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Improving Anesthesia Provider Knowledge and Competence in Patient Blood Management

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Knowledge and Competence in Patient Blood Management

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Abstract

Background*:* In the United States, blood transfusions are the most common medical procedure performed in hospitals. When used appropriately, allogeneic blood transfusions are crucial life-saving interventions essential in perioperative management. The use of blood transfusions should be based on safety, efficacy, and quality of treatment. However, a significant volume of evidence has emerged correlating blood transfusions to adverse patient outcomes, increases in cost, increases in morbidity, and mortality in surgical patients. Noting this, current transfusion practices require further evaluation. Patient Blood Management is a novel multidisciplinary approach that mitigate these negative outcomes.

Methods*:* A comprehensive literature search was conducted using CINAHL and MEDLINE databases to identify research studies from 2015 and forward that have evaluated the effectiveness of Patient Blood Management in reducing morbidity, mortality, and excess costs associated with inappropriate allogeneic blood transfusion administration.

Results*:* A total of 8 research studies were identified for review. These studies analyzed various treatment modalities within Patient Blood Management. The articles affirm the reliability and validity of the initiative in reducing the overutilization allogeneic blood transfusions in the perioperative period and thus reducing the associated adverse outcomes and cost.

Keywords: Patient Blood Management, blood transfusions, restrictive transfusion practices.

transfusion practices.

Introduction

Blood transfusions are overprescribed in elective surgeries.[1–5] They are one of the most ubiquitous medical interventions utilized in modern medicine, and their use is ingrained into

medical practice. This has resulted in allogeneic blood transfusions becoming a mainstay treatment in the perioperative period to treat a variety of pathologies to aid in maintaining a patient's optimal cardiopulmonary status. There is an apparent lack of guidelines for ordering blood transfusions during the perioperative period, which has resulted in its overuse.[1] It is estimated that in the United States of America, 1 in 7 hospitalized patients has received a blood transfusion, totaling 30 million units of blood transfused per year.[4] A growing consensus affirms that blood transfusions are overutilized and result in poor outcomes in surgical patients when administered prematurely or unnecessarily and is a significant financial burden to health systems.[1]

The Joint Commission and the American Medical Association have identified red blood cell transfusion as 1 of the top 5 overused medical procedures.[2] Studies have also determined that the decision to administer blood during elective surgeries significantly varies between different institutions and individual practitioners, suggesting that the decision to administer blood is often not based on evidence but rather on individual behavior.[3] Additionally, meta-analyses[5] have concluded that an estimated 40-60% of transfusions administered did not improve health outcomes, that only 12% of transfusions administered were appropriately used for patients who needed them, and are thus largely inappropriate. Unnecessary transfusions only increase the risk for harm and cost while providing minimal benefit. There is a clear need for a paradigm shift in the utilization of blood products during the perioperative period.

Background

In the United States, blood transfusions are the most common medical procedure performed in hospitals.[6] When used appropriately, allogeneic blood transfusions are crucial life-

saving interventions essential in perioperative management. The World Health Organization (WHO) has provisioned that all member states have adequate supplies of safe blood products accessible to all who require blood transfusions.[7] The use of blood transfusions should be based on safety, efficacy, and quality of treatment in perioperative management. However, an expansive volume of evidence has emerged correlating blood transfusions to adverse patient outcomes, increases in morbidity, and mortality in surgical patients.[1,4,8–10] Noting this, current transfusion practices require further evaluation.

Patients may also object to blood transfusions for either personal, safety, or religious reasons. Healthcare providers must understand and respect these views. One vulnerable population of particular concern includes Jehovah's Witnesses, whose religious beliefs prohibit them from receiving blood transfusions, presenting legal, ethical, and perioperative management dilemmas for anesthesia providers.[11] Preoperative, intraoperative, and postoperative optimization of a patient's own blood can preempt, reduce, or even forgo the need for the use of blood products.[9] Furthermore, noting that blood transfusions lead to adverse outcomes in patients, they should be avoided with the exceptions of traumas and acute hemorrhage, with emphasis placed on optimizing a patient's own blood.[12] Anesthesia providers must be current on these modalities to mitigate the over and inappropriate use of blood transfusion.

The concept of Patient Blood Management (PBM) was created in 2008 as a pragmatic multidisciplinary bundle to reduce the utilization of allogeneic blood transfusions and thus the associated negative sequelae and costs.[13] PBM aims to improve patient outcomes by minimizing unnecessary allogeneic blood transfusions via optimization of the patient's own blood and modifiable risk factors. PBM emphasizes 3 pillars which include: (1) optimization of endogenous erythrocytes; (2) mitigation and reduction of blood loss and bleeding; and (3)

optimization of a patient's physiological reserves to anemia.[14] Each of these pillars is then applied to the preoperative, intraoperative, and postoperative periods and has proven to reduce the use of allogenic blood transfusions, thus reducing the sequential associated adverse and negative sequelae and costs.[9]

Scope of the Problem

An estimated 30 to 40% of patients before major surgery are anemic, which is the primary indicator for allogeneic blood transfusions.[9] In the United States, 30 million units of blood are transfused each year, and every 2 seconds, someone is in need of blood products.[4,15] Blood is a finite resource; it cannot be manufactured, has a limited period of viability, and undergoes rigorous quality assurances requiring extensive resources, personnel, and monetary support to ensure its safety when being administered to patients. In 2020 and 2021, the American Red Cross declared a severe nationwide blood shortage attributed to a rise in organ transplants, elective surgeries, and traumas.[16] Shortages have forced some hospitals to delay elective surgeries until supply rebounds.[16] Future inadequacy of the national blood supply must also be accounted for. Shifting demographic trends of the U.S. population have caused a shrinking donor base of approximately 20% from 2008 to 2019.[17] A total of 50% of allogeneic blood transfusions are administered to those 65 years of age and older, and by 2031 this segment of the population will double in size.[18,19] There is the potential that if the donor base continues to decline and current utilization practices are maintained, demand will chronically exceed supply in the years to come.[20]

A significant portion of blood transfusions continue to be administered inappropriately. It is estimated that only 12% of transfusions administered to surgical patients result in improved outcomes and that 59% of blood transfusions provided no benefit to surgical patients, thus

exposing patients to unnecessary risk and harm.[5] Analysis of data from 3000 surgical patients who received blood transfusions demonstrated that 31% of allogenic blood transfusions did not have hemoglobin levels drawn prior to the administration of a transfusion.[1] Overuse, inappropriate use, cost, and limited blood supply are chronic themes in transfusion medicine. New data on questionable efficacy further emphasize the need for improved guidelines and management of the appropriate use of allogenic blood transfusions.

Consequences of the Problem

Recent studies have continued to emphasize the strong association between transfusions and adverse patient outcomes. Transfusions are a major multiplier of morbidity and mortality in surgical patients when compared to non-transfused patients.[12] These morbidities include the risk of transfusion-related infection, transfusion-related acute lung injury (TRALI), transfusion-related circulatory overload (TACO), anaphylactic reaction, intensive care unit admission, thromboembolic events, and hemolytic transfusion reactions.[13,21] For example, the occurrence of postoperative infections was anywhere from 2 to 4 times greater for patients who received an allogeneic blood transfusion.[12,22,23] Studies also suggest that the adverse effects of blood transfusion are dose-dependent.[8] The reduction of the use of blood transfusions has also been associated with decreased length of hospital stay in several tertiary care hospitals.[24] Emerging evidence also suggests that blood transfusions are significantly associated with increased cancer recurrence and promotes cancer progression.[25,26]

The economic costs of blood transfusion are immense. Per 1 unit of blood, the cost ranges from $1200 to $3800 and is expected to increase.[27] Most patients will receive more than a single unit of blood. When considering all factors, blood transfusions are estimated to cost $10 billion annually to the United States healthcare system.[28] When implemented, PBM yields

significant positive results both for patient outcomes and reduction of costs.[9] At the University of California San Diego health system, a study demonstrated a 47% reduction in transfusion for low hemoglobin levels and a 67% reduction of multi-unit transfusions, saving over $1 million.[21] Swiss and Australian studies[24,29] demonstrated savings of $3 and $6 million, respectively, with authors noting that this is likely an underestimation by not accounting for indirect costs and treatment of any potential complications associated with allogeneic blood transfusions.

Knowledge Gaps

Blood Management was first mentioned in 2008.[13] High-quality evidence on PBM and restrictive transfusion protocols have primarily been published in the last 5 to 10 years.[2] Patient blood management significantly decreases the use of allogeneic blood transfusions and associated risks.[9] Governing medical associations have highlighted the importance of PBM implementation, especially when noting continued blood shortages associated with COVID-19.[30,31] The novelty of this multidisciplinary bundle and the state of the current national blood supply denotes the importance of, and likely knowledge deficit of, PBM among healthcare providers.

A common barrier cited to implementing PBM protocols is a lack of knowledge and information among providers.[32] A survey among 4952 clinicians was conducted throughout Europe, and results demonstrated insufficient knowledge of PBM.[33] The survey noted that more than 50% of clinicians do not treat preoperative anemia and 29% stated they did not have sufficient knowledge on how to treat it.[33] Of those who chose to treat the anemia, 38% chose to treat with a preoperative blood transfusion.[33] This highlights the need for additional intervention among clinicians to increase knowledge on PBM and its perioperative management modalities.

Increasing attention has been brought to PBM; however, literature assessing awareness among providers is limited, and the available literature focuses on providers in Europe.

Proposal Solution

During elective surgeries, the decision to initiate allogenic blood transfusions varies widely between institutions and among individual providers.[1] Despite mounting evidence concerning the overuse of blood transfusion, they continue to be the most common medical procedure among inpatients in the United States.[6] There is a clear need for improved guidelines regarding the use of blood transfusions, and PBM is an effective evidence-based, multidisciplinary approach that addresses these concerns.[9]

Educational modules have been effective in enhancing knowledge among healthcare providers on various topics.[34,35] Utilization of an educational module on PBM will improve knowledge and change behavior among anesthesia providers to optimize endogenous erythrocytes better, mitigate blood loss and bleeding, and treat anemia during the perioperative period. Together, this project will reduce the adverse outcomes and costs associated with allogenic blood transfusions among all surgical patients.

