BLOOD TRANSFUSION ALTERNATIVES IN THE ADULT NON-CRITICAL PERIOPERATIVE PATIENT

by

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Abstract

Allogeneic blood transfusion therapy is currently being re-evaluated due to its increased risk of adverse effects. The purpose of this study was to develop, educate, and distribute an educational intervention regarding blood transfusion alternatives, tranexamic acid and human serum albumin. Benners’ theory “From Novice to Expert,” focuses on the incremental improvement of performance skills based on experience and education. A consent and questionnaire were distributed to 100 anesthesia providers via email and in paper format. An educational intervention followed. Fifteen providers participated in the questionnaire, while 30 took part in the educational intervention. Data was collected and analyzed using SPSS v24. Independent samples t-tests were used to compare usage of packed red blood cells, tranexamic acid, and human serum albumin for the months of August and October, before and after the educational intervention, respectively. The results did not demonstrate a statistically significant difference in the use of HSA (t(2059)= -.28, p= .777) and PRBCs (t(2059)= -.27, p= .790) pre- and post-education. However, TXA pre- and post-education usage showed a statistically significant difference (t(1726.68)= -2.86, p= .007). This result may not have been attributable to the educational intervention.
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Introduction

Annually 24 million blood products are transfused in the United States (Goodnough, Levy, & Murphy, 2013). Blood transfusion has long been the therapy of choice for treatment of gross blood loss, decreased hemoglobin and hematocrit levels, and symptomatic anemia. Transfusion of blood or blood products include but are not limited to, packed red blood cells, platelets, plasma, and/or protein. While blood transfusions may prove to be beneficial in emergency situations, such as trauma, it may not be beneficial in all situations. For example, Ferraris, Hochstetler, Martin, and Saha (2015) recognized that high risk patients had fewer adverse reactions to blood transfusions, compared to low risk patients who were transfused with the same products. Therefore, transfusions in non-life-threatening situations may prove harmful to the adult non-critical perioperative patient. Blood transfusion therapy is currently being re-evaluated due to its increased risk of adverse effects; these risks may be infectious or non-infectious in origin. Risks associated with homologous or allogeneic blood transfusions include: immune modulation, hemolytic transfusion reactions (HTR), onset of the systemic inflammatory response, transfusion related acute lung injury (TRALI), and transmission of blood borne diseases (Ferraris, Hochstetler, Martin, Mahan, & Saha, 2015; Sahu, Hemlata, & Verma, 2014).

In the US blood transfusion complications are varied both in statistics and type. In 2009, there were 44 transfusion related deaths reported to the FDA (Lavoie, 2011) and 69 deaths reported in 2011 (Goodnough et al., 2013). From 2005 to 2009 TRALI accounted for 48% of the fatalities, followed by HTR with 26%, sepsis with 12%, and transfusion associated circulatory overload with 11% (Lavoie, 2011). The incidence of an adverse outcome associated with a blood transfusion in the adult US patient is 13:100,000 (Lavoie, 2011). These statistics warrant further examination into the allogeneic blood transfusion of the adult non-critical perioperative patient.
In addition to the physical burdens associated with blood transfusions, there are financial problems as well. Costs are incurred from the collection of donated blood, testing, and storage of such blood. In the US, it is estimated that one unit of blood costs $700-$1,200 (Spahn & Goodnough, 2013). Intraoperative and postoperative blood transfusion hospital costs were found to be $4,408 and $10,479, respectively (LaPar et al., 2013). Further costs are incurred from the afore mentioned complications that may arise after blood has been administered.

Significance

Although it is important to note the effects that allogeneic blood transfusions may have on the adult non-critical perioperative patient, another population to consider are those that refuse blood products due to personal choice or religious beliefs, such as Jehovah’s Witnesses. Unlike non-critical patients who are not at risk for symptomatic anemia, Jehovah’s Witness patients may be at high risk of developing adverse anemic symptoms. Thus, it’s imperative to consider alternatives that may be beneficial to both of these populations.

Many organizations adhere to a blood transfusion policy to administer blood products. However, organizations do not have a policy in place for utilizing blood transfusion alternatives in the adult non-critical perioperative patient or those that refuse blood therapy. As a result, anesthesia providers lack a set guideline to treat these populations. A set guideline would eliminate confusion as to how to treat these patients. Currently there is no available teaching tool regarding blood transfusion alternatives. The development and implementation of an educational tool will serve to expand treatment options in these populations, while increasing knowledge to providers.

During the perioperative visit a patient may be at risk for surgical bleeding depending on comorbidities, surgical technique, and/or the particular surgery itself. These are all common
occurrences among the perioperative patient. Excessive blood loss could result in decreased physical capacity, difficulty rehabilitating, and blood transfusions to the perioperative patient (Laszczyca et al., 2015). The purpose of this study is to develop, educate, and distribute an educational intervention on blood transfusion alternatives. The focus of this intervention is to reduce allogeneic blood transfusions and increase the use of blood transfusion alternatives in the adult non-critical perioperative patient and those that refuse blood therapy.

Specific Aim

The specific aim of this capstone project is to:

- Educate anesthesia providers on the adverse effects of allogeneic blood transfusions and the benefits of the use of blood transfusion alternatives, human serum albumin and tranexamic acid.

Capstone Project PICO Question

Does an educational intervention on blood transfusion alternatives decrease the number of patients transfused with packed red blood cells or increase the use of tranexamic acid and human serum albumin in the adult non-critical perioperative patient?

Review of Literature

A thorough literature search of the Cochrane Review, Google Scholar, PubMed, and EBSCO databases were completed. Keywords used to identify current information on blood transfusion alternatives included: blood substitutes, bloodless medical and surgical procedures, bloodless surgery, blood conservation strategy, transfusion-free surgery, and transfusion alternative strategy. This generated 3,064 articles; inclusion criteria were then applied. They were as follows: articles dating from 2000-2017, articles published in English, and studies utilizing adults ages 19 and older. After duplications were removed, this search yielded 158
articles. These items were further analyzed for accuracy, trustworthiness, and appropriateness to the purpose of the project. This decreased the remaining articles to 22. These articles were then further reviewed for applicable data.

**Blood Transfusion Alternative: Human Serum Albumin**

Human Serum Albumin (HSA) plays a major role in patient morbidity and mortality. The anemic-hypovolemic perioperative patient is at an increased risk for morbidities and mortalities. Roberts et al. (2011) performed a systematic review of cohort studies and found that patient mortality is inversely related to HSA concentration. They noted for every 2.5g/L decrease in HSA concentration, mortality rates increased between 24-56% (Roberts et al., 2011). HSA used for fluid resuscitation reduces mortality (Delaney et al., 2011). In addition to HSA decreasing death rates in the acutely ill adult perioperative patient, it has also shown to significantly decrease morbidity rates (Vincent, Navickis, & Wilkes, 2004). Vincent et al. (2004) performed a meta-analysis of 71 randomized trials and found that HSA exerted a protective effect causing an overall decrease in morbidity. Therefore, it is important to maintain or increase the HSA concentration in the adult anemic-hypovolemic perioperative patient.

This important blood transfusion alternative strategy involves the use of plasma expanders. Hypovolemia in the anemic patient can cause a multitude of harmful effects. Loss of the ability to transport oxygen efficiently due to a decrease in blood volume can result in decreased cardiac output with subsequent hypoxia, dyspnea, fatigue, tachycardia, hypotension, and pallor (Lasch, Evans, & Schatell, 2009). To help correct this hemorrhagic hypovolemia, a volume expander can be utilized. HSA is the most abundant protein found in plasma and serves as an excellent volume expander (Ascenzi & Fasano, 2010). Its immense oncotic pressure within the plasma serves as the primary modulator of fluid distribution throughout the bodies.
BLOOD TRANSFUSION ALTERNATIVES

compartments (Fanali et al., 2012). HSA used to resuscitate hypovolemia associated with anemia, provides significant maintenance of intravascular volume and cardiac output (Cartotto & Callum, 2012).

