect the same results in their practice settings. Additionally, the project implementers underwent training to ensure quality and completeness in
the delivery of the educational information. The goal of the intervention was to increase nursing knowledge of this evidence-based practice. Offering ICU nurses evidence-based education may improve their knowledge to best practice standards. Topics covered under this sub-title will cover evidence-based data on red blood cell transfusion practice in the ICU (Appendix A).

The data-collection tool and measurement method used in this project was a questionnaire (Appendix B). Thus, the questionnaire was the data-collection instrument used to measure the effectiveness of the education program. In a review of the literature, a validated tool was not discovered, therefore a self-designed questionnaire was developed. Face validity was established through three independent expert nursing and medical reviews. A doctorate prepared tenured nurse educator, a medical director and practicing intensivist physician, and a pathologist physician whom is the medical director of the department of laboratory medicine, were the experts used in the development of the questionnaire. Minor changes were made in response to this. The questionnaire began with multiple-choice knowledge questions and ended with structured biographical questions. These techniques increased the reliability of the tool and collected information.

Conclusion

Defining the focus population, generating an evidence-based education program, and creating validated questionnaires provide the tools needed to design an effective project for the individuals, organization, and ultimately patients on the evidence-based practice of blood transfusion in the ICU.
Chapter V: Implementation Procedures and Process

Implementation of an evidence-based education program on RBC transfusion in the ICU required preparation, literature validation, and resource utilization. In chapter five, the steps of implementation procedures and process will be reviewed.

Implementation Procedures and Process

Following the practice change project identification and completion of the literature review, the evidence-based PowerPoint education program was generated as well as the questionnaires to evaluate nursing knowledge of evidence-based RBC transfusion practice in the ICU. Institutional Review Board (IRB) approval was pursued and subsequently obtained from both the hospital facility and Chatham University. An exempt proposal was submitted and granted (Appendix C).

A collaborative, multi-disciplinary team was assembled to design the implementation procedures and process for the practice change project. Administrative support was obtained from the Chief Nursing Officer, Chief Quality Officer, and Magnet® Coordinator. A written project protocol was generated and the project implementer(s) were educated on the implementation process and data collection procedure. The nurse administrators and ICU nurse managers were informed of the project via meetings and written communication. The nurse managers received a letter via electronic mail informing them of the practice change project involving an evidence-based education program (Appendix D). Subsequently, the ICU nurses received a letter, via electronic mail, inviting them to participate in this evidence-based education program (Appendix E). The letter defined the project as one focusing on educating ICU nurses on an evidence-based topic and evaluating nursing knowledge to assess the effectiveness of the educational program. The letter stated there would be a questionnaire administered before and
after an educational program at their scheduled unit-based monthly meeting. Additionally, the letter stated that the questionnaire would include biographical questions, questions about their current scope of clinical practice and experience, and their knowledge of an evidence-based clinical topic. Informed consent was not pursued because the only record linking the subject and the project would be the consent document. The principal risk would be potential harm resulting from a breach of confidentiality. Participation was voluntary. If the nurse did not wish to participate, he/she was able to notify the project implementer(s) when they attended the unit-based meeting.

During a pre-project contact, the project implementer(s) also posted brochures in each ICU and in each nurses’ mailbox. Furthermore, the project implementer(s) prepared for the meetings by assigning random paired numbers to each questionnaire, assembling the envelopes containing the two, labeled questionnaires, securing the necessary audio-visual equipment, ordering the food, and reserving the rooms.

At each unit-based meeting, the project implementer(s) re-iterated the project purpose, ensured confidentiality, and asked if the participants had questions. The participants were informed of the strategies used to increase confidentiality. These action plans included storing data in a secure place with limited access and using blank envelopes containing the pre and post questionnaire. The questionnaires were labeled with unique identical numbers to enable paired analysis and to aggregate reporting of responses, while maintaining confidentiality. The participants were also informed that the questionnaires would be kept in a locked file cabinet for future reference and destroyed after the project has been completed or August 17, 2009, whichever is sooner. The project implementer(s) and Chatham University faculty involved in the project were the only individuals with access to the questionnaires. The participants were
Evidence Based Blood Transfusion Education

informed that the project would last approximately 35 minutes: 10 minutes for the pre-education program questionnaire, 15 minutes for the education program, 10 minutes for the post-education questionnaire. The directions for the questionnaire were given at the onset of the project. The participants were informed of the different types of questions requiring multiple-choice and dichotomous answers. Prior to starting, the participants were asked if he/she has further questions regarding the project, educational program and/or questionnaire.