Summary of Literature

Blood transfusions are overprescribed in the perioperative stage.[1–5] The use of blood transfusions is one of the most important medical developments in the 20th century; however, its utilization is one of the most ubiquitous medical interventions in modern medical practice as a way to maintain a patient's optimal cardiopulmonary status. During the perioperative period, there are protocols and guidelines for the administration of blood product which are not clear, often resulting in the overuse of blood transfusions due to an abundance of caution from healthcare providers.[1] In direct opposition to historical practices, blood transfusions are not

always necessary and may, in fact, cause patients harm resulting in worse outcomes, and are a significant financial burden to health systems.[1]

The Joint Commission and the American Medical Association have identified red blood cell transfusion as the single most common medical procedure.[2] Individual behavior, rather than evidence-based data, is the greatest factor in determining the initiation of blood administration, and these practices varying across different providers and institutions.[3] The majority of blood transfusions given in the United States are used inappropriately and only a small percentage (12%) were administered were appropriately used for patients who needed them.[5] Most transfusions in the US increase cost and risk without any clear benefit, current practices are not sustainable and are in need of change, based on high quality research and evidence. PBM intentions are to improve safety, efficacy, and quality of treatment through all phases of care for the surgical patient to mitigate the associated morbidity, mortality, and adverse patient outcomes prevalent in the perioperative period. Some patients may also object to the use to blood products for other reasons such as religious, or personal views. Healthcare providers should be able to accommodate these needs.

Rationale

Patient Blood Management (PBM) is a relatively novel tool conceived in the last 14 years, it strives for a pragmatic multidisciplinary approach to reduce the utilization of blood transfusions and thus the associated negative consequences.[13] At its core, PBM focuses on the individual's modifiable risk factors and how to best optimize patients in order to minimize or overall forgo the use of allogeneic blood transfusions. The three pillars of PBM include: (1) optimization of hematopoiesis, (2) minimizing surgical blood loss and bleeding, and (3) optimizing of a patient's physiological tolerance to anemia.[14] These principles each have an

application throughout each phase in the perioperative period and have been proven and tested in various settings to reduce the use of unnecessary blood transfusions.

Due to PBMs relative novelty, most high quality literature has only been published in recent years.[2] Thus resulting in a knowledge deficit across many providers on the matter and denoting the importance of educational interventions to increase awareness. Many governing bodies, such as the World Health Organization and the America Society of Anesthesiologists, have also noted depleting reserves in blood banks due to the COVID-19 pandemic, which further emphasizes the importance of conservative blood transfusion usuage.[30,31]

There has been increasing attention brought towards PBM as a viable tool to address concerns of safety, and appropriate of a finite resource. However, many providers are still not proficient in the basic principles of PBM as denoted by a survey on PBM sent to 7 hospitals in Europe where there were widespread inconsistencies on how to appropriately intervene when patients were preoperatively anemic.[33]

Objective

This literature review aims to summarize the impact Patient Blood Management (PBM) has in the perioperative period through 3 dimensions. First, this review will analyze the latest evidence-based interventions in Patient Blood Management and its rationale. Next, it will assess the validity of utilizing the PBM initiative in reducing the utilization of allogeneic blood transfusions in the perioperative period and associated adverse patient outcomes. Finally, the literature will examine past implementation of PBM and review what financial impact PBM has when implemented in facilities.

Methodology

Eligibility Criteria & Information Sources

Peer-reviewed articles selected for the literature review were chosen based on specific inclusion and exclusion criteria. Search limits included articles studying adult populations, published from 2015 and forward, and were available in English. Exclusion criteria included studies where subjects were less than 18 years of age. Database sources used for the literature review were accessed through Florida International University (FIU) library services. A review of the current literature for this topic was conducted via queries of the electronic databases PubMed and the Cumulative Index to Nursing and Allied Health Literature (CINAHL). The literature review was guided by utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Keyword search terms were identified based on the clinical question, using Boolean operators and search symbols. These included: Patient Blood Management, Bloodless Surgery, Perioperative, restrictive transfusion strategy, and anesthesia provider.

Search Strategy

Key search terms were further expanded with the assistance of the FIU Health Science Librarian and included ("Patient Blood Management") AND ("Perioperative"). This search yielded a total of 100 articles through the CINAHL database and 145 articles from MEDLINE. This search was further refined to include only adults ages 18 and over, published in the last 6 years, in English, and available in full text. This yielded 55 and 53 articles, respectively. Titles were excluded if the focus was not on the PBM protocol. The search was further refined to articles that focused on specific providers: (Anesthesia* OR Anesthesiologist* OR Anesthetist*). A total of 23 articles were then selected for a full review of the abstract; of those articles, 11 were assessed by reading the full text. Articles were then excluded if management focused on

intensive care and/or pediatric patients. Only the articles that met the highest level of research were chosen, leaving 8 articles for review.

Table 1: Search Key Words

First Keyword	Second Keyword	Third Keyword
"Patient Blood Management"	"Perioperative	"Anesthesia" OR "Anesthetist" OR "Anesthesiologist"

Results

Study Characteristics

The 8 articles selected for the literature review comprehensively analyze the fundamental conceptual framework and concerns related to Patient Blood Management. Overall, these articles assess current transfusion practices, advantages and disadvantages of PBM, implementation and patient outcomes, financial consequences, and current knowledge on PBM. Several articles located on the topic definitively demonstrate that reducing the overutilization of allogeneic blood transfusions in the perioperative period can reduce the associated adverse outcomes and cost.

Ferraris et al[8] analyzed current transfusion practices, the type of patients who receive allogeneic blood transfusion during surgery, and how it affects patient outcomes. The authors, who initially conceptualized PBM over 10 years, further analyzed the effectiveness of PBM and its future potential, while other studies further support the use of PBM to reduce unnecessary transfusions.[2,9] Post-implementation PBM also has a significant financial impact on health systems.[36] To effectively support the potential need for transfusion practice changes, Manzini et al[33] evaluated knowledge and current practices among clinicians, the first such study assessing knowledge of PBM that has been conducted in the United States. Finally, a meta-analysis was

conducted on Patient Blood Management and its effectiveness in reducing negative consequences and costs of blood transfusions.[37]

All the studies were centered on adults 18 years of age and older. A total of 4 of the studies were systematic reviews or meta-analyses with a Level I evidence level.[2,10, 36,37] An additional 3 were cohort studies associating patients who received blood transfusions with a variety of outcomes.[8,25,33] Another study was a Clinical Focused Review by the original author who first conceptualized Patient Blood Management.[9]

Results of Individual Studies

(1) Ferraris et al[8] sought to determine if there are an identifiable set of patient characteristics that can be correlated with adverse and positive patient outcomes when given an allogeneic blood transfusion. This study was conducted via queries of the American College of Surgeons National Surgical Quality Improvement Project database of patients who received allogeneic blood transfusions within 72 hours of their operative procedure and compared those who did not receive blood, noting differences in morbidity and mortality. Through the queries, 470 407 patients were included, with data retrieved from surgeries between 2010 and 2012. The queries did exclude trauma patients, pediatric patients, patients on cardiopulmonary bypass and aortic procedures. Surgeries that were included that comprised the vast majority of blood transfusions including cardiothoracic surgery, general surgery, neurosurgery, and vascular surgery.[8]

Patients who received 1 or more units of red blood cells within 72 hours of surgery had a respective mortality or severe morbidity rate of 11.3% and 55.4%.[8] Compared to non-transfused patients, associated mortality and morbidity was 1.3% and 6.1%, respectively. There was a 300-400% increase in morbidity and mortality for anemic patients who received a blood transfusion

compared to non-transfused anemic patients. Patients considered low risk for adverse surgical outcomes had the highest mortality and morbidity rates of transfused patients. High-risk patients do not have significantly increased risk when receiving blood transfusions. This study highlights the importance of effective preoperative assessment of transfusion risk profiles. The authors further support the concept of limiting transfusions used to minimize operative risk in their discussion. This study also noted that blood transfusion practices vary widely across institutions, and, further, guidelines are needed to optimize patient outcomes.[8]

(2) One meta-analysis, by Trentino et al[10] , assessed the effects of restrictive and liberal transfusion strategies on patient mortality. The authors support the utilization of restrictive transfusion thresholds for most patient populations.[10] Databases used were MEDLINE, Embase, Web of Science Core Collection, PubMed, Google Scholar, and the Joanna Briggs Institute EBP Database. Only systematic reviews and meta-analyses were included. A total of 346 articles were screened, while 43 full-text articles were assessed for eligibility. A final 19 studies were included in the qualitative synthesis. Of the meta-analyses reviewed, 12 (75%), found there was no reported difference in mortality between liberal and restrictive transfusion practices. Another 4 meta-analyses (25%) supported significantly lower mortality for patients where restrictive transfusion practices were utilized. Overall, the authors supported the use of restrictive hemoglobin thresholds in most patient populations.[10]

(3) Spahn et al[9], the original authors who first conceptualized PBM over the course of 10 years, sought to affirm and narrate its clinical application, limitations, and potential for future uses throughout the perioperative period.[9] The article summarizes and synthesizes PBM utilization in the preoperative, intraoperative, and postoperative periods, specifying what interventions and lab values should be used to optimize patients, and provides a clinical

framework for PBM implementation. The authors note a variety of PBM interventions.[9] Preoperatively, the authors suggests the use of intravenous iron and erythropoietin. Intraoperatively, measures such as reducing transfusion thresholds, novel surgical techniques, cell savage, and normovolemic hemodilution are recommended. Postoperatively, PBM endorses the use of restrictive transfusion thresholds, minimization of laboratory blood draws, and goal-directed coagulation algorithms. Overall, the review affirms that blood transfusions are associated with prolonged hospitalization, intensive care admission, infection, thromboembolic events, and mortality.[9]