HSA therapy has multiple beneficial effects and uses in the medical and surgical field. These effects include volume expansion, increased HSA concentration, colloid osmotic pressure, and hemodilution (Mahlon & Roberta, 2001). HSA is licensed in the US for the treatment of hypovolemia or shock, burns, hypoalbuminemia, and hypoproteinemia (Mahlon & Roberta, 2001). HSA is the cornerstone for emergency treatment in the anemic-hypovolemic shock patient, where volume restoration is necessary (Roberts, Blackhall, Alderson, Bunn, & Schierhout, 2011). Depending on the surgery and comorbidities, adult perioperative patients may be at risk for losing large amounts of blood. Fluid resuscitation therapy, through the use of HSA, can be used to increase blood volume while decreasing the risk of mortality (Roberts et al., 2011). HSA provides increased intravascular volume expansion when compared with crystalloids, due to its ability to maintain capillary membrane permeability and provide oncotic pressure (Delaney, Dan, McCaffrey, & Finfer, 2011). HSA can provide a temporary treatment for the replacement of lost volume, while the actual cause of the problem, such as surgical bleeding, is addressed (Bunn & Trivedi, 2012). The US Hospital Consortium Guidelines recommend that HSA is used before the availability of blood therapy in the case of hemorrhagic shock (Perel, Roberts, & Ker, 2013).

**Blood Transfusion Alternative: Tranexamic Acid**

Tranexamic Acid (TXA) is another blood transfusion alternative that is commonly used in the perioperative setting. TXA is a synthetic derivative of the amino acid lysine. It functions as an antifibrinolytic agent that competitively blocks lysine-binding sites on plasminogen molecules.
to prevent the breakdown of fibrin (Cid & Lozano, 2005; Jiang, Ma, & Ma, 2016). As a result, it stabilizes blood clots by interfering with fibrinolysis and reduces blood loss (Ho & Ismail, 2003; Wong et al., 2008).

Total knee arthroplasty (TKA), total hip arthroplasty (THA), and spinal surgery are known for their high risk of bleeding (Wei & Liu, 2015; Wong et al., 2008). For example, the use of a tourniquet and implantation of instruments during ischemic conditions of a TKA induces coagulation activation and fibrinolysis at the site (Ho & Ismail, 2003). This can result in a significant amount of blood loss, resulting in an allogeneic transfusion. Allogeneic blood transfusions are associated with risks such as infective complications, immune sensitization and reaction, over-transfusion, renal failure, and coagulopathy (Ho & Ismail, 2003; Sukeik, Alshryda, Haddad, & Mason, 2011). To combat the use of allogeneic blood transfusions and blood loss, an antifibrinolytic such as TXA is warranted. TXA aids in maintaining hemostasis, decreasing the risk of allogeneic blood transfusions, and perioperative blood loss (Formby, Pickett, Van Blarcum, Mack, & Newman, 2015).

In the United States TXA has been used successfully to hinder bleeding after dental extractions, tonsillectomies, prostate surgery, heavy menstrual bleeding, cardiac surgery, and in patients with hemophilia (Lukes et al., 2010; Sukeik et al., 2011). However, TXA has been mostly found to reduce blood loss and transfusion requirements in the joint replacement perioperative patient (Kagoma et al., 2009). Sukeik et al. (2011) conducted a systematic review and meta-analysis of the efficacy of TXA in the THA patient. They noted that TXA was overall cheaper than other antifibrinolytic medications and penetrated joints more efficiently. As a result, TXA decreased blood loss by 20% and reduced transfusion rates in the THA patient (95% CI: -164 to -44; p = 0.0006) (Sukeik et al., 2011). Johansson, Pettersson, & Lisander (2005) conducted
a double-blind, randomized trial on the use of intravenous TXA on THA patients. They found that total blood loss decreased by 27% (95% CI: 12–42; \( p < 0.001 \)) and that eight of the 47 TXA patients received blood compared to 23 of the 53 placebo group (Johansson et al., 2005). Cid and Lozano (2005) conducted a meta-analysis on TXA use in the TKA patient. They noted that TXA use significantly decreased the number of patients requiring blood transfusion when compared to the control placebo group (summary OR, 0.10; 95% CI, 0.06-0.18; \( p < 0.00001 \)) (Cid & Lozano, 2005). Poeran et al. (2014) conducted a retrospective cohort study that accessed the Premier Perspective database of 510 hospitals from years 2006-2012. They examined postoperative outcomes of 872, 416 total hip and knee arthroplasty procedures. They found that TXA use significantly reduced the need for allogeneic or autologous blood by 69\% (\( p < 0.001 \)) (Poeran et al., 2014).

The effect of TXA on spinal fusion surgery bears similar results. Wong et al. (2008) conducted a double-blind randomized control trial, at three medical centers, evaluating TXA’s effect on 150 adult spinal fusion perioperative patients. Spinal reconstruction is associated with a high risk of bleeding, often requiring allogeneic blood transfusion (Wong et al., 2008). Wong et al. (2008) found that patients in the TXA group lost 25\% to 30\% less total perioperative blood loss compared to the placebo group (3079 +/- 2558ml vs 4363 +/- 3030ml, \( p = 0.017 \), respectively). They also found that the TXA group had higher hemoglobin levels than the placebo group; the percentage decrease in hemoglobin post-op was lower in the TXA group compared to the placebo group (31.1 +/- 14.2\% vs 34.5 +/- 13.7\%, \( p = 0.154 \), respectively) (Wong et al., 2008). Tse et al. (2011) conducted a review of current techniques geared at reducing perioperative blood loss and allogeneic blood transfusion in the major spine surgical
patient. They noted that TXA was an effective, inexpensive, and safe method for reducing blood loss during and after spine surgery (Tse, Cheung, Ng, & Luk, 2011).

The efficacy and safety of TXA have been studied over the years. Yang, Chen, & Wu (2012) conducted a meta-analysis of randomized controlled trials to evaluate the safety and effectiveness of TXA on TKA. They found that TXA significantly decreased blood loss in the TXA group compared to the placebo group (weighted mean difference, -504.90mL (95% CI, -620.89 to -388.92mL); p < 0.00001) (Yang et al., 2012). In addition, the study showed that the number of blood transfusions per patient was significantly less in the tranexamic acid group compared with the placebo group (weighted mean difference, -1.43 units (95% CI, -1.69 to -1.17 units); p< 0.00001) (Yang et al., 2012). This meta-analysis denoted no significant difference in the prevalence of deep vein thrombosis (DVT) and pulmonary embolism in the TXA group, when compared to the placebo group. DVT rate of formation was not affected by the use of TXA when compared to the placebo group (OR, 0.75 (95% CI, 0.34 to 1.67); p= 0.48) (Yang et al., 2012). The rate of pulmonary embolism was also not affected by TXA use compared to placebo (OR, 0.65 (95% CI, 0.18 to 2.33); p= 0.50).

Mahomed, Evans, Gandhi, & Mahomed, (2013) conducted a meta-analysis on the safety and efficacy of TXA on THA and TKA. They measured outcomes on total blood loss, number of allogeneic blood transfusions given, and the incidence of DVT (Mahomed et al., 2013). Total blood loss of TKA patients that received TXA, was less when compared to the control group (-1.149 (95% CI -1.298 to -1.000); p< 0.001) (Mahomed et al., 2013). Total blood loss in the THA patient that received TXA was less, compared to the control group (-0.504 (95% CI, -0.672, -0.336); p< 0.001) (Mahomed et al., 2013). The combined Odds Ratio for the number of TKA patients receiving allogeneic blood transfusions was found to be (0.145 (95% CI, 0.094 to
indicating that patients that received TXA received less allogeneic blood transfusions compared to the control group (0.327 (95% CI, 0.208 to 0.515); p< 0.001) (Mahomed et al., 2013). The combined OR for the number of patients who developed a DVT for TKA and THA were 1.030 (95% CI, 0.439 to 2.420); p= 0.946 and 1.070 (95% CI, 0.393 to 2.911); p= 0.895, respectively. Results determined that TXA decreased both total blood loss amount and number of allogeneic blood transfusions in the THA and TKA patient. Also, minimal differences were noted in regards to thromboembolic complications with TXA use.