Following this introduction, the envelopes were dispersed and the participants were asked to complete questionnaire number one and place the completed questionnaire in the supplied envelope. Following completion of the initial questionnaire, the participants completed the evidence-based educational program. Subsequently, the participants completed the final questionnaire. The participants were asked to place the completed questionnaires in the blank envelope and submit it to the project implementer(s). Following completion of the second questionnaire, the participants received a reference card (Appendix F) summarizing clinical pearls from the education program. The participants also received breakfast or lunch, served after the project, for their inconvenience and assistance.

**Conclusion**

Disseminating evidence through small group presentations is a strategy to guide clinical practice changes and involve the professional nurses in the process (Melynyk & Fineout-Overholt, 2005). Evidence-based practice is essential for effective patient care. Promoting evidence-based practice of RBC transfusions in the ICU raises awareness about the importance of applying research findings in nursing practice (Melynyk & Fineout-Overholt).
Chapter VI: Evaluation and Outcomes of the Practice Change Initiative

The intended outcome of implementing an evidence-based education program on RBC transfusion in the ICU was improved nursing knowledge and thus delivery of quality patient care decisions that are based on evidence. In chapter VI, the evaluation and outcomes of the practice change initiative will be discussed.

Measurement Tool: Questionnaire

As discussed previously in chapter IV, the measurement tool was a self-designed written questionnaire (Appendix B). Face validity was established through three independent expert nursing and medical reviews. The questionnaire included biographical and knowledge questions to collect data on the participants’ demographics and to assess knowledge on RBC transfusion practices in the ICU. The first questionnaire consisted of 17 questions: 10 knowledge questions and 7 demographic questions. The second questionnaire consisted of the 10 knowledge questions. The questionnaire was used to evaluate the effectiveness of the evidence-based education program. Knowledge was assessed prior to and following the evidence-based education program.

Measurement Outcomes

Forty-six nurses from three separate intensive care units at a level II western Pennsylvania hospital participated in the practice change project and completed both questionnaires, enabling paired analysis. One project implementer marked all of the tests. The demographics of the participants are listed in Table 1. The results of the tests were statistically evaluated to assess mean scores prior to and following an evidence-based education program and comparison of the findings using a paired t-test analysis. SPSS® statistical software program was used to analyze the data. Completion of the evidence-based education program resulted in
improved levels of nursing knowledge on RBC transfusion practice in the ICU. The mean score on the knowledge test prior to completion of the educational program was 66.3 % and subsequently increased to 89.3 % following the evidence-based education program. This change represents a total increase of 23% among the participants (paired t test, $P = <0.0001$; Figure 1). Scores of 66.3%, prior to the education program, seem to reflect that the ICU nursing staff had little understanding of the evidence-based practice of RBC transfusion in the ICU.
Table 1

Demographics of the Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Self reported, % (n = 46)</th>
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<tr>
<td><strong>Highest level of nursing education achieved</strong></td>
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</tr>
<tr>
<td>Associates degree / diploma, nursing</td>
<td>28.3</td>
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<tr>
<td>Bachelor’s degree, nursing</td>
<td>69.6</td>
</tr>
<tr>
<td>Master’s degree, nursing</td>
<td>2.2</td>
</tr>
<tr>
<td>Doctorate degree, nursing</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Licensed nursing experience, years</strong></td>
<td></td>
</tr>
<tr>
<td>&lt; 1</td>
<td>10.9</td>
</tr>
<tr>
<td>1 – 5</td>
<td>34.8</td>
</tr>
<tr>
<td>6 – 10</td>
<td>10.9</td>
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<tr>
<td>&gt; 10</td>
<td>43.5</td>
</tr>
<tr>
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<td>13.0</td>
</tr>
<tr>
<td>1 – 5</td>
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<tr>
<td>6 – 10</td>
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<tr>
<td>&gt; 10</td>
<td>32.6</td>
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<tr>
<td><strong>Nursing specialty certification (i.e. CCRN®)</strong></td>
<td></td>
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<tr>
<td>Yes</td>
<td>32.6</td>
</tr>
<tr>
<td>No</td>
<td>67.4</td>
</tr>
</tbody>
</table>
Conclusion