(4) A systematic review by Sadana et al[2] reviewed 31 studies by comparing restrictive and liberal transfusion strategies. This article promotes the utilization and development of Patient Blood Management programs, providing specific methods for optimal transfusion practices. All studies reviewed were randomized control trials (RCTs) published in the last 10 years at the time of publication. Included were 7 of the 8 most cited trials, 4 of which were published in the previous 4 years at the time of publication. The total sample size was 12 587.[2] The authors established cutoffs for transfusions; stating that red blood cell transfusions are not indicated in hemodynamically stable patients with 7g/dl or greater hemoglobin levels. Further, transfusions are not indicated in orthopedic or cardiac surgery for patients with underlying cardiovascular disease with hemoglobin levels of 8g/dl or greater. The article also provided a blueprint for specific methods for optimizing transfusion practice that would lead to an increased quality of care and reduced costs.[2] These methods included nutritional optimization, pre-operative anemia treatment, and novel cell savage techniques.[2]

(5) With high-quality evidence emerging on the topic of PBM, Althoff et al[37] conducted a systematic review and meta-analysis. This study aimed to determine the effectiveness of PBM

implementation in reducing morbidity, mortality, and improving clinical outcomes in patients throughout the perioperative period. All studies included must have addressed each of the 3 pillars of PBM. Overall, 17 studies were analyzed, yielding a sample size of 235 779. Of those, 100 886 were participants pre-PBM implementation, and 134 893 were post-PBM implementation. The authors conclude by supporting the use of PBM in various healthcare settings. The meta-analysis revealed implementation of PBM significantly reduces the incidence of transfusion by 39%, decreases the number of red blood cells (RBC) units transfused per patient, reduces the length of hospital stay, reduces the number of total complications, and decreases mortality rate.[37]

(6) A subsequent study by Meybohm et al[36] used the data from Althoff et al[37] to conduct a thorough cost-benefit analysis of the financial benefit of implementing comprehensive Patient Blood Management programs through the previous meta-analysis. Sampling methods and interventions were the same as the aforementioned study. The cost of utilization of PBM interventions, such as cell salvage, tranexamic acid, and iron supplementation was $143.42 per patient. Patients under PBM had lower transfusion rates, decreased length of stay, and fewer units transfused in total. This yielded a savings of $174.05 per patient.[36] Overall, comprehensive implementation of PBM improves patient safety and is cost-effective.[36]

(7) There are many patient populations where emerging evidence continues to highlight the detrimental outcomes that may be associated with red blood cell transfusions; one population of particular concern are cancer patients. Wu et al[25] conducted a retrospective cohort study of colorectal cancer patients (n=4030) post-red blood cell transfusions to assess the recurrence of cancer and overall mortality. Records were reviewed with a median follow-up time of 46.1 months. Propensity score matching was used to mitigate difference in patient characteristics and

Cox regression analysis was utilized. Analysis demonstrated that red blood cell transfusions were associated with shorter disease-free status and lower overall mortality. Larger transfusion amounts were associated with even higher rates of overall mortality. The authors note that overall evidence oftentimes remains inconclusive, and the study supports measures aimed at minimizing and restricting transfusion thresholds.[25]

Patient Blood Management was first mentioned in 2008.[13] High-quality evidence on PBM, and restrictive transfusion protocols have primarily been published in the last 5 to 10 years.[2] The novelty of this multidisciplinary approach led Manzini et al[33] to conduct a multi-site cohort study assessing clinician knowledge on PBM principles and practices in 7 hospitals via a multi-site survey. A 39-item survey on PBM was created and sent to 7 hospitals in Europe. A Yates correct chi-squared test was used for analysis. The survey was sent to 4953 clinicians resulting in 788 (16%) responses. Participants included surgeons, anesthesia providers, and medical specialists. Notable results were that 24% of respondents did not associate preoperative anemia with perioperative morbidity and mortality. Half of the clinicians did not treat preoperative anemia, and of those who did treat, 38% chose to treat with red blood cell transfusion. Responses indicated poor knowledge of PBM based on the inconsistencies in the treatment of preoperative anemia.[33] This highlights the need to enhance understanding of PBM among healthcare providers.

Discussion

Summary of the Evidence

Recent studies have continued to emphasize the strong association between transfusions and adverse patient outcomes. Transfusions are a significant multiplier of morbidity and mortality in surgical patients when compared to non-transfused patients.[8] These morbidities

include the risk of transfusion-related infection, transfusion-related acute lung injury (TRALI), transfusion-related circulatory overload (TACO), anaphylactic reaction, intensive care unit admission, thromboembolic events, and hemolytic transfusion reactions.[9] Studies also suggest that the adverse effects of blood transfusion are dose dependent and that the reduction of the use of blood transfusions has also been associated with decreased length of hospitalization.[8 37] Additionally, emerging evidence also suggests that blood transfusions are significantly associated with increased cancer recurrence and promotes cancer progression.[25,26] The economic cost of blood transfusions is immense, and meta-analyses have revealed that PBM is a significant cost-saving measure if effectively implemented.[36]

Further intervention to enhance knowledge is needed and warranted for this significant patient quality concern and financial burden to health systems. To address these concerns, the literature supports the use of Patient Blood Management principles in the perioperative phase of surgical care. High-quality evidence supports the utilization of PBM in health systems to mitigate the associated detrimental risks and financial impact.

Some of these modalities include intravenous iron and erythropoietin, novel surgical techniques, cell savage, normovolemic hemodilution, restrictive transfusion thresholds, minimization of laboratory blood draws, and goal-directed coagulation algorithms.[2,9] The novelty of this multidisciplinary bundle denotes a likely knowledge deficit of PBM among healthcare providers. Of clinicians surveyed in one study, over half did not treat preoperative anemia. Of those who did treat, a significant portion (38%) treated with a blood transfusion, directly against the pillars of PBM.[33] A potential barrier to implementing PBM protocols is a lack of knowledge and information among providers; further intervention to enhance knowledge may be warranted.

Conclusion

Patient blood management is a practical, evidence-based, multidisciplinary approach that addresses the adverse sequelae and costs associated with inappropriate blood transfusion administration. Despite mounting evidence concerning the overuse of blood transfusions, they continue to be the most common medical procedure among inpatients in the United States. The literature reviewed assessed the main concerns surrounding the overuse of allogeneic blood transfusions and evidence supporting PBM implementation. Overall, it can be argued that blood transfusions prolong hospitalization, as well as lead to an increase in intensive care admissions, infections, thromboembolic events, morbidity and mortality, and are a significant patient quality concern and financial burden to health systems.

To address these concerns, the literature supports the use of PBM principles in the perioperative phase of surgical care. There continues to be a significant knowledge deficit regarding PBM among clinicians due to the novelty of the initiative. High-quality evidence supports the utilization of PBM in health systems to mitigate the associated detrimental risks and financial impact. The information obtained from this literature review lays the framework for a quality improvement (QI) project focusing on enhancing provider knowledge on the principles and practices of PBM.

Table 1: Summary of Literature Review

Author(s)	Purpose	Methodology/ Research Design	Intervention(s)/ Measures	Sampling/Setting	Primary Results	Relevant Conclusions
Althoff et al (2019)[37]	The purpose of this study was to determine the effectiveness of PBM implementation in reducing morbidity, mortality and improving clinical outcomes in patients throughout the perioperative period.	Systematic Review and Meta-analysis Level I	A search was done using the Cochrane Library and Medline Databases. Dates of publications ranged from 2000 to 2017. All studies included must address each of the three pillars of PBM.	17 studies were included with a large sample size of participants. (n= 235, 779). Pre-PBM implementation. (n = 100, 886) Post-PBM implementation. (n = 134, 893)	Implementation of PBM significantly reduces the incidence of transfusion by 39%. Decreased the number of RBC units transfused per patient, decreased length of hospital stay, decreased number of total complications, and decreased mortality rates.	The study further supports PBM implementation in all healthcare settings.
Ferraris et al (2015)[8]	This study sought to determine if there are an identifiable set of patient characteristics that are correlated with adverse patient outcomes and positive	Retrospective Observational Cohort Study Level III	Queried the American College of Surgeons National Surgical Quality Improvement Project database of patients who received blood within 72 hours of their operative procedure compared to those who did not receive blood, noting differences in	Sample size was large (n= 470,407). Data were pooled from patients between 2010 to 2012. The database excluded trauma and pediatric patients, the authors further excluded patients on cardiopulmonary	Of patients who received $\geq$ 1 allogeneic blood transfusion within 72 hours of surgery had a respective mortality or serious morbidity of 11.3% and 55.4%. Compared to non-transfused patients, associated mortality and morbidity was, 1.3% and 6.1%, respectively.	Improved preoperative assessment of transfusion risk profiles is needed for patients. The authors support the concept of limiting transfusions used to minimize operative risk. Blood transfusion practices widely vary across institutions, and further guidelines are