**Theoretical Framework**

To help understand the value of blood transfusion alternatives in the adult perioperative non-critical patient Benners’ theory “From Novice to Expert” was utilized. The theory offers a systematic approach to understanding different levels of clinical performance between various anesthetic providers (Gentile, 2012). Certified registered nurse anesthetists (CRNA) in 34 states, including New York, are required to have medical supervision to order blood transfusion alternatives perioperatively. The CRNA works as a team with an anesthesiologist or an operating room physician and they collectively determine the need for the use of blood transfusion alternatives (“Title: Section 405.13 - anesthesia services,” 2014). The other 16 states are part of the ‘Opt Out of Physician Supervision’ and are able to independently order blood transfusion alternatives.

In order for anesthesia providers (anesthesiologists and CRNAs) to function proficiently in utilizing blood transfusion alternatives, they often progress through multiple stages of development to achieve their optimal skill level (Benner, 1982). These stages or proficiency levels are as follows: novice, advanced beginner, competent, proficient, and expert (Benner,
1982). This theory focuses on the incremental development of performance skills based on experience and education (Benner, 1982).

The novice practitioners in this project would be anesthesia providers that are unfamiliar with the risks of allogeneic blood transfusions, signs and symptoms of severe anemia, and blood transfusion alternatives and their benefits. These practitioners would be offered the opportunity to participate in blood transfusion alternative education session. This teaching tool can be utilized as an informational guide for treating the adult-anemic non-critical perioperative patient.

The advanced beginner practitioner, are anesthesia providers that demonstrate a marginally satisfactory performance (Benner, 1982). This practitioner can recognize symptoms based on previous experience and would be able to apply that knowledge to current situations. This group of providers can also benefit from a detailed education program of blood transfusion alternatives.

The competent practitioner develops plans that are long-ranged (Benner, 1982). This anesthesia provider is more experienced and therefore utilizes advanced planning and organization to set priorities. These practitioners are also more equipped through experience to recognize clinical situations more rapidly. This is a skill needed in urgent and emergent bleeding crises. The competent practitioner may have important qualities that are required for implementing blood transfusion alternative methods. The competent practitioner may gain speed with further exposure to blood transfusion alternatives. The proficient anesthesia provider gathers multiple pieces or symptoms from a perioperative case and uses experience to put them together to form a whole. This holistic approach allows the proficient practitioner to improve their decision-making skills (Benner, 1982). These practitioners are then able to recognize abnormal signs and symptoms, then modify treatment as needed.
Application of Benners’ theory encompasses three distinct areas of learning across the education continuum (Ulrich, 2011). The first area involves a change from reliance on abstract principles to dependence on experience (Ulrich, 2011). This involves the movement from the novice anesthesia provider to the advanced beginner. The second area along the education continuum involves moving away from the understanding that every situation deserves equal priority (Ulrich, 2011). Here, the competent provider organizes situations in order of importance. The third area of educational growth involves becoming an involved participant, rather than a detached observer (Ulrich, 2011). The proficient and expert practitioner become involved by making decisions based on experience and analytical tools.

Setting

The setting for this study was at a suburban hospital in Western New York, that has a 265-bed facility that offers surgery to a wide variety of patients. However, they exclude high-risk services such as vascular, cardiac, and trauma; these cases are associated with a high risk of bleeding and subsequent blood transfusions. Therefore, they would not qualify as non-critical cases.

Recruitment

Recruitment measures included sending an email to all anesthesia providers within the Hospital’s healthcare system. This email contained a brief synopsis of the proposed study and study methods. Anesthesia providers were made aware that the study involved a questionnaire followed by an educational intervention. They were advised that participation would be voluntary and no financial burden would be placed upon them.
Protection of Human Rights

Informed Consent

Approval for this project was received by the Institutional Review Board (IRB) from The University at Buffalo on August 16, 2017; IRB approval ID #FWA00008824. A consent from anesthesia providers were obtained for their participation in the questionnaire. Consent from patients were not required, since their electronic anesthesia records were viewed retrospectively.

To protect project participants, data collected from the questionnaire and retrieved from electronic anesthesia records were de-identified and stored in a computer that was password protected. Paper data obtained from the questionnaire was stored in a locked file in Wende Hall, at The University at Buffalo School of Nursing.

Study Design

The study design for this project was an experimental cohort study. This design evaluated the effect of a blood transfusion alternative educational intervention on anesthesia providers’ practice with the use of allogeneic blood transfusions or blood transfusion alternatives, in the non-critical adult perioperative patient.

Records were obtained from the hospital’s pharmacy and blood bank departments regarding use of TXA, HSA, and PRBC for the months of August and October. Information was also gathered from anesthesia electronic records over a 1-month period before and after the educational intervention. IRB was approved in August, thus the month of August was chosen as the control month; this was the month prior to educational exposure. The educational intervention was implemented during the month of September. Anesthesia providers were exposed to the consent form, questionnaire, educational paper, PowerPoint in-service presentation, and review card. October marked one-month after the educational exposure.
Information retrieved included the number of patients transfused, number of units of packed red blood cells (PRBCs) transfused, number of blood transfusion reactions, and the number of TXA and HSA infused in the operating room. The amount of each product utilized by each patient was noted, along with any transfusion reactions. These data points were collected and entered into Statistical Package for Social Science (SPSS) version 24, for analysis. Independent sample t-tests were used to measure the usage of PRBCs, TXA, and HSA for the months of August and October, before and after educational exposure, respectively.

**Methodology**

The consent for participation and a questionnaire, developed by the researcher, were distributed via email to all anesthesia providers within the Hospital’s healthcare system. The provider list was given to the researcher by the anesthesia department’s head secretary, as approved by the head anesthesiologist. The anesthesia providers included CRNAs, attending anesthesiologists, and anesthesia residents and fellows. These providers were approached through multiple facets of communication, which included in person and via email. Questionnaires have been shown to exhibit a coefficient of reliability of 0.95 and internal consistency with a Cronbach alpha of 0.86-0.94 (Yamasato et al., 2007). The questionnaire used in this study was not tested. However, based on Yamasato et al.’s (2007) report, questionnaires in general are reliable.

The consent and questionnaire were distributed prior to the educational intervention. The questionnaire consisted of 10 True-False items on blood transfusion alternatives TXA and HSA. Descriptive data gathered from the questionnaire included age, gender, and years of experience. Providers received privacy and up to 30-minutes to complete the questionnaire.
The educational intervention, developed by the researcher, consisted of a 30-minute PowerPoint in-service presentation on the risks associated with allogeneic blood transfusion in the non-critical adult perioperative patient and the benefits of blood transfusion alternatives, TXA and HSA. The presentation was given by the researcher. Following the presentation, a laminated pocket-sized reminder-card of key points and a more detailed educational paper on the benefits of TXA and HSA were distributed. These educational teaching tools can serve as a guide to using blood transfusion alternatives. All questions and concerns were addressed following the educational intervention.

In addition to the email recruitment of anesthesia providers, paper copies of the consent and questionnaire were left in the anesthesia lounge in a folder with a typed note describing its contents. Participants were encouraged to leave completed forms in a secure envelop in the anesthesia department secretary’s office. A follow-up email was sent out via the anesthesia department, inviting all anesthesia providers to attend morning rounds that would include a presentation on blood transfusion alternatives. A 30-minute educational in-service PowerPoint was presented to anesthesia providers, followed by distribution of printed material containing key points from the presentation. This included a laminated reminder-card and an educational paper for reference. The laminated reminder-card and educational paper served as an educational tool for providers. Following the meeting, patients’ anesthesia records were reviewed for the number of PRBC, TXA, and HSA used for August and October 2017. In addition, they were also reviewed for blood transfusion reactions. This data was then entered into an Excel spreadsheet for organizational purposes. SPSS v 24 was used to analyze the data.
Variables

The independent variable in this study was the educational intervention. This variable was differentiated by a pre-education or post-education time frame. These groups were measured using a nominal level in SPSS v24. The dependent variables, PRBC, TXA and HSA, were measured using a ratio scaled measurement in SPSS v24.