The intended primary outcome, improved nursing knowledge, was achieved. Knowledge improved after the evidence-based education program, as indicated by higher mean scores on the second questionnaire, thus reflecting the effectiveness of the education program. Evidence-based practice is an important part of nursing education. For clinicians to become evidence-based providers who make decisions based on the best and up-to-date literature, incorporating patient goals and their professional expertise, they must actively use information (Thompson, Cullum, McCaughan, Sheldon, and Raynor, 2004). Nurses are increasingly viewed as key decision makers within the healthcare team (Thompson et al.). Given this status, it is essential that nurses be provided with information and thus knowledge that is literature supported, to guide their ever-increasing clinical decisions.
Chapter VII: Implications for Nursing Practice

Nurses’ clinical decisions have important implications for patient outcomes (Thompson, Cullum, McCaughan, Sheldon, and Raynor, 2004). Clinical decisions are guided by available information. Educating ICU nurses on the evidence-based practice of RBC transfusion has implications for nursing practice. In Chapter VII, these implications as well as limitations of the practice change project will be discussed.

*Nursing Implications*

Acute care nurses were found to rely on human sources for information in areas that they were uncertain (Thompson, Cullum, McCaughan, Sheldon, and Raynor, 2004). This was reportedly due to accessibility. Additionally, McKnight (2006), in an observational study, found that ICU nurses information seeking was limited to human resources, the patient chart, and other existing clinical information systems. She further described that nurses felt that searching for and analyzing information from the Internet may be unethical, as it would take time away from direct patient care. Providing nurses with evidence-based practice information and thus knowledge will decrease their clinical uncertainty in practice (Thompson et al.). Nurses need to be informed of the correlation between their clinical care delivery and patient care outcomes. If the nursing intervention is linked, via the evidence, to patient outcomes, they can learn what is effective in their care delivery practices (Doran & Sidani, 2007).

Given the lack of nursing literature on the evidence-based RBC transfusion practice in the ICU, it is difficult for nurses to integrate best practice without the needed information. ICU nurses, who participated in the evidence-based RBC transfusion practice education program, had achieved a 23% higher score on the knowledge test following the education program and thus will likely be better prepared to make well-informed decisions about patient care surrounding
RBC transfusions. Additionally, improved nursing knowledge may result in expedited diagnosis of adverse events from RBC transfusions, rapid implementation of treatment modalities when these events occur, and advocacy for evidence-based RBC transfusion indications. These implications may not only result in improved patient morbidity, mortality, and hospital cost, but also may decrease the attrition rate of nurses and improve their professional satisfaction. Lastly, the practice change project outcomes may influence ICU nursing professionals and management to integrate evidence-based education programs into their unit-based meetings to continue to improve nursing knowledge to reflect published best practices.

Although the literature supports a more restrictive RBC transfusion trigger for most ICU patients, many clinicians and institutions have not adopted policies that reflect best practice. Integrating this literature-supported practice may have a profound economic implication within an organization as well as within the United States. With up to 45% of ICU patients receiving blood transfusions (Marik & Corwin, 2008) at a hospital cost of $213.94 per unit of RBC’s (Department of Health & Human Services, 2008), adopting an evidence-based practice standard may have a far-reaching financial effect.

Doran and Sidani (2007) hypothesize that having “direct access to evidence-based resources increases nurses’ utilization of nursing interventions consistent with evidence-based resources and ultimately result in improvement in patient outcomes” (p. 6). Following the evidence-based RBC transfusion program, a reference card, summarizing evidence-based clinical pearls, was distributed as a direct access resource. Evidence suggests that patients who receive evidence-based care experience 28% better outcomes (Melnyk & Fineout-Overholt, 2005). Having champions for this practice change project in nursing administration, advanced practice nursing, nursing education, and clinical nursing as well as planned outreach visits and reminders
in the form of evidence-based reference cards is a multifaceted strategy shown to be effective in changing behavior (Melnyk & Fineout-Overholt). Given the improved nursing knowledge following the evidence-based education program, it would be prudent to include the reference card and topic review in the ICU nursing orientation program as well as integrate evidence-based RBC transfusion in the annual ICU nurse competency process.