	patient outcomes when given an allogeneic blood transfusion.		morbidity and mortality.	bypass and aortic procedures. Surgeries included were cardiothoracic surgery, general surgery, neurosurgery, and vascular surgery. 30-day morbidity, mortality, and postoperative complications were measured.	There was a 300- 400% increase in morbidity and mortality for anemic patients who received a blood transfusion compared to non-transfused anemic patients. Patient considered to be low risk for adverse surgical outcomes has the highest mortality and morbidity rates of transfused patients. High-risk patients do not have significant risk when receiving blood transfusions.	needed to optimize patient outcomes.
Manzini et al (2018)[33]	This study assesses clinicians' knowledge of PBM principles and practices in 7 hospitals via a multi-site survey.	Multi-Site Cohort Study Level IV	A 39-item survey on PBM was created and sent to 7 hospitals in Europe. Yates correct chi-squared test was used for analysis.	Participants included surgeons, anesthesia providers, and medical specialists. The survey was sent to 4,953 clinicians resulting in 788 (16%) responses.	24% of respondents did not associate preoperative anemia with perioperative morbidity and mortality. Half of the clinicians did not treat preoperative anemia. And those who did treat, 38% chose to treat with red blood cell transfusion.	Responses indicated poor knowledge of PBM. There were inconsistencies on the treatment of preoperative anemia. Programs are needed to enhance knowledge on Patient Blood Management.
Meybohm et al (2020)[36]	The study sought to conduct a	Metanalysis Level I	All studies included must address each of	17 studies were included with a	The cost of utilization of cell salvage, TXA, and iron	Comprehensive implementation of PBM improves patient

	thorough cost-benefit analysis of the financial benefit of implementation of comprehensive PBM programs through meta-analysis		the three pillars of PBM. Endpoints measures include: transfusion rate, transfused units per patient, LOS, the total number of complications, and mortality.	large sample size of participants. (n= 235, 779) Pre-PBM implementation. (n = 100, 886) Post-PBM implementation. (n = 134, 893)	supplementation was €124.04 per patient. Patients under PBM have lower transfusion rates, decreased LOS, and less units transfused in total. This yielded a saving of €150.64 per patient. Overall cost savings was €21.60 per patient.	safety and is cost-effective.
Sadana et al (2018) [2]	This study reviewed the latest transfusion practice guidelines and evidence supporting these guidelines. The goal of this publication is to promote the utilization and development of PBM programs and provided specific methods for	Systematic Review Level I	31 studies were reviewed which compared restrictive versus liberal transfusion strategies.	All studies were RCTs and published in the last 10 years at the time of publication. Seven of the eight most cited trials were included, four of which were published in the last four years at the time of publication. (n=12, 587)	Red Blood cell transfusion is not indicated in hemodynamically stable patients with hemoglobin levels of 7 g/dl or greater. Transfusions are not indicated in orthopedic or cardiac surgery for patients with underlying cardiovascular disease with hemoglobin levels of 8 g/dl or greater.	The study supports the implementation of Patient Blood Management programs. The authors provide a blueprint for specific methods for optimizing transfusion practice which will lead to increase quality of care and reduced costs.

	optimal transfusion practices.					
Spahn et al (2020)[9]	The authors sought to affirm the use of PBM and summarize its clinical application throughout the perioperative periods, its limitations, and potential for future use.	Clinical Focused Review: Literature Review Level V	The articles summarize and synthesized the utilization of PBM in the preoperative, intraoperative, and postoperative periods and specified what interventions biometrics should be used to optimize patients, and provided a clinical framework for PBM.	The authors narrate the biometric values, tools, and interventions supported in PBM and detail the evidence to support their endorsement.	Blood transfusions are associated with prolonged hospitalization, intensive care admission, infection, thromboembolic events, and mortality. Preoperatively the literature suggests the use of IV iron and erythropoietin. Intraoperatively, measures such as reducing transfusion thresholds, novel surgical techniques, cell savage, and normovolemic hemodilution. Postoperatively, PBM endorses the use of restrictive transfusion thresholds, minimization of laboratory blood drawn, and goal-directed coagulation algorithms.	Patient blood Management reduced the utilization of allogeneic erythrocytes transfusions, associated negative sequelae, and costs.
Trentino et al (2020)[10]	This study aimed to synthesize the outcomes of	Systematic Review and Meta-analysis	The search utilized publications from 2008 to 2018. Databases used were	A total of 346 articles were screened. And 43 full-text articles	12 meta-analyses (75%) reported no difference in mortality between liberal	The authors support the utilization of restrictive transfusion thresholds

	restrictive and liberal transfusion strategies on patient mortality by reviewing systematic review and meta-analyses.	Level I	MEDLINE, Embase, Web of Science Core Collection, PubMed, Google Scholar, and the Joanna Briggs Institute EBP Database. Only systematic reviews and meta-analyses were included.	were assessed for eligibility. A final 19 studies were included in the qualitative synthesis.	and restrictive transfusion practices. 4 meta-analyses (25%) supported significantly lower mortality for patients where restrictive transfusion practices were utilized.	can be applied to most patient populations.
Wu et al (2018)[25]	This study retrospectively assessed the recurrence of and mortality among colorectal cancer patients who have red blood cell transfusion.	Retrospective Cohort Study Level IV	Patients records were evaluated for cancer outcomes focusing on postoperative overall survival and disease free status.	4,030 were reviewed with a median follow-up time of 46.1 months. Propensity score matching was used to mitigate difference in patient characteristics and cox regression analysis was utilized.	Analysis demonstrated that red blood cell transfusions were associated with shorter disease-free status and lower overall mortality. Larger transfusion amounts with associated with even higher rates of overall mortality.	The authors support strategies aiming at minimizing transfusion requirements.

Purpose/PICO Clinical Questions/Objectives

As a central aspect of improving the use of PBM in practice, results from the literature must be translated into a workable formula, in this case the purpose, PICO (population, intervention, comparison, outcome) clinical question, and objectives for the project must be spelled out. The purpose of this quality improvement project is to increase anesthesia provider knowledge of PBM. The PICO question to guide this project is therefore: In anesthesia providers (**P**), does the use of an educational module on Patient Blood Management (**I**), increase knowledge of perioperative PBM (**O**) when compared to before the educational intervention (**C**)?

Breaking down this question into its respective elements, the following can be seen:

- Population (P): Anesthesia Providers
- Intervention (I): Patient Blood Management educational module.
- Comparison (C): Pre-education knowledge level
- Outcomes (O): Improved provider knowledge of perioperative Patient Blood Management

Goals and Outcomes

The goal of this DNP project is to increase anesthesia provider knowledge on Patient Blood Management as a part of the standard of care. In the clinical site proposed for this project, there is currently no Patient Blood Management protocol. This project will be an important step in closing the knowledge gap on PBM and eventual improved competence in the proper utilization of allogeneic blood transfusions. The goals and objectives of this DNP project were guided by the Specific, Measurable, Attainable/Achievable, Relevant, and Timely (SMART) tool.[38]

Specific

Anesthesia Providers (Certified Registered Nurse Anesthetists and Physician Anesthesiologist) will be provided with an educational module on Patient Blood Management. Utilization of an educational module on PBM will improve knowledge and change behavior among anesthesia providers to optimize endogenous erythrocytes better, mitigate blood loss and bleeding, and treat anemia during the perioperative period.

Measurable

The effectiveness of the educational module on Patient Blood Management will be calculated through the analysis of a pre- and post-educational module questionnaire that will be provided to participants before and after the educational intervention. Outcomes will be measured by evaluation of the anesthesia provider's knowledge on PBM, the appropriate use of allogeneic blood transfusions, and awareness of the negative sequalae associated with blood transfusions utilization. Item analysis of the pre and post intervention questionnaire will be utilized for metrics.

Achievable

As a result of the provider education module, the development of which is guided by best andragogical techniques and evidence-based practice, anesthesia providers will have improved knowledge and awareness on PBM, proper utilization of blood transfusions, and be able to promote more restrictive transfusion practices. Attendance and demonstration of knowledge gained demonstrate the achieveable nature of this goal.

Realistic

Utilization of an educational module on PBM will improve knowledge levels and change behavior among anesthesia providers to optimize endogenous erythrocytes better, mitigate blood loss and bleeding, and treat anemia during the perioperative period.

Timely

The Patient Blood Management Educational module intervention will be created and implemented over the course of 6 months. Within 3 months afterwards, item analysis will occur of the pre and post questionnaire.

Program Structure

The development and implementation of the educational module on Patient Blood Management will require a collaborative effort. A comprehensive analysis will be conducted to accurately assess the needs and opportunities at the clinical site in order to guide the value, significance, and dissemination of the intervention.[38] A strength, weakness, opportunities, and threats (SWOT) analysis will be conducted to evaluate the internal and external characteristics and threats to the project's development.

SWOT Analysis

Strengths

Mount Sinai Medical Center in Miami Beach is Florida's largest private, independent, non-profit, teaching hospital.[39] It was ranked in the top 5% of hospitals in the United States for the year 2020/2021 and is the only Ivy League-affiliated hospital in South Florida.[39] Being a teaching hospital, Mount Sinai regularly integrates the latest evidence-based practice and encourages scholarly efforts, making it more readily adaptable and accepting to change. Miami Beach Anesthesiology Associates, Inc has coordinated all anesthesia services for Mount Sinai Medical Center since its inception in 1997.

Throughout its history, the group has trained hundreds of Student Registered Nurse Anesthetists and supported many through their doctoral theses, highlighting its unique ability to seamlessly integrate and support scholarly research. Currently, there are 30 Certified Registered

Nurse Anesthetists and 20 Physician Anesthesiologist employed at Mount Sinai Medical Center. This project has the support of key stakeholders at Mount Sinai. Carmen Chan DNP, CRNA, APRN will serve as the main clinical site advisor; she has been employed at the group since 2019. The Chief Nurse Anesthetist is Jampierre Mato DNP, CNRA, APRN, who serves as Executive CRNA Director of Miami Beach Anesthesiology Associates, has been in this position for over 13 years, and has trained over 500 student registered nurse anesthetists. He has several scholarly works published, has expressed support for this project and will facilitate in this project's implementation.

Weaknesses

Mount Sinai Medical Center currently has no PBM or bloodless surgery protocol. With any proposed change, resistance to said change will occur. There are approximately 50 anesthesia providers at Mount Sinai Medical Center. While the intention is to educate all anesthesia providers, there are time and logistical constraints that may impede in obtaining a sample size that will yield significant results.