Measurement

The 10-True/False-item questionnaire distributed to anesthesia providers, was measured by counting the total amount of questions answered correctly out of a total of 10 possible points.

The measurement of the effect of the teaching intervention was evaluated by assessing the total number of PRBC, TXA, and HSA used in the months of August and October. To measure and analyze change an independent samples t-test was used. A decrease in the number of patients transfused and an increase in the number of patients infused with TXA and HSA in the month of October would indicate that the teaching intervention was effective. In addition, a decrease in blood transfusion reactions secondary to a decrease in the number transfused, would also be helpful in decreasing adverse reactions commonly associated with allogeneic blood transfusions.

Statistical Analysis

Frequencies and percentages were used to analyze descriptive data. Independent samples t-tests were used to compare the numerical usage data for PRBC, TXA, and HSA, for the months of August and October.

Sample

The sample of anesthesia providers that participated in the questionnaire included 15 providers that varied in age and years of anesthesia experience. These providers included
anesthesiologists, fellows, residents, and CRNAs. A total of 30 anesthesia providers participated in the educational intervention. Four of the 15 providers that participated in the questionnaire also participated in the educational in-service.

The total sample of adult surgical patients reviewed during the months of August and October totaled 2,061. The total number of patients that were seen in the operating room for the month of August were 986, five of them being pediatric cases. Of the 981 adult patients four received PRBCs only, eight received TXA only, one received TXA and PRBC, and two received PRBCs and HSA. Total number of PRBCs, TXA, HSA recipients transfused/infused in August were seven, nine, and two, respectively. The total number of patients that were seen in the operating room for the month of October were 1,092, twelve of them being pediatric cases. Of the 1,080 adult patients, three received PRBCs only, 25 received TXA only, two received HSA only, and two received PRBCs and HSA. The total number of PRBCs, TXA, HSA recipients transfused/infused in October were five, twenty-five, and four, respectively. The adult surgical patients for the months of August and October varied in gender, age, and surgical procedure. Both groups included perioperative patients that were not high risk for receiving blood transfusions, classifying them as non-critical.

Results

Characteristics of Participants

Fifteen anesthesia providers, anesthesiologists and certified registered nurse anesthetists, participated in the questionnaire portion of the study. Four of the providers were male and 11 were female. There were a variety of ages between providers; their age ranged from 25 to 65. Five providers were between the ages of 25-35. Three were between the ages of 36-45 and one was between the ages of 46-55. Six providers were between 56-65 years old. There was also a
wide range of experience among the group. Two participants were new to anesthesia, having less than one year of anesthesia experience. Three had experience between one-to-five years and four between six-to-twenty years. There were six providers who had 21 years or more of anesthetic experience (see Table 1).

Analysis of Questionnaire

A questionnaire was distributed to anesthesia providers to establish gaps in knowledge of blood transfusion alternatives TXA and HSA prior to an educational intervention. The 10-item True/False questionnaire was measured using a ratio scale for the number of questions answered correctly/incorrectly. The questionnaire was scored out of a possible 10 points. Of the 15 anesthesia providers who participated, 14 scored three or less questions incorrectly. However, one provider answered seven questions incorrectly (see Figure 1). Four participants answered questions two, three, and nine incorrectly. Eight anesthetic providers answered question one incorrectly (see Figure 2). The average number of incorrect answers were 2, with a SD= 1.5.

Anesthesia Experience vs Questionnaire Results

A Pearson’s r was computed to assess the correlation between the number of correctly answered questions and the participants’ anesthetic experience. There was no statistically significant evidence to support that there was a correlation between correctly answered questions and years of experience [r=.147, n= 15, p= 0.601]. Correlation significance was set at .01 level (2-tailed) (see Figure 3).

Comparison of Before and After Education: Usage Groups

The usage of PRBCs, TXA, and HSA were measured for the months of August and October. Data collected in August provided measurements before the educational intervention. The October measurement took place one month after exposure to the educational intervention.
For the months of August and October there were a total of 981 and 1,080 adult non-critical perioperative patients in the OR, respectively. A two-tailed, independent samples t-test was computed to compare usage rates in August with usage rates in October of PRBCs, TXA, and HSA. There was not a statistically significant difference in PRBCs usage between pre-education (M= - .003, SD= .010) and post-education intervention (M= -.003, SD= .009); t(2059)= -.27, p= 0.790. The mean amount of PRBCs transfused among seven perioperative patients in August was 1.57 units. A total of 11 units of PRBCs were transfused to seven out of a total of 981 patients in August, pre-educational intervention. The mean amount of PRBCs transfused among five perioperative patients in October was 2 units. Ten units of PRBCs were transfused to five out of a total of 1080 patients in October, post-educational intervention. Numerically the amount perioperative patients transfused with PRBCs after the educational intervention showed a slight decrease; seven and five patients were transfused pre- and post-educational intervention (see Figure 4). HSA also did not have a statistically significant difference between its pre-education (M= -.222, SD= .783) and post-education usage (M= -.222, SD= .777); t(2059)= -.28, p= 0.777. The mean amount of HSA infused to two perioperative patients in August was 300ml. A total of 600ml of HSA were infused to two out of 981 patients in August, pre-educational intervention. The mean HSA infused among four perioperative patients in October was 225ml. A total of 900ml of HSA was infused into four out of 1,080 patients in October, post-educational intervention. The number of patients infused with HSA after the educational intervention increased slightly from two pre-intervention, to four post-educational intervention (see Figure 4). There was a statistically significant difference between TXA’s pre-education (M= -22.286, SD= 8.528) and post-education usage (M= -22.286, SD= 8.317); t(1726.68)= -2.86, p= 0.007 (see Figure 4). The mean amount of TXA infused to nine perioperative patients in August was
1330mg. A total of 11,973mg of TXA was infused into nine out of a total of 981 patients in August, pre-educational intervention. The mean amount of TXA infused to 25 perioperative patients in October was 1490mg. A total amount of 37,250mg of TXA was infused into 25 out of a total of 1,080 patients in October, post-educational intervention. This showed a numerical increase in the number of patients infused with TXA post-educational intervention, increasing from nine in August to 25 in October (see Figure 4).

Discussion

With an aging population and growing healthcare system, multiple treatment plans for blood therapy should be explored. To help meet this need, an educational intervention on blood transfusion alternatives was developed. This intervention included information retrieved from scholarly articles, on the benefits of TXA and HSA and the risks of PRBCs.

The studies participants consisted of a variety of ages. Therefore, an age range was used to provide some discretion of age exposure to the researcher. Some of these providers worked with the researcher and may not have wanted full disclosure of their age.

The hospital utilized 100 anesthetic providers. All providers received e-mails informing them of the blood transfusion alternative in-service and attached were the consent form and questionnaire. These emails were sent with a link that confirmed when it was opened by the provider. All of the providers opened the email. However, only 15 providers participated in the questionnaire. The low interest shown by providers came as a surprise. Many said they would participate in the questionnaire, but failed to do so. To increase questionnaire response rates incentives, such as a prepaid gift card, could have been offered. Another option to increase questionnaire responsiveness would be to offer the questionnaire via the internet. This would
make it more convenient for each participant. In addition, multiple reminder emails could have been sent out to anesthesia providers to increase questionnaire participation.

The questionnaire scores indicated that the majority of these anesthetic providers were knowledgeable on blood transfusion alternatives, TXA and HSA. Since the average incorrect answer was only 2, this showed a slight need for an educational intervention. The actual need for education may not be representative of the entire group, since only 15 out of 100 providers participated in the questionnaire.