APNs play an important role as information and change agents in acute care settings (Doran & Sidani, 2007). There are various types of strategies that are thought to be effective for promoting evidence-based practice. Melnyk and Fineout-Overholt (2005) discussed how disseminating evidence to guide clinical practice changes through group presentations are not only successful, but they also intimately involve the clinical staff in the process. This not only motivates change toward best practice and recruits champions for evidence-based care, but also may overcome the common barriers of skepticism and misperception. Doran and Sidani hypothesize that when APN’s facilitate evidence-based decision-making and outcomes review, that the uptake of evidence into practice will be increased. This improved uptake of evidence promotes best practice, resulting in desired patient outcomes (Doran & Sidani). This reflects another institutional asset of recruiting and retaining APN’s within organizations and offers an opportunity for APN’s to champion evidence-based RBC transfusion practices and blood conservation techniques in a standardized policy and protocol development in the ICU.

There is some evidence to indicate that healthcare providers who integrate evidence-based care delivery into their practice experience higher levels of professional satisfaction (Melnyk & Fineout-Overholt, 2005). With an aging population, rapidly advancing technologies, and shortage of nursing professionals, it is imperative to continue to recruit and retain dedicated professionals to our profession. The use and teaching of evidence-based practice may not only
improve patient outcomes, but also decrease cost and reduce attrition rates in healthcare professions (Melnyk and Fineout-Overholt). Involving nurses in quality care delivery efforts may lead to a more positive perception of their work environment and may also produce higher levels of patient satisfaction (Hall, Moore, & Barnsteiner, 2008). Although there are numerous challenges in nursing, “by learning and utilizing specific competencies related to quality, they may increase the effectiveness of their advocacy for patients, increase the value they bring to the institutions in which they work, and enhance the satisfaction they derive from nursing throughout their careers” (Hall, Moore, & Barnsteiner, p. 419). As nurses learn more about quality, evidence-based care initiatives and practice changes, they can improve their effectiveness as a member of the care delivery team and accelerate practice changes within their workplace (Hall, Moore, & Barnsteiner).

Limitations of the Practice Change Project

There were several limitations of the practice change project. The knowledge questionnaire that was used was the same in the pre-education program evaluation and the post-education program evaluation. This would lead to concern with prior exposure to the knowledge questions. This may have contributed to improved evaluations because of knowledge of the questions rather than knowledge of evidence-based RBC transfusion practice. To potentially amend this limitation, different knowledge questions could be used between the tests to eliminate prior exposure to the test questions.

Another limitation considered was the timing of the questionnaires. There was a baseline, pre-education program questionnaire and then a post-education program questionnaire that was given immediately following the education program. Due to a lack of time, there was not a four to six month follow-up questionnaire completed to assess sustainable knowledge. A third
questionnaire would be recommended to assess nursing knowledge in four to six months following the education program.

**Conclusion**

Implementation of an evidence-based blood transfusion education program in the ICU has far-reaching implications to both patient’s and nursing professionals. “As evidence-based practice gains momentum, continuing education practitioners increasingly confront the need to develop and conduct events promoting the uptake of research findings” (McWilliam, 2007, p. 72). Empowering nurses with the current evidence and trends in blood transfusion practice may lead to an expedited diagnosis, rapid implementation of treatment modalities when adverse events occur, and advocacy for literature supported care delivery. Furthermore, professional satisfaction may improve and attrition rates may decrease by integrating evidence-based care into nursing practice. There continue to be expanding opportunities for APN’s in the acute care environment. APN’s can broaden their practice and share their expertise by education nursing professionals on current evidence-based practices.
Chapter VIII: Summary and Conclusions

“Patients want to receive quality clinical care, and practitioners desire to provide that care” (Melnyk & Fineout-Overholt, 2005, p.3). Evidence-based practice is the solution that meets the needs of the patient and the professional desires of the provider. The goal of evidence-based practice is to provide the highest quality of care using the best, published literature findings. Unfortunately, there are some healthcare providers that are skeptical of the relationship between evidence-based practice and delivery of quality patient care (Menlyk & Fineout-Overholt). Therefore, these select clinicians do not adopt the results of well-performed studies and trials into their clinical practice. This has been true in RBC transfusion practice in the critically ill.