At Mount Sinai Medical Center there are currently 30 Certified Registered Nurse Anesthetist, and 20 Physician Anesthesiologist, obtaining an adequate sample size for this intervention that will yield statistically significant results may be challenging. Lastly, Mount Sinai Medical Center only accepts a limited amount of Doctoral Nursing Practice projects for implementation each year, and there is a possibility this project will not be accepted for implementation and thus other avenues will need to be explored in the event of this occurrence.

PBM is intended as a multidisciplinary bundle and although anesthesia providers are paramount in the administration and the decision to transfuse red blood cells, surgeons, nurses, and other healthcare professionals should be involved to establish a comprehensive front in

addressing the problem. This project aims towards education anesthesia providers only and thus limiting its scope excludes other vital components of PBM. Additionally, certain PBM interventions, such as nutritional status optimization, would not be realistic in this clinical setting as anesthesia providers often do not see patients until the day of surgery. Mount Sinai Medical Center does not currently house a pre-evaluation of patients by anesthesia services before the day of surgery.

Opportunities

Mount Sinai Medical Center currently has no protocol on Patient Blood Management or Bloodless surgery techniques. The site has many of the resources to be able to conduct such interventional change. Additionally, the educational module has the support of the Chief Nurse Anesthetist. The novelty of this multidisciplinary bundle denotes a likely knowledge deficit of PBM among healthcare providers. Of clinicians surveyed in 1 study, over half did not treat preoperative anemia. Of those who did treat, a significant portion (38%) treated with a blood transfusion, directly against the pillars of PBM.[33] This denotes a further need. Mount Sinai is also a teaching hospital with staff that are likely to be receptive to such an intervention. To our knowledge no such intervention on Patient Blood management has been conducted by a previous doctoral student and there is no protocol in place for bloodless surgery or PBM.

Threats

Threats in a SWOT analysis are defined as any factor that may potentially hinder or interfere with the intervention's ability to achieve its desired objectives.[38] One of these includes resistance to change or deviation from the current standard of care. Additionally, Patient Blood Management is best implemented when presented as a full interdisciplinary bundle, but this

educational module intervention is intended to target only anesthesia providers and not the other components of PBM.

Other external factors include a potentially low response rate to the survey which could yield a small sample size that is not able to produce results of statistical significance. There is also the potential that many of the anesthesia staff are trained on how to utilize PRBCs appropriately and education on PBM may not be needed because they follow best practices. Conversely, some providers may be resistant to changing their practice on what they consider appropriate utilization of PRBCs.

Definition of Terms

For the purpose of this quality improvement project, the following terms have been defined:

- Allogenic blood: Involves 2 individuals of the same species, where the donor and recipient are 2 separate individuals.
- Autologous blood: Blood deriving from the same individual, where donor blood and the recipient is the same person.
- Bloodless surgery: Specialized surgical service that provides alternative modalities of treatment for patients for whom blood transfusions are not possible i.e., Jehovah's Witnesses.
- Patient Blood Management**:** According to the Society for the Advancement of Patient Blood Management, PBM is defined as "the timely application of evidence-based medical and surgical concepts designed to maintain hemoglobin concentration, optimize hemostasis and minimize blood loss in an effort to improve patient outcome."[37]

- Restrictive Transfusion Practices: Practices that help guide the utilization of blood transfusions on multiple patient factors rather than the sole "trigger" of low hemoglobin levels.

Conceptual Underpinning and Theoretical Framework of the Project

The conceptual framework of this project is based on Kotter's change model, which is a set of sequential steps designed to establish and sustain organizational change. The 8 steps of this process are: to create a sense of urgency that the change is needed, form a strong guiding coalition of leaders, define a clear vision for the change, communicate the vision to obtain buy-in, empower action by removing obstacles, generate short-term wins, immediately build on the short-term successes, and anchor the change in the organizational culture.[40] Kotter's model has been time-tested over several decades, as well as shown to be effective and is the leading contemporary model of institutional change.

Kotter's model focuses on steps that will lead to change, particularly those pertinent to this educational module, including establishing a sense of urgency, creating a coalition, developing a vision, and empowering a base of people to take action. These steps can be introduced through information dissemination in the educational module and should foster a culture of change in relation to blood administration among anesthesia providers.

Patient blood management is a practical, evidence-based, multidisciplinary approach that addresses the adverse sequelae and costs associated with inappropriate blood transfusion administration. There continues to be a significant knowledge deficit regarding PBM among clinicians, due to the novelty of the initiative. High-quality evidence supports the utilization of PBM in health systems to mitigate the associated detrimental risks and financial impact. The information obtained from the 8 studies lay the framework for a quality improvement (QI)

project focusing on enhancing provider knowledge on the principles and practices of Patient Blood Management. Following this intervention, additional QI initiatives may be warranted to continue improvement on PBM in this facility, as ingraining a change in practice takes time and Kotter's change model provides a systematic flow to define, implement, and secure that changes are sustainable.

Methodology

Setting and Participants

This study will take place at Mount Sinai Medical Center with the private anesthesia group Miami Beach Anesthesiology Associates, LLC. There are a total of 50 anesthesia providers; 20 are Physician Anesthesiologists, and 30 are Certified Registered Nurse Anesthetists. The practice is located in Miami Beach, Florida.

Description of Approach and Project Procedures

The DNP project will commence by asking anesthesia providers at Mount Sinai Medical Center to participate in the study. A pre- and post-test design will be used to measure PBM knowledge and competency. Data collected before the educational intervention will include demographic information, provider's degree, and years in practice.

A team of expert stakeholders will be identified, with the goal of assessing and improving anesthesia provider's knowledge on Patient Blood Management. The expert stakeholders will guide the development of the pre- and post-intervention questionnaire and the development of the educational module intervention. Participants will be first provided with the pre-intervention assessment tool to measure their knowledge on appropriate utilization of PBM, such as optimization of endogenous erythrocytes, mitigation of blood loss and bleeding, and effectively treating anemia. Next, the participants will be provided with an educational intervention

addressing the core tenants of Patient Blood Management. The intervention will be conducted through a PowerPoint presentation through in-services. After the intervention, participants will then take an additional questionnaire that will assess their post-educational knowledge of the intervention, with results then analyzed.

Protection of Human Subjects

All providers who participate in the educational module will be invited to do so via email or in person. Should the Institutional Review Board (IRB) deem that this study poses more than minimal risk, participants will be further presented with a HIPPA compliant survey platform for consent. Participants have the right to refuse consent for participation at any point.

Benefits of participation include potential improvement of knowledge and competence around the topic of Patient Blood Management. All data will be de-identified; however, due to the sample size of the project it is possible that participants may be recognized through indirect identifiers. All data will be protected through password-encrypted databases only accessible to the co-investigator.

Data Collection

Data to be collected will include information such as years providers have been practicing, education, and if they are familiar with PBM. A 21-item survey will be used to assess providers current knowledge level of PBM prior to the educational module intervention. Higher scoring individuals will indicate a higher level of competence in Patient Blood Management. Items will be scored on with multiple choice and select all that apply questions. After the intervention, individuals will be asked to take the questionnaire again to assess for changes in knowledge.

Data Management and Analysis Plan

Data will be stored in an electronic database to which only the co-investigator will have access. No direct identifiers will be collected, and results will be reported as aggregate data. Scores will be compared pre- and post-intervention.

Discussion of the Results with Implications to Advanced Nursing Practice

A hypothesis yielding valid results would have positive implications for the intervention. It would imply that an educational module on PBM is an effective way to enhance knowledge with the potential to reduce overutilization of blood transfusions. Educational modules have been effective in enhancing knowledge among healthcare providers on various topics.[34,35] Utilization of an educational module on PBM will improve knowledge and change behavior among anesthesia providers to optimize endogenous erythrocytes better, mitigate blood loss and bleeding, and treat anemia during the perioperative period. This will then reduce the adverse outcomes and costs associated with allogenic blood transfusions among all surgical patients. Conversely, a hypothesis yielding negative results could mean that the educational module was inadequate, or that the anesthesia providers may have already had adequate knowledge on PBM principles. Following this intervention, next steps can be identified where the greatest need for improvement may be identified such as outlining a PBM protocol or initiation of a scenario-based assessment tool of when providers would choose to transfuse or not. This will be dependent on results from the survey.

Timeline

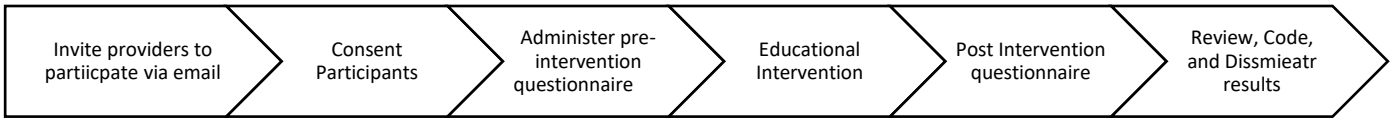
To further increase operationalization of the proposed DNP project, a timeline for the completion of significant activities that are related to the project is included below, an overview of the key activities necessary for the completion of this project, along with the time frame in

which each specific activity will be completed. All project components will be completed over the next 12 months starting in January 2022 with a target completion date of December 2022.

Project Tasks

1. Develop the education intervention
2. Develop the Patient Blood Management questionnaire
3. Choose an electronic database
4. If needed – write consent
5. Request IRB approval
6. Create and send study invitation
7. Administer pretest questionnaires
8. Perform educational intervention
9. Administer posttest
10. Review and code provider progress notes
11. Analyze data

Project Timeline



RESULTS

Demographics

A total of 10 CRNAs participated in the study. Demographics of the participants were 8 females, and 2 males, with ages ranging from 27 to 63. Of those who participated 7 held a doctoral degree in anesthesia, 2 masters degrees, and 1 bachelors degree. Ethic makeup included 2 Caucasian, 1 African American, 2 Asians, 4 Hispanics, and 1 who self identified as "other". Response rate to both the pre and post intervention questions was 100%.