This study showed that six out of the 15 anesthesia providers who participated in the questionnaire had 21 or more years of experience. This was considerably higher than the other participants anesthetic experience. This originally seemed to have played a significant role in the results of the questionnaire; the mean score of incorrect answers was two. However, a Pearson’s $r$ indicated that there was no statistically significant evidence that the number of correct answers and experience were correlated ($p=0.601$). A Pearson’s $r$ value of one indicates a perfect correlation, but this study’s $r$ value was .147, indicating no relationship between experience and number of correctly answered questions. These providers had some knowledge of the subject, irrelevant to their years of experience. Even though 11 of the 15 providers scored 8 or more answers correctly, the other four participants did not. None of the participants answered all the questions correctly. Most providers answered the first question incorrectly, this may be due to lack of knowledge or a misinterpretation of the question possibly based on incorrect wording. These providers incorrectly answered false to the statement that HSA concentration was indirectly related to mortality in the acute and chronically ill patient. Most practitioners thought that the concentration of HSA and mortality were directly linked. This along with other incorrectly answered questions, indicated some need for education.
Thirty providers responded to the emailed invitation to attend the educational in-service. The amount present could have been due to some being scheduled off, assigned to another site, or lack of interest. Baruch and Holtom (2008) examined the response rates for surveys used in research. They found that the average response rate for studies that utilized data collected from organizations was 35.7%, with a standard deviation of 18.8. This helps support that 30 out of 100 providers who responded to the in-service was a typical response rate. However, such a small response impacted the results of the study tremendously. For a cohort study to achieve statistically significant data, a larger response rate would be necessary.

An independent samples t-test was used to measure the group as a cohort. The independent samples t-test was done to determine whether there was a statistically significant difference between pre- and post-education usage of PRBCs, TXA and HSA in the anesthetic group as a whole. Independent samples t-test is an analysis of dependence. Thus, it was used in this study to evaluate whether a change in usage was dependent on the educational intervention. To determine dependence, the mean usage of PRBCs, TXA and HSA in August were compared to their mean usage in October. This mean was based on the total amount of patients seen in the OR for the months of August (981) and October (1,080). The mean usage of PRBCs for August and October were -0.003 and -0.003, respectively, with a p value of 0.790. This indicated that PRBC usage after the educational intervention was not statistically significant. Due to the large amount of OR patients seen in August and October the mean number of transfusions per total patient was minute. Thus, to show a numerical change the mean unit of PRBCs transfused to PRBC-recipients were taken. In August an average of 1.57 units were transfused to the seven PRBC-recipients. Whereas, in October an average of 2 units of PRBCs were transfused to ten PRBC-recipients.
The mean usage of HSA for August and October were -.222 and -.222, respectively, with a p value of 0.777. This indicated that HSA usage after the education intervention was not statistically significant. These small numbers are also contributory to the large amount of patients seen in August and October. The mean number of HSA infused to the two HSA-recipients for August was 300ml. In October the mean number of HSA infused to the four HSA-recipients was 225ml. Statistically, there’s no significant change between pre- and post-educational intervention HSA usage.

There was a statistically significant difference in the mean usage of TXA pre- and post-education intervention. The mean usage of TXA in August and October were -22.286 and -22.286, respectively with a p value of 0.007. This data indicated a statistically significant change in TXA usage. Similarly, due to the large amount of perioperative patients seen in the months of August and October the mean for both groups are minor. However, when you compare the mean between TXA recipients in August and October the numerical value is significantly larger. The average amount of TXA received by the nine TXA-recipients for the months of August and October was 1330mg and 1490mg, respectively. This displayed a significant numerical change in TXA usage.

PRBCs and HSA mean usage were not statistically significantly different between August and October. Even though numerically PRBCs pre-education use decreased after the in-service from a total of seven to five units after the educational exposure, this occurred by chance and it could not be generalized to the population. In the case of HSA, its usage increased from its pre-education value of 600ml to 900ml post-education; this also was attributable to chance. The implication of these results suggests that the in-service appears to have no effect on the providers use of PRBCs and HSA after the education.
The usage between TXA’s pre-education and post-education were statistically significant. TXA usage increased after the educational exposure. Before the educational intervention, the mean usage of TXA in TXA-recipients was 1330mg; after the education the mean usage of TXA was 1490mg. This finding suggested that the in-service influenced providers usage of TXA, thus causing it to increase. However, one must question the mechanism of how the providers where followed. Since providers were followed as a group and not as individuals, the in-service and emails may not have caused change. The increase in TXA usage post in-service could have been attributed to chance. In order to have a more accurate measurement of blood transfusion alternative and PRBCs usage, a longitudinal study and a larger cohort would be needed.

**Redesign of the Study**

In order for this study to be effective it has to be redesigned from the beginning. After receiving IRB approval an informational email should be sent to all anesthesia providers detailing the purpose and activities involved in the study and how they could participate. Providers should also be approached in person to describe study purpose and what their role would be as participators. Since multiple emails would be sent out to providers, they should be adequately spaced to avoid informational overload. For example, an informational email could be sent in week one. Week twos’ email would include the consent form for participation and a reminder of the purpose of the study and the importance of their participation. The questionnaire can be sent out in week three along with another reminder of study purpose. The questionnaire could be offered in a paper format or offered on-line; this will provide versatility to the participant. To incite participation, a five dollar gift card to Starbucks could be sent after successful completion of the questionnaire. The invitation to attend the educational intervention in-service could be sent in week four, along with the educational paper and a reminder of the
importance of participation. To incite attendance for the in-service another monetary gift card of higher value could be offered, such as a gift card. Funding for the incentives would be sponsored by the researcher. After completing the in-service, the questionnaire should again be given to all in attendance. The first questionnaire would be given to determine a gap in knowledge; redistribution of the same questionnaire after the in-service would be given to see if the gap was resolved. These incentives would have increased participation.

The questionnaire should have been tested for its test-retest reliability and internal consistency. Internal consistency can be calculated by using item analysis. To determine that the items on the questionnaire are associated, a Cronbach’s alpha would be calculated using SPSS v24 (Spekle et al., 2011). To determine the questionnaires test-retest reliability, the questionnaire would be given twice to determine the percentage of agreement and by utilizing Cohen’s Kappa with a 95% CI for each of the ten questions (Spekle et al., 2011). To determine reliability and internal consistency volunteers that are not anesthesia participants would be needed. One hundred volunteers could be gathered from the nurse anesthetist and nurse practitioner programs at the University at Buffalo. This would involve recruitment measures such as offering a five dollar gift card to Starbucks for each completed questionnaire. An email with the attached questionnaire and an online link to the questionnaire would be sent twice to all qualifying nursing students prior to the start of the study. The first questionnaire could be sent out one-month before the study and the second questionnaire could be sent out two-weeks before the study to the same recipients.

A major design flaw that must be addressed is the tracking of study participants. In addition to tracking questionnaire participants who attended the educational in-service, all participants should have been tracked. This could have been accomplished by obtaining a sign-in
sheet and/or distributing and collecting a second questionnaire after the in-service. This will not only help to keep track of who attended, but it would be another way to determine if the in-service increased their knowledge of blood transfusion alternatives TXA and HSA. This would be particularly true for the participants who completed the questionnaire prior to the intervention. In the case of all in-service attendees, their OR usage of PRBCs, TXA, and HSA would be monitored directly. This would be done by collecting usage data from specific anesthetic providers that attended the in-service. This would be a more effective way to track participants and evaluate the effectiveness of the intervention. This would call for a different way to measure results.

The statistical tests that would be used to measure the pre- and post-education usage of PRBCs, TXA and HSA by anesthesia providers that were tracked directly, would be a dependent samples t-test. This test compares the means of two related groups to determine if there’s a statistically significant difference in PRBCs, TXA and HSA usage after exposure to the educational intervention. Monitoring in-service attendees directly versus monitoring the anesthesia group as a cohort strengthens the implication of study findings.

*Future Implications*

Future implications for this study would include the use of this educational intervention, on blood transfusion alternatives, to provide education to other hospital facilities and departments. The potential long-term benefit for future practice would be to decrease the morbidity and mortality associated with allogeneic blood transfusions, by increasing the use of TXA and HSA. Use of information from this educational intervention, can also be utilized to help develop a blood transfusion alternative policy. This can help decrease confusion associated with
blood alternatives. Anesthesia providers will have a more uniformed way of administering these alternatives.