Anemia is common in the critically ill population. Given this clinical finding, large numbers of RBC transfusions occur in the United States. In 2006, 14.7 million units of RBC’s were transfused, an increase of 3.3% over a two year period (Department of Health & Human Services, 2008). The most recent literature suggests that up to 45% of ICU patients receive blood transfusions (Marik & Corwin, 2008) at a hospital cost of $213.94 per unit of RBC’s (Department of Health & Human Services). Furthermore, it has become evident that RBC transfusions carry not only the well-recognized immunologic adverse events and transfusion-transmitted infections associated with this common clinical practice, but also excess morbidity and mortality from the less recognized adverse events of TRALI, TACO, and TRIM. Therefore, published recommendations are available to support current best practice.

The routine use of RBC transfusion in patients who are hemodynamically stable and not acutely bleeding is not supported by the current data. Although there is uncertainty about the absolute transfusion trigger for acute myocardial infarction and unstable angina patients, there is
data available to support a transfusion trigger of 7g/dL to maintain a hemoglobin of 7 to 9 g/dL in most critically ill patients. RBC transfusions have well known benefits and are often life saving. However, liberal RBC transfusions should not continue to be a cornerstone of therapy in the critically ill. Concerns regarding excess morbidity and mortality associated with liberal RBC transfusions coupled with the emerging risk associated with immunomodulation should prompt nursing education of the current evidence of transfusion practice, blood conservation techniques, and the risks associated with this frequently prescribed treatment, often driven by tradition alone.

There is limited nursing literature published on the evidence-based practice of RBC transfusions and their more contemporary inherent risks. This practice change project revealed that nursing knowledge, prior to an education program, was relatively low with a mean score of 66.3%. In comparison, Salem-Shatz, Avorn, and Soumerai (1990) found that there were widespread deficiencies in physicians’ knowledge of transfusion risks and indications.

The purpose of this practice change project was to implement an evidence-based education program on the topic of blood transfusion practice to ICU nurses to impact patient care outcomes. It takes an average of 17 years for new knowledge generated by randomized controlled trials to be incorporated into practice, and even then application is variable (Institute of Medicine, 2001). Making evidence available and accessible to nurses may expedite this process. Nurses are often the providers who deliver abnormal laboratory values to physicians, APNs, and physician assistants. They have an integral role in delivering evidence-based care to patients. The goal of this project was to educate ICU nurses on blood transfusion indications, adverse events, and blood conservation interventions that can be implemented to decrease blood loss in the ICU. Following the education program, nursing knowledge increased by 23% to a mean score of 89.3%. The nurses were provided with data, information, and nursing
interventions that will impact patient care. Empowering the ICU nurses with knowledge on RBC transfusion best practices may lead to expedited diagnosis of the more contemporary adverse events of TACO and TRALI, rapid implementation of treatment modalities when adverse events occur, decrease in patient blood loss by integrating closed circuit sampling on all arterial lines, point-of-care microanalysis, use of pediatric blood tubes or low volume adult tubes, responsible diagnostic phlebotomy, and coordination of phlebotomy, decrease hospital cost as well as advocacy for integration of literature supported transfusion thresholds. In 1993, Soumerai et al., designed a randomized, controlled multicenter trial to determine if educational outreach visits can improve the appropriateness of blood product utilization. They concluded that these brief, focused educational outreach visits by transfusion specialists can substantially improve the appropriateness and cost-effectiveness of blood product use in surgery (Soumerai et al., 1993). Furthermore, Zilberberg and Shorr (2007) estimated the annual reduction of approximately 40,000 TSACs and nearly $1 billion could potentially be avoided and saved annually with the adoption of a restrictive, evidence-based transfusion strategy. Although cost effectiveness is not the primary motivator for RBC transfusion practice change, many changes can simultaneously decrease costs while enhancing outcomes (Hall, Moore, & Barnsteiner, 2008).