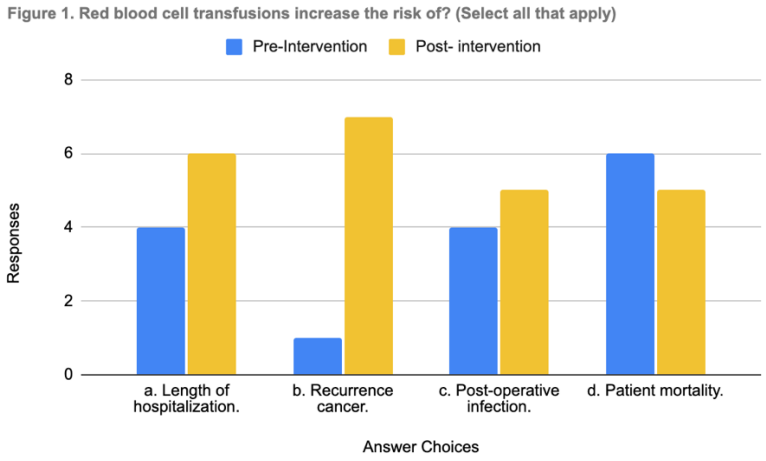
Table 1. Participant demographic data (N=10)

Characteristics		**Participants**
Gender, n (%)	Male	2 (20%)
	Female	8 (80%)
Age, n (%)	20-29	2 (20%)
	30-39	2 (20%)
	40-49	4 (40%)
	50-59	1 (10%)
	60+	1 (10%)
Ethnicity, n (%)	African American	1 (10%)
	Asian	2 (20%)
	Caucasian	2 (20%)
	Hispanic	4 (40%)
	Other	1 (10%)
Level of Education, n (%)		
	Bachelors	1 (10%)
	Masters	2 (20%)
	Doctorate	7 (70%)

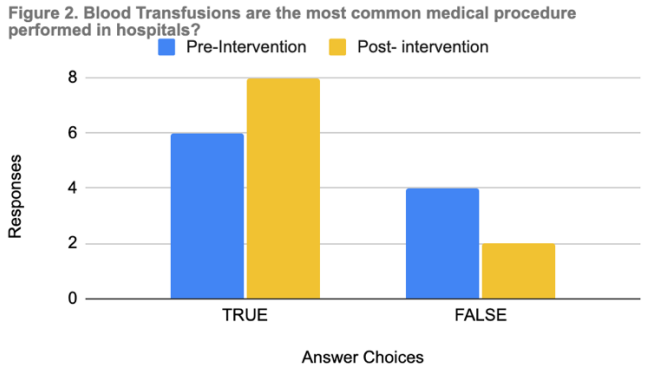
Pre and Post Test Questionnaire

Item 1 (Figure 1) was a select all that apply question which stated: "Red blood cell transfusions increase the risk of?" All responses were correct. Pre-intervention, 4 responses stated they increased the length of hospitalization, 1 respondent correctly identified they increase

the recurrence of cancer, 4 responses stated increase the risk of post-operative infections, and 6 responses indicated they increase patient mortality overall. In the post-intervention questionnaire, 6 responses stated they increased the length of hospitalization, 7 respondent correctly identified they increase the recurrence of cancer, 5 responses stated increase the risk of post-operative infections, and 5 responses indicated they increase patient mortality overall.

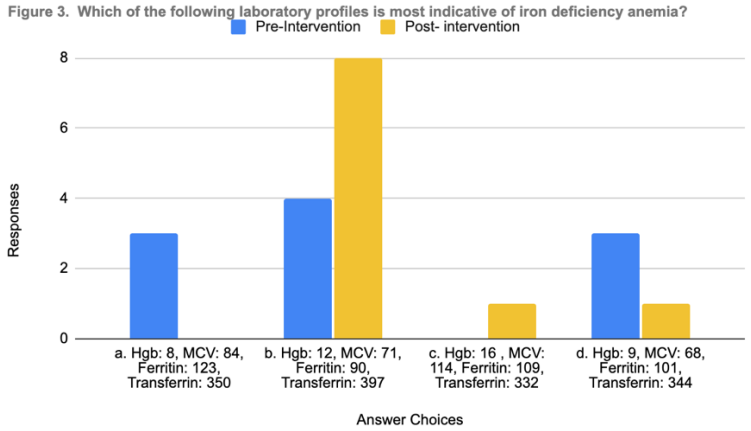


Item 2 (Figure 2) was a true and false question which stated: “Blood Transfusions are the most common medical procedure performed in hospitals?” True was the correct response. Pre-intervention, 6 responses were true, and 4 were false. In the post-intervention questionnaire 8 respondents answered true, and 2 answered false.

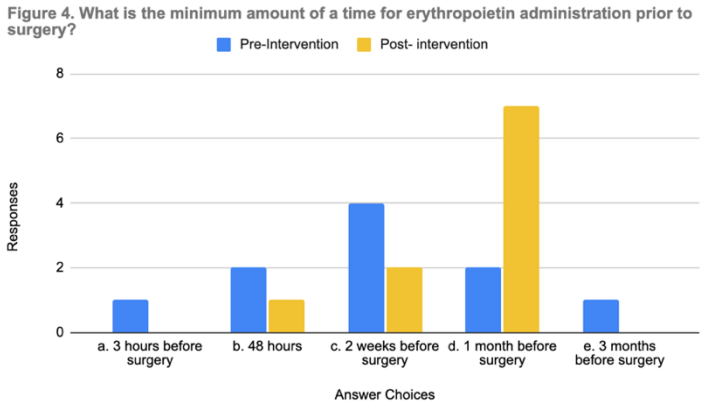


Item 3 (Figure 3) was a multiple-choice question which stated: “Which of the following laboratory profiles is most indicative of iron deficiency anemia?” Answer Choice B “Hgb: 12,

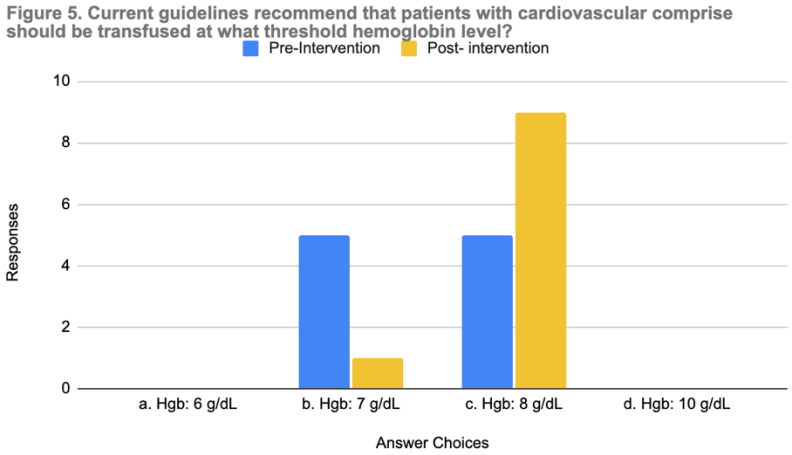
MCV: 71, Ferritin: 90, Transferrin: 397" was the correct response. Pre-intervention, 3 respondent selected A, 4 correctly selected answer choice B, no respondents selected answer choice C, and 3 selected answer choice D. In the post-intervention questionnaire, 0 respondents selected A, 8 correctly selected answer choice B, 1 respondent selected answer choice C, and 1 selected answer choice D.



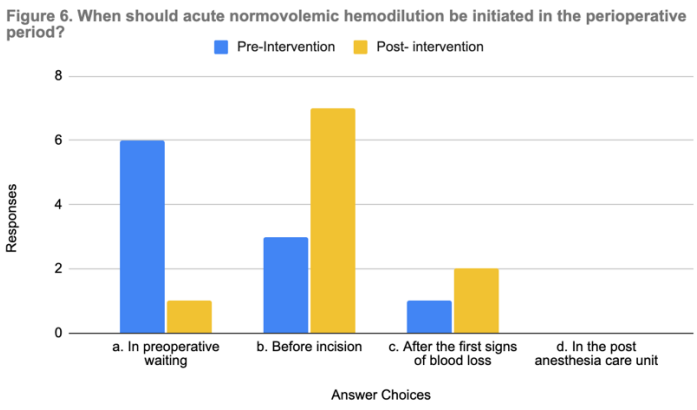
Item 4 (Figure 4) was a multiple-choice question which stated: "What is the minimum amount of a time for erythropoietin administration prior to surgery?" Answer Choice D " 1 month before surgery" was the correct response. Pre-intervention, 1 respondent selected A, 2 selected answer choice B, 4 respondents selected answer choice C, and 2 selected correctly selected answer choice D, and 1 respondent selected answer choice E. In the post-intervention questionnaire, 0 respondents selected A, 1 selected answer choice B, 2 respondents selected answer choice C, 7 selected answer choice D, and no respondents selected answer choice E.



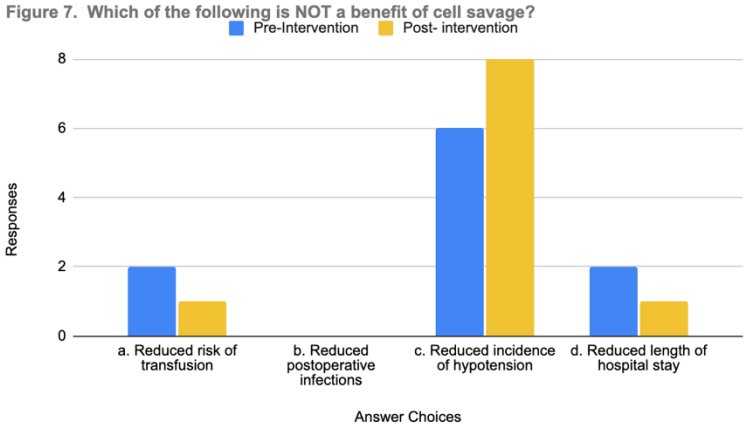
Item 5 (Figure 5) was a multiple-choice question which stated: “Current guidelines recommend that patients with cardiovascular comprise should be transfused at what threshold hemoglobin level?” Answer Choice C “Hgb: 8 g/dL” was the correct response. Pre-intervention, 0 respondents selected A, 5 selected answer choice B, 5 respondents correctly selected answer choice C, and 0 selected answer choice D. In the post-intervention questionnaire, 0 respondents selected A, 1 selected answer choice B, 9 respondents selected answer choice C, 0 selected answer choice D.