**Summary**

Allogeneic blood transfusion therapy can be harmful in the adult non-critical perioperative patient. Adverse effects include immune modulation, TRALI, transmission of blood borne diseases, and elevated costs. To help decrease these adverse effects blood transfusion alternatives, TXA and HSA, are utilized. TXA helps to decrease blood loss and blood transfusions, while HSA works as a volume expander to help minimize blood loss. An educational intervention on the adverse effects of allogeneic blood transfusion and the benefits of blood transfusion alternatives could help influence usage rates if implemented correctly. Direct monitoring of anesthesia providers after exposure to the educational intervention is key to monitoring change effectively.

**Strengths and Limitations**

Strengths associated with this project include the development of an educational tool on blood transfusion alternatives. This tool may further be used to benefit non-anesthetic practitioners in the use of blood transfusion alternatives. Another strength of this project included the use of frontline workers. These anesthesia providers were motivated and asked questions that stimulated learning. Another strength was that this study utilized multiple dependent variables to measure change. This added to the rigor of the study.

Limitations associated with this project included the inability to verify provider participation in the educational training. Without positive verification, it could not be known if the education influenced the providers usage of PRBC, TXA, and HSA. Additional limitations included small sample size of providers that took part in the study and short amount of time used
to collect data. A longer time period to educate providers and collect data would provide more accurate results.

**Implications for Practice**

This study was completed to evaluate the effect of an educational intervention on anesthesia providers usage of PRBC, TXA, and HSA. It’s long term benefit for future practice is to decrease the adverse effects associated with allogeneic blood transfusions by increasing the use of blood transfusion alternatives, such as TXA and HSA. Decreasing the burden associated with blood transfusions will allow for a quicker recovery and improved patient satisfaction.

**Implications for Research**

This study can be built upon for future research. Implementing a long-term study that would follow each anesthetic provider from the beginning of the educational intervention to the end of the study will provide for a direct analysis of change. Results from a more extensive study can benefit patients substantially by decreasing morbidity and mortality associated with allogeneic blood transfusions.

**Implications for Policy**

This study identified the potential benefits associated with blood transfusion alternatives TXA and HSA. A future institutional policy on blood transfusion alternatives could be developed based on the educational intervention.

**Conclusion**

The overall findings of this study could not support that an educational intervention can influence anesthesia providers use of PRBCs, TXA, and HSA. However, a future study that tracked specific providers, using the same methodology could be used to track the impact of the educational intervention on TXA and HSA usage by the anesthetic provider.
### Appendix

#### Table 1

*Demographic Data of Questionnaire Participants*

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Figure 1. Number of incorrectly answered questions by each participant.

Figure 2. Line graph displaying the number of times a specific question was answered incorrectly.
Figure 3. Correctly answered questions correlated with participants anesthetic experience.
Figure 4. Number of patients transfused/infused with PRBCs, TXA, and HSA pre- and post-education. *p= .007
References


August 29, 2017  
501 Capen Hall  
Buffalo, NY 14260  

Dear Anesthesia Providers:  

My name is Odesi Samantha Junor and I’m a third-year nurse anesthesia student at the University at Buffalo. I will be conducting an experimental study to determine if an educational intervention on anesthetic providers will help decrease risks associated with allogeneic blood transfusions or increase the use of blood transfusion alternatives, tranexamic acid and human serum albumin. A consent form and questionnaire will be distributed to all anesthesia providers. Following completion of the questionnaire, an educational intervention will be provided. The educational intervention will include a 30-minute presentation during morning conference, on the benefits of blood transfusion alternatives and the risks of allogeneic blood transfusion. In addition, a pocket-sized reminder card on blood transfusion alternatives and a detailed 2-page educational paper will be distributed to all participants. Your participation is totally voluntary and will be highly appreciated. The information gathered from the questionnaire will be stored in a locked room at the University at Buffalo. Any identifiable markers will be encrypted. Please contact me via email with questions or concerns. Thank you for your consideration.  

Sincerely,  
Odesi S. Junor
Descriptive Data

Gender: Male/Female

Age (Years): 25-35, 36-45, 46-55, 56-older

Years of Anesthetic Practice: < 1 year, 1-5, 6-10, 11-15, 16-20, 21-25, 26-over
Blood Transfusion Alternatives Questionnaire

T/F 1) Serum albumin concentration is directly related to mortality in the acute and chronically ill patient (Roberts, Blackhall, Alderson, Bunn, & Schierhout, 2011).

T/F 2) Albumin exerts a significant protective effect on morbidity in hospitalized patients (Vincent, Navickis, & Wilkes, 2004).

T/F 3) Albumin provides equal intravascular volume expansion when compared with crystalloids, due to its maintenance of capillary membrane permeability and providing oncotic pressure (Delaney, Dan, McCaffrey, & Finfer, 2011).

T/F 4) Indications for which albumin therapy is licensed in the United States include hypovolemia or shock; burns; hypoalbuminemia or hypoproteinemia (Mahlon & Roberta, 2001).

T/F 5) Albumin therapy has multiple effects, including volume expansion, increased serum albumin concentration and colloid osmotic pressure, and hemodilution (Mahlon & Roberta, 2001).

T/F 6) Tranexamic acid (TXA) has been used successfully to stop bleeding after dental extraction, tonsillectomy, prostate surgery, heavy menstrual bleeding, cardiac surgery, and in patients with hemophilia (Sukeik, Alshryda, Haddad, & Mason, 2011).

T/F 7) TXA is a synthetic derivative of the amino acid lysine that exerts its antifibrinolytic effect through the reversible blockade of lysine-binding sites on plasminogen molecules and a competitive inhibitor of plasminogen activation, and therefore interferes with fibrinolysis (Cid & Lozano, 2005; Ho & Ismail, 2003).

T/F 8) In Total hip and knee arthroplasty procedures, the use of TXA had no significant association with the reduction in the need for allogeneic or autologous blood transfusions (Poeran et al., 2014).

T/F 9) TXA is associated with changes in prothrombin time, activated partial thromboplastin time, and the prevalence of deep-vein thrombosis or pulmonary embolism. There’s an increased incidence of thromboembolic complications with the use of TXA (Mahomed, Evans, Gandhi, & Mahomed, 2013; Yang, Chen, & Wu, 2012).

T/F 10) Among patients with acute coronary syndromes, patients who undergo transfusion have increased rates of death and myocardial infarction, even after adjustment for important confounding factors (Kagoma et al., 2009). Allogeneic blood transfusions carry significant risks of immunological reactions, transmission of disease, intravascular hemolysis, transfusion induced coagulopathy, renal failure, admission to intensive care and even death (Sukeik et al., 2011).
Reminder Card

- Risks associated with blood transfusions include: immune modulation, hemolytic transfusion reactions (HTR), onset of the systemic inflammatory response, transfusion related acute lung injury (TRALI), and transmission of blood borne diseases.
- While blood transfusions may prove to be beneficial in emergency situations, it may not be beneficial in all situations.
  - High risk patients, such as trauma, vascular, open heart, and obstetrics, did not suffer significant amounts of adverse reactions to blood transfusions as did low risk patients.
- Human serum albumin (HSA) therapy has multiple effects, including volume expansion, increased serum albumin concentration and colloid osmotic pressure, and hemodilution.
  - HSA provides increased intravascular volume expansion when compared with crystalloids, due to its maintenance of capillary membrane permeability and ability to provide oncotic pressure.
  - The US Hospital Consortium Guidelines recommend that colloids, such as HSA, be used in hemorrhagic shock prior to the availability of blood products.
- In the US tranexamic acid (TXA) has been used successfully to stop bleeding after dental extraction, tonsillectomy, prostate surgery, heavy menstrual bleeding, cardiac surgery, and in patients with hemophilia.
- TXA is commonly used in the orthopedic population to decrease perioperative bleeding and the need for allogeneic blood transfusions.
- There’s a misconception of an increased association of thrombolytic events and TXA use.
  - TXA use, does not change prothrombin time, activated partial thromboplastin time, and the prevalence of deep-vein thrombosis or pulmonary embolism.
  - There’s minimal differences in the incidence of thromboembolic complications with the use of TXA.
Permission to Take Part in a Human Research Study

University at Buffalo Institutional Review Board (UBIRB)
Office of Research Compliance | Clinical and Translational Research Center Room 5018
875 Ellicott St. | Buffalo, NY 14203
UB Federal wide Assurance ID#: FWA00008824

Title of research study: Adult Consent to Participate in a Research Study

Version Date: August 28, 2017

Investigator: Odesi Junor

Why am I being invited to take part in a research study?
You are being invited to take part in this research study because you are an adult English-speaking anesthesia provider.