In summary, delivery of evidence-based RBC transfusion practices will impact patient morbidity, mortality, and hospital cost. Furthermore, professional satisfaction is higher for providers who use an evidence-based approach to care delivery. In critical care, nursing roles are expanding, technology is advancing, and the nursing shortage is increasing. This dynamic work environment combined with the physical and emotional demands of an ICU nurse often leave little time to personally critique their practices. However, research continues to produce evidence
that demands translation to the bedside practices for improved patient outcomes. “Tradition-bound practices must come to an end” (Melnyk & Fineout-Overholt, 2005, p. 458).
References


systematic review of the literature. *Critical Care Medicine, 36*(9), 2667-2708.


Appendix A: Education Program Topic Outline

1. Define anemia
2. Review the etiology of anemia in critically ill patients
3. Review the anemia physiology cascade
4. Current risks of transfusion transmitted infections from test-negative blood components
5. Red blood cell compatibility selection
6. Facts about blood transfusions
   a. Prevalence of blood transfusions
   b. Cost of blood transfusions
7. Risks of blood transfusions
   a. Transfusion Related Acute Lung Injury
      i. Mortality
      ii. Signs and symptoms
      iii. Treatment
      iv. Pathophysiology
   b. Transfusion Associated Circulatory Overload
      i. Prevalence
      ii. Mortality
      iii. Signs and symptoms
      iv. Treatment
   c. Transfusion Related Immunomodulation
      i. pathophysiology
8. Blood Storage….How long is okay?
9. Review of immunologic blood transfusion reactions
   a. Acute hemolytic reaction
   b. Febrile non-hemolytic reaction
   c. Anaphylactic reaction
10. Recognition of other complications of blood transfusions
    a. Delayed hemolytic transfusion reaction
    b. Urticarial transfusion reaction
    c. Citrate toxicity
    d. Hyper/hypokalemia
    e. Hypothermia
    f. Iron overload
11. Literature Review of red blood cell transfusion practice and trends
    a. TRICC Study (1999)
    b. ABC Study (2002)
    c. CRIT Study (2004)
    d. SOAP Study (2008)
12. Current evidence and trends of transfusion practice (‘Transfusion triggers’)
   a. Hemoglobin < 7g/dL
   b. Symptomatic Anemia
   c. Myocardial Infarction
   d. Unstable Angina

13. Intensive Care Unit Nurses making a difference
   a. Closed circuit blood sampling
   b. Phlebotomy: use of pediatric tubes, when appropriate
      Generate blood transfusion guidelines
Appendix B: Questionnaire

1. The etiology of anemia in the critically ill patient is associated with:
   a. Blood loss
   b. Decreased red blood cell production (decrease erythropoietin synthesis and resistance to erythropoietin)
   c. Decreased red blood cell life span
   d. All of the above

2. What is the average total volume of blood drawn in a 24-hour period per patient in the Intensive Care Unit?
   a. 15 – 25 ml
   b. 40 – 50 ml
   c. 65 – 75 ml
   d. 90 -100 ml

3. Based on standard laboratory testing of blood products, the risk for transfusion transmitted infection is:
   a. 1 in 2 million for Hepatitis C virus
   b. 1 in 2 million for Hepatitis B virus
   c. 1 in 2 million for HIV
   d. All of the above
   e. A and C

4. Red blood cell transfusions are associated with which of the following adverse events?
   a. Transfusion Related Acute Lung Injury (TRALI)
   b. Transfusion Associated Circulatory Overload (TACO)
   c. Transfusion Related Immunomodulation (TRIM)
   d. All of the above

5. Which of the following is/are a symptom(s) of Transfusion Related Acute Lung Injury (TRALI)?
   a. Hemothysis
   b. Hypoxemia within six hours of blood transfusion
   c. Peripheral edema
   d. B and C
6. **When a patient receives an ABO mismatched unit of blood, what adverse event could this result in?**

   a. Febrile nonhemolytic reaction  
   b. Allergic reaction  
   c. Acute hemolytic reaction  
   d. Citrate toxicity

7. **What is the most common immunologic transfusion reaction?**

   a. Acute hemolytic reaction  
   b. Delayed hemolytic reaction  
   c. Febrile nonhemolytic reaction  
   d. Anaphylactic reaction