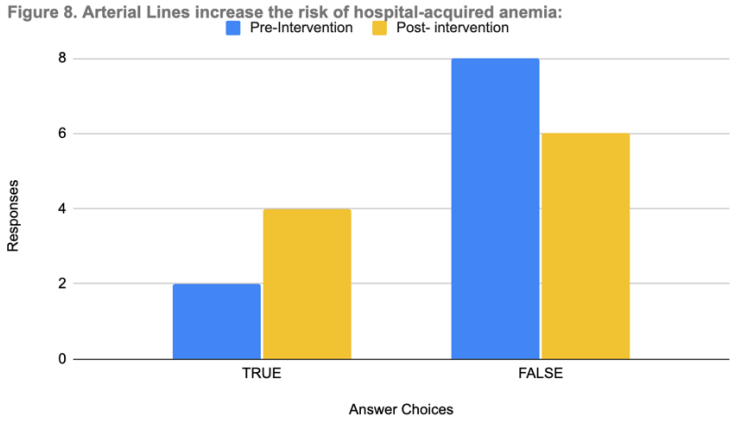
Item 6 (Figure 6) was a multiple-choice question which stated: “When should acute normovolemic hemodilution be initiated in the perioperative period?” Answer Choice B “Before incision” was the correct response. Pre-intervention, 6 respondents selected A, 3 correctly selected answer choice B, 1 respondent selected answer choice C, and 0 selected answer choice D. In the post-intervention questionnaire, 1 respondent selected A, 7 selected answer choice B, 2 respondents selected answer choice C, 0 selected answer choice D



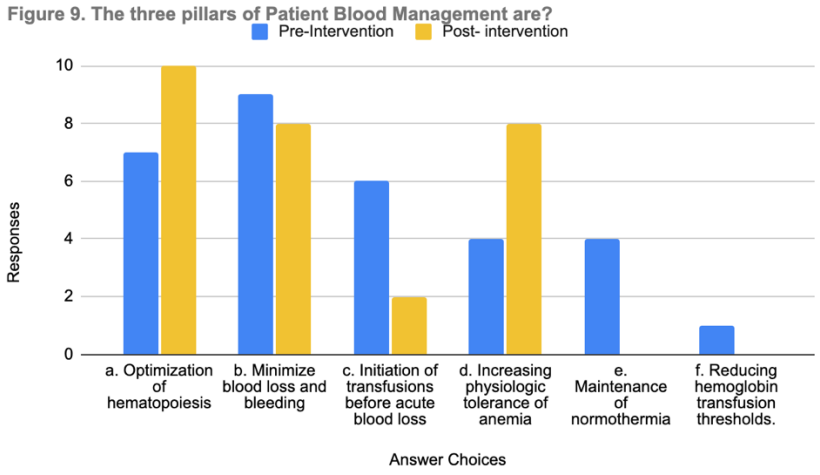
Item 7 (Figure 7) was a multiple-choice question which stated: “Which of the following is NOT a benefit of cell savage?” Answer Choice C “Reduced incidence of hypotension” was the correct response. Pre-intervention, 2 respondents selected A, 0 selected answer choice B, 6 respondent correctly selected answer choice C, and 2 selected answer choice D. In the post-intervention questionnaire, 1 respondent selected A, 0 selected answer choice B, 8 respondents selected answer choice C, 1 selected answer choice D.



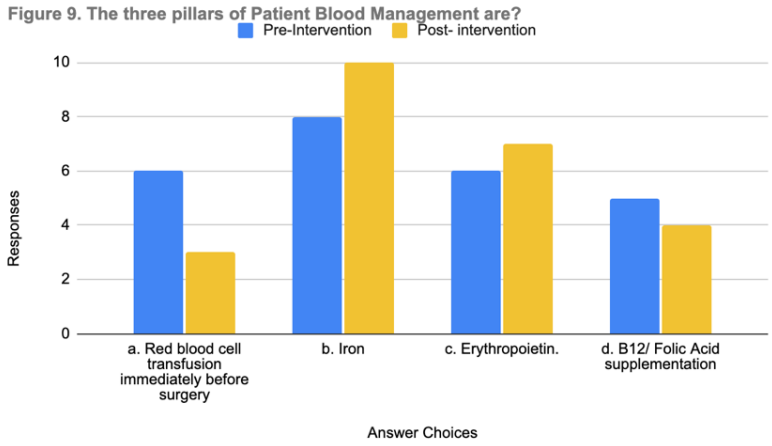
Item 8 (Figure 8) was a true and false question which stated: “Arterial Lines increase the risk of hospital-acquired anemia” True was the correct response. Pre-intervention, 2 responses were answered true, and 8 were false. In the post-intervention questionnaire 4 respondents answered true, and 6 answered false.



Item 9 (Figure 9) was a select all that apply question which stated: “The three pillars of Patient Blood Management are?” Answers A (Optimization of hematopoiesis), B (Minimize Blood Loss and Bleeding) , and D (Increasing physiologic tolerance of anemia) were correct. Pre-intervention, 7 responses stated optimization of hematopoiesis, 9 respondents selected minimize blood loss and bleeding, 6 responses selected initiation of transfusions before acute blood loss, 4 responses selected increasing physiologic tolerance of anemia, 4 responses selected maintenance of normothermia, and 1 response selected reducing hemoglobin transfusion thresholds. In the post-intervention questionnaire, 10 responses correctly stated optimization of hematopoiesis, 8 respondents correctly selected minimize blood loss and bleeding, and 8 responses correctly selected increasing physiologic tolerance of anemia.



Item 10 (Figure 10) was a multiple-choice question with multiple answers were possible which stated: “Which of the following pre-operative treatments for anemia would you offer?” Pre-intervention, 6 respondents selected A, 8 selected answer choice B, 6 responses were answer choice C, and 5 selected answer choice D. In the post-intervention questionnaire, 3 respondent selected A, 10 selected answer choice B, 7 respondents selected answer choice C, 4 selected answer choice D



Aggregated pre and post-test results were compiled (Table 2). The pre-test for the purpose of determining each clinician's baseline knowledge was delivered prior to the PowerPoint Presentation and it was identical to the Post-Test at the conclusion of the project. The post-test was presented after the educational module, and it was meant to determine if any learning had occurred and if clinicians would willing to implement PBM principles into their own anesthetic practice. All participants attained a higher score when compared to their performance on the pre-test. Furthermore, 10 (100%) of clinicians claimed that they would be willing to apply what they learning into their own practice.

Table 2. Pre and Post Test Results

Participant	Pre-Test Score	Post-Test Score
#1	4/10 (40%)	8/10 (80%)
#2	5/10 (50%)	10/10 (100%)
#3	3/10 (30%)	7/10 (70%)
#4	2/10 (20%)	8/10 (80%)
#5	5/10 (50%)	6/10 (60%)
#6	1/10 (10%)	10/10 (100%)
#7	3/10 (30%)	9/10 (90%)
#8	6/10 (60)%)	9/10 (90%)
#9	5/10 (50%)	9/10 (90%)
#10	4/10 (40%)	10/10 (100%)

Discussion

The educational modules significant positive results. All participants attained higher scores on the post-test when compared to the pre-test. On average, outcomes improved by 203.3%. The number of clinicians that would be "willing" to incorporate PBM into their perioperative management was 100%. Pre-test scores also denote a significant deficit of knowledge among anesthesia providers regarding Patient Blood Management, highlighting the need for implementation of patient blood management education and programs. This educational intervention was able to improve anesthesia provider knowledge and competence in Patient Blood Management in its limited sample. However, the sample size was small and limited to one anesthesia group.

Limitations

The most significant limitation of this study is its small sample size of 10 participants. A total of 40 CRNAs were solicited for participation, and 10 took part of in the study. Another limitation was that all interaction was web-based. Not only can an email invitation be easily overlooked, but also there is no guarantee that partakers would complete the online module without distractions.

Conclusion

The extensive literature review has shown that Patient Blood Management has great potential to prevent negative sequalae associated with allogenic blood transfusions. However, the novelty of this multidisciplinary bundle and the state of the current national blood supply denotes the importance of, and likely knowledge deficit of, PBM among healthcare providers.

A common barrier cited to implementing PBM protocols is a lack of knowledge and information among providers The educational module carried out by the author of this scholarly paper demonstrated that anesthesia providers are willing to learn new ways for the perioperative management of allogenic blood transfusions. It also demonstrated that they are open to adjusting their clinical practice in pursuit of the best possible patient outcomes. It is worthwhile to conduct future research on PBM with a focus on implementation of a PBM program. New standardized guidelines could help decrease the incidence of morbidity and, and decrease healthcare costs.