What should I know about a research study?
- Someone will explain this research study to you.
- Whether or not you take part is up to you.
- You can choose not to take part.
- You can agree to take part and later change your mind.
- Your decision will not be held against you.
- You can ask all the questions you want before you decide.

Who can I talk to?
If you have questions, concerns, or complaints, or think the research has hurt you, talk to the research team at odesijun@buffalo.edu. You may also contact the research participant advocate at 716-888-4845 or researchadvocate@buffalo.edu.

This research has been reviewed and approved by an Institutional Review Board (“IRB”). You may talk to them at (716) 888-4888 or email ub-irb@buffalo.edu if:
- You have questions about your rights as a participant in this research.
- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

Why is this research being done?
During the perioperative visit a patient may be at risk for surgical bleeding depending on comorbidities, surgical technique, and/or the particular surgery itself. These are all common occurrences among the perioperative patient. Excessive blood loss could result in decreased physical capacity, difficulty rehabilitating, and blood transfusion to the operative patient. The purpose of this study is to present a blood transfusion alternative educational intervention, geared to decrease surgical blood loss and reduce allogeneic blood transfusions in the adult non-critical perioperative patient and those that refuse blood therapy. As a result, complications associated with allogeneic blood transfusions could be potentially decreased.

How long will the research last?
We expect that you will be in this research study for two-weeks.

How many people will be studied?
We expect about __20___ people in this research study.
Permission to Take Part in a Human Research Study

What happens if I say yes, I want to be in this research?
You will be given a 10-item questionnaire to complete within 30-minutes. Two-weeks after completing the questionnaire, an educational intervention will be given on blood transfusion alternatives. The questionnaire and educational intervention will be distributed within two-weeks of each other.

What are my responsibilities if I take part in this research?
If you take part in this research, you will be responsible to: Answering questions on a questionnaire, attend a 30-minute presentation on blood transfusion alternatives, and review an educational-paper and key-point summary sheet.

What happens if I do not want to be in this research?
Your participation in this research study is voluntary. You may choose not to enroll in this study. The important risks and possible benefits of these alternatives include: There are no anticipated risks. Benefits include an increase in knowledge of the risks associated with allogeneic blood transfusions and benefits of blood transfusion alternatives.

What happens if I say yes, but I change my mind later?
You can leave the research at any time it will not be held against you. If you decide to leave the research, there will be no adverse effects. If you decide to leave the research, contact the investigator so that the investigator can be aware.
If you stop being in the research, already collected data may not be removed from the study database. Data collected to the point of withdrawal will be used in the study. After withdrawal subjects will not be contacted further.

Is there any way being in this study could be bad for me?
There are no known risks associated with these procedures.

Will being in this study help me in any way?
We cannot promise any benefits to you or others from your taking part in this research. However, possible benefits include increase your knowledge in blood transfusion alternatives.

What happens to the information collected for the research?
Efforts will be made to limit the use and disclosure of your personal information, including research study, to people who have a need to review this information. We cannot promise complete secrecy. Organizations that may inspect and copy your information include the IRB and other representatives of this organization.

You will not be paid for participating in this study.
Permission to Take Part in a Human Research Study

Signature Block for Capable Adult

Your signature documents your permission to take part in this research. By signing this form you are not waiving any of your legal rights, including the right to seek compensation for injury related to negligence or misconduct of those involved in the research.

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August 16, 2017

Dear Odesi Junor:

On 8/16/2017, the IRB reviewed the following submission:

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The IRB approved the study from 8/16/2017 to 8/15/2018 inclusive. Before 8/15/2018 or within 30 days of study closure, whichever is earlier, you are to submit a continuing review with required explanations. You can submit a continuing review by navigating to the active study and clicking Create Modification / CR.

If continuing review approval is not granted before the expiration date of 8/15/2018, approval of this study expires on that date. The Initial Study materials for the project referenced above were reviewed and approved by the SUNY University at Buffalo IRB (UBIRB) by Initial Study Review. Before to 8/15/2018 inclusive. Before 8/15/2018 or within 30 days of study closure, whichever is earlier, you are to submit a continuing review with required explanations. You can submit a continuing review by navigating to the active study and clicking Create Modification / CR.

If continuing review approval is not granted before the expiration date of 8/15/2018, approval of this study expires on that date, or within 30 days of study closure, whichever is earlier, you are to submit a continuing review application with required explanations. You can submit a continuing review application by navigating to the active study in Click IRB and clicking Create Modification / Continuing Review. Studies cannot be conducted beyond the expiration date without re-approval by the UBIRB.
University at Buffalo Institutional Review Board (UBIRB)
Office of Research Compliance | Clinical and Translational Research Center Room 5018
875 Ellicott St. | Buffalo, NY 14203
UB Federalwide Assurance ID#: FWA00008824

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system.

UB IRB approval is given with the understanding that the most recently approved procedures will be followed and the most recently approved consent forms will be used. If modifications are needed, those changes may not be initiated until such modifications have been submitted to the UBIRB for review and have been granted approval.

Prior to the expiration of this approval, you will receive notification that it is time for the UBIRB to conduct its periodic review of your study. Studies cannot be conducted beyond expiration date without re-approval by the UBIRB.

As principal investigator for this study involving human participants, you have responsibilities to the SUNY University at Buffalo IRB (UBIRB) as follows:

1. Ensuring that no subjects are enrolled prior to the IRB approval date.
2. Ensuring that the study is not conducted beyond the expiration date without re-approval by the UBIRB.
3. Ensuring that the UBIRB is notified of:
   • All Reportable Information in accordance with the Reportable New Information Form Smart Form.
   • Project closure/completion by the Continuing Review/Modification/ Study Closure smart form.
4. Ensuring that the protocol is followed as approved by UBIRB unless a protocol amendment is prospectively approved.
5. Ensuring that changes in research procedures, recruitment or consent processes are not initiated without prior UBIRB review and approval, except where necessary to eliminate apparent immediate hazards to subjects.
6. Ensuring that the study is conducted in compliance with all UBIRB decisions, conditions, and requirements.
7. Bearing responsibility for all actions of the staff and sub-investigators with regard to the protocol.
8. Bearing responsibility for securing any other required approvals before research begins.
University at Buffalo Institutional Review Board (UBIRB)
Office of Research Compliance | Clinical and Translational Research Center Room 5018
875 Ellicott St. | Buffalo, NY 14203
UB Federalwide Assurance ID#: FWA00008824
If you have any questions, please contact the UBIRB at 716-888-4888 or ub-irb@buffalo.edu.
BLOOD TRANSFUSION ALTERNATIVES IN THE ADULT NON-CRITICAL PERIOPERATIVE PATIENT

Odest Samaatha Junior, SRNA

Purpose

- The purpose of this study was to:
  - Develop
  - Educate
  - And distribute an educational intervention on blood transfusion alternatives, tranexamic acid, and human serum albumin.

Study Question: PICO

Does an educational intervention on blood transfusion alternatives decrease the number of patients transfused with packed red blood cells or increase the use of tranexamic acid and human serum albumin in the adult non-critical perioperative patient?