8. **The evidence in the literature thus far suggests that RBC transfusions could be associated with _____________:**

   a. Increased morbidity  
   b. Increased mortality  
   c. Higher risk of postoperative complications if the blood is stored for > 2 weeks  
   d. All of the above

9. **Which of the following critically ill patients would you notify a physician or provider with anticipation of receiving an order for a blood transfusion, supported by current evidence based practice?**

   a. Hemoglobin concentration < 7g/dL  
   b. Patient with unstable angina / acute coronary syndrome with a hemoglobin < 10 g/dL  
   c. Acute symptomatic anemia (tachycardia, change in mental status, cardiac ischemia, shortness of breath) not responsive to adequate volume resuscitation  
   d. Hemoglobin concentration < 10 g/dL  
   e. All of the above  
   f. A, B, and C

10. **Which of the following are ways a nurse can improve blood management strategies in the ICU?**

    a. Use of closed circuit blood sampling  
    b. Use of pediatric tubes for blood collection, when appropriate  
    c. Generate a multidisciplinary blood transfusion guideline for implementation in daily clinical practice  
    d. All of the above
11. Level of Nursing Education: choose highest level achieved

a. Diploma / Associate Degree, Nursing  
b. Bachelor of Science in Nursing (BSN)  
c. Master of Science in Nursing (MSN)  
d. Doctorate in Nursing

12. Licensed Nursing Experience

a. <1year  
b. 1-5 years  
c. 6-10 years  
d. >10 years

13. Licensed Nursing Experience in Intensive Care Unit Practice Setting

a. < 1 year  
b. 1-5 years  
c. 6-10 years  
d. >10 years

14. Intensive care specialty that you currently practice in

a. Medical  
b. Surgical  
c. Medical/Surgical  
d. Other

15. Number of beds in intensive care unit where you currently work

a. <8  
b. 8-15  
c. >15

16. Nursing Specialty Certification (i.e. CCRN, CEN, RN-C)

a. Yes (Type: ________)  
b. No

17. Gender

a. Male  
b. Female
Appendix C: IRB Approval Letters
March 31, 2009

Melissa Zaccheo, MSN, CRNP
2635 East Carson St., Apt 302
Pittsburgh, PA 15203

Dear Ms. Zaccheo:

On March 31, 2009, your study, “Blood Transfusion Practice in the Intensive Care Unit: Evaluation Nursing Knowledge”, was screened for exempt status according to the policies of this institution and the provisions of applicable federal regulations. This research is exempt (does not require formal IRB review) because it presents no risk to subjects and involves research conducted in commonly accepted educational settings, involving normal educational practices. The approved Letter of Informed Consent is attached.

You may initiate your project as of this date.

Please note: any changes or amendments to the study must be resubmitted with the protocol and consent form (if applicable) for evaluation by the Chairperson or Administrator of the IRB.

Sincerely,

Ruth Fries

Ruth Fries, BS, CIP, Administrator, Institutional Review Board

cc. Sandra Fortna, MD, IRB Chairperson
Don Bucher, CRNP
Appendix D: Nurse Manager Informant Letter

Date

Name of Nurse Manager
Nurse Manager
Hamot Medical Center
201 State Street
Erie, PA 16550

Dear:

I am pursuing my Doctor of Nursing Practice degree from Chatham University in Pittsburgh, Pennsylvania. As part of fulfilling my requirements, I am completing a capstone project that integrates implementation of evidence-based education programs for critical care nurses in acute care settings.

We know that patients who receive evidence-based care have better outcomes. Teaching evidence-based practice on specific clinical topics, to nurses, may be a way to improve patient safety and quality, as well as nursing professional satisfaction. Empowering your nurses with up to date knowledge may lead to improved nursing knowledge, patient advocacy, decrease adverse events, decrease costs, and improved care delivery based on best practice standards.

This project will encompass an evidence-based education program given by myself and/or Donald H. Bucher, MSN, CRNP. A questionnaire will be given to the voluntary participants prior to and following the education program. We will be supplying breakfast or lunch to the participants, as well as giving each nurse a reference card at the completion of the program for their assistance. We are anticipating the process will take approximately 35 minutes.

We are requesting that our program be integrated into your unit-based meeting on May 7th, 2009. If invited, we would ask that our program be the first item on your agenda.

I am hoping to gain your support to champion evidence-based education for nursing. I am looking forward to hearing from you regarding your interest in this program for your nurses. You can contact me via telephone at (412) 535-3787 or e-mail at MZaccheo@chatham.edu with any questions or concerns. Please inform me as soon as possible regarding your decision so that I can plan appropriately.

Thank you,

Melissa M. Zaccheo, MSN, CRNP

Melissa M. Zaccheo, MSN, CRNP
Appendix E: Nurse Informant Letter

Dear Intensive Care Unit Nurse,

This letter is to formally invite you to participate in an evidence-based education program. We are implementing a clinical project to improve nursing knowledge of an evidence-based clinical topic in the intensive care unit (ICU). We are implementing this education program to Pennsylvania licensed ICU nurses who have been involved with the practice of this clinical topic within the acute care hospital setting. This program is being conducted as a capstone project for a Doctor of Nursing Practice Degree at Chatham University in Pittsburgh, Pennsylvania.

Your nurse manager provided a number of ICU Registered Nurses to us. If you would like to participate in this education program you will be asked to complete a questionnaire, at Hamot Medical Center, before and after an educational program. The questionnaire(s) will consist of biographical questions, questions regarding your experience with and knowledge of the evidence based clinical topic. The process will last approximately 35 minutes. Your answers will only be used to assist with our evaluation of the education program efficacy. Your name will not be identified in the generated project reports.

If you would like to participate, we will notify you of the scheduled date and time that the program will be held via a flyer in your mailbox. Additionally, we will answer any questions regarding the nature of the project and/or questionnaire/education process. The questionnaires will be kept for future reference and destroyed after the completion of the project or by August 17, 2009, whichever is sooner.
Participation is voluntary. You may choose not to participate in this project. If you choose not to participate, you will not be treated differently in any way. If you agree to participate, you can terminate your involvement in the project at any time, or refuse to answer questions.

Thank you for your assistance and cooperation with regard to this project. Once the education program and questionnaires have been completed, you will receive breakfast or lunch and a reference card summarizing the education program, for your inconvenience and time. You may also request a copy of the project results by providing your name and address to a project implementer, separate from your questionnaire submission.

If you have any further questions, you may contact, Melissa Zaccheo at 412-535-3787 at any time.

_Melissa M. Zaccheo, MSN, CRNP_

Melissa M. Zaccheo, MSN, CRNP

_Diane Hunker, Ph.D., MBA, RN_

Diane Hunker, Ph.D., MBA, RN
Appendix F: Reference Card

**EVIDENCE-BASED RED BLOOD CELL TRANSFUSION PRACTICE IN THE ICU**

**Transfusion ‘Triggers’ in the ICU**

- Target Hgb: 7 – 9 g/dL
- Exceptions: Acute MI and unstable angina (exact number remains controversial...many transfuse to keep Hgb > 10g/dL)
- Symptomatic Anemia

**YOU can make a difference...remember:**

- Always used closed circuit sampling with arterial lines
- Point-of-care microanalysis
- Use pediatric tubes or low-volume adult tubes when appropriate (check with lab 1st)

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**Adverse Events to Think About.........**

- **Transfusion-Related Acute Lung Injury (TRALI)**
  - hypoxemia (requiring oxygen within 2 – 6 hrs. after transfusion), pulmonary infiltrates, fever, absence of circulatory overload, respiratory distress within 2 – 6 hrs. after transfusion.
  - Treatment: supportive care, intubation, volume & vasopressors, if indicated

- **Transfusion-Associated Circulatory Overload (TACO)**
  - pulmonary edema, hypoxemia, dyspnea, tachypnea, JVD, symptoms occur w/in 6 hrs. of transfusion
  - Treatment: volume reduction, diuretics

- **Immunologic Blood Transfusion Reactions (non-inclusive)**
  - Acute Hemolytic Reaction (pt. receives mismatched blood) **Medical Emergency: STOP transfusion, NSS, supportive care, notify prescriber & lab**
  - Febrile Non-hemolytic Reaction: (most common)
  - Anaphylactic Reaction: (may be life threatening!)