Background/Justification

- Annually 24 million blood products are transfused in the United States
- Risks associated with homologous or allogeneic blood transfusions include:
  - Immune modulation
  - Hemolytic transfusion reactions (HTR)
  - Overdegree systemic inflammatory response
  - Transfusion-related acute lung injury (TRALI)
  - Transmission of blood borne diseases

(Chimowitz, Gravlee, & Murphy, 2016; Naka, Nakada, & Iwao, 2012)
High Risk vs Low Risk

- Blood transfusions may not prove to be beneficial in all situations.
- High-risk patients have fewer adverse effects when transfused, compared to low-risk patients.
- Transfusions in non-life-threatening circumstances can prove harmful.

(From: [Hematology - M. M. B. N.]

Transfusion Costs

- Financial burden associated with allogeneic blood transfusions.
- One unit of blood costs $70-$120.
- Intraperioperative blood transfusion hospital costs were $14,035 and $15,471, respectively.


Significance

- Jehovah’s Witnesses refuse allogeneic blood transfusion therapy despite risk to life.
- Many organizations do not offer an allogeneic blood transfusion alternative policy.
- As a result, anesthetists provide lack a set guideline.
- Currently there is available teaching but regarding blood transfusion alternatives.


Theoretical Framework

- Bennis theory addresses these stages of development.
- Stages of Bennis theory “From Novice to Expert.”
  - Novice
  - Advanced Novice
  - Competent
  - Proficient
  - Expert
**Review of Literature: Human Serum Albumin**
- Loss of the ability to transport oxygen efficiently due to a decrease in blood volume can result in:
  - Decreased cardiac output
  - Hypotension
  - Tachycardia
  - Fatigue
  - Weakness

**HSA Benefits**
- To help correct hypovolemia in an anemic patient where an expandable is necessary
- Human serum albumin (HSA) is the most abundant protein found in plasma
- HSA acts as an unsaturated volume expander

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**Review of Literature: Tranexamic Acid**
- Tranexamic acid (TXA) functions as an antifibrinolytic agent to prevent the breakdown of fibrin
- TXA has been used successfully to reduce bleeding after dental extraction, tonsillectomy, prostate surgery, heavy menstrual bleeding, cardiac surgery, and patients with hemophilia
- However, TXA has been found to reduce blood loss and transfusion requirements in the joint replacement patient

**Benefits of Tranexamic Acid**
- TXA helps to maintain hemostasis
- Decreases postoperative bleeding
- Decreases alloimmune blood transfusion

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For more information, please refer to the references:
- [Cardinal et al., 2015](#)
- [Davis et al., 2016](#)
- [Kim et al., 2017](#)
Methodology

- Approval for the project was received by the Institutional Review Board (IRB) from The University at Buffalo; IRB approval ID # IRB0000098A.
- Setting:
  - A suburban hospital in Western New York, that has a 300-bed facility that offers surgery to a wide variety of patients.
- Informed consent:
  - The consent and questionnaire were sent out to anesthesia providers after IRB approval via email.

Methodology: Recruitment

- Recruitment measures included sending an email to all anesthesia providers.
- Paper copies of the consent and questionnaire were left in the anesthesia lounge.
- A follow-up email was sent out via the anesthesia department, letting all anesthesia providers about the study.

Methodology: Timeline

- The consent and questionnaire were distributed after IRB approval.
- Records were obtained from the hospital’s pharmacy and bloodstream department regarding TIA, HSA, and PRBC distribution.
- Information was collected from anesthesia electronic records over the same period.
- Educational intervention was given in September.
- Post-intervention data was collected in October.

Questionnaire

[Text not translated due to the nature of the document.]

BLOOD TRANSFUSION ALTERNATIVES
Educational Intervention

- 30-minute PowerPoint intervention
- Distribution of educational paper
- Distribution of laminated reference card

Methodology: Medical Records Review

- Records obtained from the blood bank, pharmacy, and anesthesia medical records include:
  - Total number of patients seen in operating room (OR) for the months of August and October
  - Number of units of PRBCs transfused in August and October
  - Number of FFPs for transfusion
  - Number of FFA and HSA infused in August and October
  - Number of TDA and HSA infusions
  - Amount of products utilized by each patient

These data were collected and entered into Statistical Package for Social Science (SPSS) version 24, for analysis.

Methodology: Variables and Measurements

- Variables:
  - The independent variable in this study was the educational intervention
  - The dependent variables were PRBC, TDA, and HSA

- Measurements:
  - The 10-question pre-test questionnaire was measured by counting the total amount of questions answered correctly
  - The effectiveness of the teaching intervention was measured by testing PRBC, TDA, and HSA used in August and October
  - To measure and analyze change, an independent samples t-test was used

Methodology: Sample Size

- Fifteen anesthesia providers participated in the questionnaire
- A total of 30 anesthesia providers participated in the educational intervention
- Number of adult patients in August was 881
- Number of adult patients in October was 1,080
Demographics of Questionnaire Participants

<table>
<thead>
<tr>
<th>Number of Participants</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
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<tbody>
<tr>
<td>10</td>
<td>6</td>
<td>4</td>
<td>5</td>
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<td>Age Range (Years)</td>
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<tr>
<td>60-69</td>
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</tbody>
</table>

Incorrectly Answered Questions per Participant

Figure 1. Number of incorrectly answered questions by each participant.

Results: Experience vs Correct Answers

- A Pearson's r was computed to assess the correlation between the number of correctly answered questions and the participant's years of experience.
- There was no statistically significant evidence to support that there was a correlation between correctly answered questions and years of experience (r = .47, p = .15).
- Correlation significance was set at .01 level (p-value).

PRBCs, TXA, HSA Usage in August and October

Figure 2. Distribution of participants' usage of PRBCs, TXA, and HSA in August and October.
BLOOD TRANSFUSION ALTERNATIVES

Discussion

- Increased enrollment measures
- Anesthetic providers' knowledge of blood transfusion alternatives
- A Pearson's r indicated no statistically significant evidence that the number of consent
  sessions and experience were correlated (p = 0.001)
- Did have 21 or more years of experience
- Thirty providers responded to the emailed educational intervention invitation

Discussion: PRBCs, HSA, TXA

- The mean usage of PRBCs and HSA were not statistically significant in August compared
to their mean usage in October
- The mean usage of PRBCs for August and October were 0.29 units/patient
- The mean usage of HSA for August and October was 2.22 units/patient
- Imitation of results showed the educational intervention had shifted on PRBCs and HSA usage
- However, TXA showed a statistically significant difference between August and October usage
- The mean usage of TXA for August and October were 22.289 units/patient
- TXA usage significantly increased the education exposure
- This may not have been influenced by the education
- Only PRBCs, HSA, and TXA recipients were used to compare usage change

Flaws in Design

- Lack of enrolling study participants
- Failure to administer inquiry in sheet
- Failure to administer second questionnaire

Redesign

- Pilot test questionnaire
- Questionnaire should be offered before and after educational intervention
- Offer questionnaire online in addition to paper
- Offer educational intervention on multiple days at different times
- Provide attendees a gift card could be offered
- Anesthetic providers should be invited directly
- Measure directly researched providers using a dependent samples t-test
Future Implications

- Decrease adverse effects associated with allogeneic blood transfusions, by increasing the use of TIA and HSA
- Develop a viable institutional policy on blood transfusion alternatives
- Use of policy to help Jehovah’s Witness patients

Strengths

- Development of an educational intervention
- Use ofeline reviewers
- Study utilized multiple dependent variables to measure change
- Examine that review

Limitations

- Inability to verify provider attendance in the educational training
- Small sample size of providers that took part in the study
- Short amount of time used to collect data

Summary

- Allogeneic blood transfusion therapy can be harmful
- To decrease adverse effects blood transfusion alternatives, TIA and HSA are utilized
- An educational intervention on the adverse effects of allogeneic blood transfusion and the benefits of blood transfusion alternatives could help influence usage rates
- Effect monitoring of anesthetic providers after exposure to the educational intervention is key to maintaining change effectively
References


References


References