References

1. Frank SM, Savage WJ, Rothschild JA, et al. Variability in blood and blood component utilization as assessed by an anesthesia information management system. *Anesthesiology*. 2012;117(1):99-106. doi:10.1097/ALN.0b013e318255e550

2. Sadana D, Pratzer A, Scher LJ, et al. Promoting high-value practice by reducing unnecessary transfusions with a patient blood management program. *JAMA Intern Med*. 2018;178(1):116-122. doi:10.1001/jamainternmed.2017.6369

3. Gombotz H, Rehak PH, Shander A, Hofmann A. Blood use in elective surgery: the austrian benchmark study. *Transfusion (Paris)*. 2007;47(8):1468-1480. doi:10.1111/j.1537-2995.2007.01286.x

4. Colin Hemez. Blood transfusion costs. Yale Global Health Review. Published December 21, 2016. Accessed September 10, 2021. https://yaleglobalhealthreview.com/2016/12/21/blood-transfusion-costs/

5. Shander A, Fink A, Javidroozi M, et al. Appropriateness of allogeneic red blood cell transfusion: the international consensus conference on transfusion outcomes. *Transfus Med Rev*. 2011;25(3):232-246.e53. doi:10.1016/j.tmrv.2011.02.001

6. Pfuntner A, Wier LM. *Most Frequent Procedures Performed in US. Hospitals, 2010*. Agency for Healthcare Research and Quality; 2013:9. https://www.hcup-us.ahrq.gov/reports/statbriefs/sb149.pdf

7. World Health Organization. Blood safety and availability. Published June 10, 2020. Accessed September 11, 2021. https://www.who.int/news-room/fact-sheets/detail/blood-safety-and-availability

8. Ferraris VA, Hochstetler M, Martin JT, Mahan A, Saha SP. Blood transfusion and adverse surgical outcomes: the good and the bad. *Surgery*. 2015;158(3):608-617. doi:10.1016/j.surg.2015.02.027

9. Spahn DR, Muñoz M, Klein AA, Levy JH, Zacharowski K. Patient blood management: effectiveness and future potential. *Anesthesiology*. 2020;133(1):212-222. doi:10.1097/ALN.0000000000003198

10. Trentino KM, Farmer SL, Leahy MF, et al. Systematic reviews and meta-analyses comparing mortality in restrictive and liberal haemoglobin thresholds for red cell transfusion: an overview of systematic reviews. *BMC Med*. 2020;18(1):154. doi:10.1186/s12916-020-01614-w

11. Campbell YN, Machan MD, Fisher MD. The jehovah's witness population: considerations for preoperative optimization of hemoglobin. *AANA J*. 2016;84(3):173-178.

12. Goodnough LT, Shander A, Riou B. Patient blood management. *Anesthesiology*. 2012;116(6):1367-1376. doi:10.1097/ALN.0b013e318254d1a3

13. Spahn DR, Moch H, Hofmann A, Isbister JP. Patient blood management: the pragmatic solution for the problems with blood transfusions. *Anesthesiology*. 2008;109(6):951-953. doi:10.1097/ALN.0b013e31818e3d75

14. Gombotz H, Hofman A, Rehak P, Kurz J. patient blood management (part 2). Practice: the 3 pillars. *Anasthesiologie Intensivmed Notfallmedizin Schmerzther AINS*. 2011;46(7-8):466-474. doi:10.1055/s-0031-1284465

15. American Red Cross. US blood supply facts. Published 2021. Accessed September 11, 2021. https://www.redcrossblood.org/donate-blood/how-to-donate/how-blood-donations-help/blood-needs-blood-supply.html

16. Jiménez J. There's a 'severe blood shortage' in the US, red cross says. *The New York Times*. https://www.nytimes.com/2021/06/23/health/blood-supply-crisis.html. Published June 23, 2021. Accessed September 11, 2021.

17. Sapiano MRP, Jones JM, Savinkina AA, Haass KA, Berger JJ, Basavaraju SV. Supplemental findings of the 2017 national blood collection and utilization survey. *Transfusion (Paris)*. 2020;60(S2):S17-S37. doi:10.1111/trf.15715

18. Bureau UC. By 2030, all baby boomers will be age 65 or older. The United States Census Bureau. Published December 10, 2019. Accessed September 11, 2021. https://www.census.gov/library/stories/2019/12/by-2030-all-baby-boomers-will-be-age-65-or-older.html

19. Le Calvé S, Somme D, Prud'homm J, Corvol A. Blood transfusion in elderly patients with chronic anemia: a qualitative analysis of the general practitioners' attitudes. *BMC Fam Pract*. 2017;18:76. doi:10.1186/s12875-017-0647-8

20. Satyavarapu A, Wagle D. Improving the fragile US supply of blood. Published September 15, 2020. https://www.mckinsey.com/industries/public-and-social-sector/our-insights/improving-the-fragile-us-supply-of-blood

21. Jenkins I, Doucet JJ, Clay B, et al. Transfusing wisely: clinical decision support improves blood transfusion practices. *Jt Comm J Qual Patient Saf*. 2017;43(8):389-395. doi:10.1016/j.jcjq.2017.04.003

22. Janssen SJ, Braun Y, Wood KB, Cha TD, Schwab JH. Allogeneic blood transfusions and postoperative infections after lumbar spine surgery. *Spine J*. 2015;15(5):901-909. doi:10.1016/j.spinee.2015.02.010

23. Kim JL, Park JH, Han SB, Cho IY, Jang KM. Allogeneic blood transfusion is a significant risk factor for surgical-site infection following total hip and knee arthroplasty: a meta-analysis. *J Arthroplasty*. 2017;32(1):320-325. doi:10.1016/j.arth.2016.08.026

24. Leahy MF, Hofmann A, Towler S, et al. Improved outcomes and reduced costs associated with a health-system–wide patient blood management program: a retrospective

observational study in four major adult tertiary-care hospitals. *Transfusion (Paris)*. 2017;57(6):1347-1358. doi:10.1111/trf.14006

25. Wu HL, Tai YH, Lin SP, Chan MY, Chen HH, Chang KY. The impact of blood transfusion on recurrence and mortality following colorectal cancer resection: a propensity score analysis of 4,030 patients. *Sci Rep*. 2018;8(1):13345. doi:10.1038/s41598-018-31662-5

26. Atzil S, Arad M, Glasner A, et al. Blood transfusion promotes cancer progression: a critical role for aged erythrocytes. *Anesthesiology*. 2008;109(6):989-997. doi:10.1097/ALN.0b013e31818ddb72

27. Kacker S, Frick KD, Tobian AAR. The costs of transfusion: economic evaluations in transfusion medicine. *Transfusion (Paris)*. 2013;53(7):1383-1385. doi:10.1111/trf.12188

28. International Foundation for Patient Blood Management. *Why Change the Paradigm?*; no date. https://www.ifpbm.org/knowledge/videos/paradigm-video

29. Kaserer A, Rössler J, Braun J, et al. Impact of a patient blood management monitoring and feedback programme on allogeneic blood transfusions and related costs. *Anaesthesia*. 2019;74(12):1534-1541. doi:10.1111/anae.14816

30. Committee on Patient Blood Management. Pandemics and patient blood management. American Society of Anestheologist. Published July 12, 2021. Accessed September 11, 2021. https://www.asahq.org/in-the-spotlight/coronavirus-covid-19-information/pandemics-and-patient-blood-management

31. Shander A, Goobie SM, Warner MA, et al. Essential role of patient blood management in a pandemic: a call for action. *Anesth Analg*. Published online April 20, 2020:10.1213/ANE.0000000000004844. doi:10.1213/ANE.0000000000004844

32. Delaforce A, Duff J, Munday J, Hardy J. Overcoming barriers to evidence-based patient blood management: a restricted review. *Implement Sci*. 2020;15(1):6. doi:10.1186/s13012-020-0965-4

33. Manzini PM, Dall'Omo AM, D'Antico S, et al. Patient blood management knowledge and practice among clinicians from seven european university hospitals: a multicentre survey. *Vox Sang*. 2018;113(1):60-71. doi:10.1111/vox.12599

34. Abu Farha R, Abu Hammour K, Rizik M, Aljanabi R, Alsakran L. Effect of educational intervention on healthcare providers knowledge and perception towards pharmacovigilance: a tertiary teaching hospital experience. *Saudi Pharm J*. 2018;26(5):611-616. doi:10.1016/j.jsps.2018.03.002

35. Mohd Mydin FH, Yuen CW, Othman S. The effectiveness of educational intervention in improving primary health-care service providers' knowledge, identification, and anagement of elder abuse and neglect: a systematic review. *Trauma Violence Abuse*. Published online December 11, 2019:1524838019889359. doi:10.1177/1524838019889359

36. Meybohm P, Straub N, Füllenbach C, et al. Health economics of patient blood management: a cost-benefit analysis based on a meta-analysis. *Vox Sang*. 2020;115(2):182-188. doi:10.1111/vox.12873

37. Althoff FC, Neb H, Herrmann E, et al. Multimodal patient blood management program based on a three-pillar strategy: a systematic review and meta-analysis. *Ann Surg*. 2019;269(5):794-804. doi:10.1097/SLA.0000000000003095

38. Moran K, Burson R, Conrad D. *The Doctor of Nursing Practice Project: A Framework for Success*. 3rd ed. Jones and Bartlett Learning; 2020.

39. Mount Sinai Medical Center. About Mount Sinai Medical Center. Mount Sinai Medical Center. Published 2021. Accessed December 11, 2021. https://www.msmc.com/about-msmc/our-story/

40. White KM, Dudley-Brown S, Terhaar MF. *Translation of Evidence Into Nursing and Healthcare*. Springer Publishing Company, LLC; 2019.

Appendix A: Recruitment Letter

Nicole Wertheim College of Nursing and Health Sciences
Department of Nurse Anesthetist Practice

Improving Anesthesia Provider Knowledge and Competence in Patient Blood Management

Dear Mount Sinai Medical Center Anesthesia Provider:

My name is Eduardo Subero, and I am a student from the Anesthesiology Nursing Program Department of Nurse Anesthetist Practice at Florida International University. I am writing to invite you to participate in my quality improvement project. The goal of this project is to improve health care provider knowledge on the use of Patient Blood Management and its evidence based alternative approaches to minimize perioperative packed red blood cells (PRBC) transfusions. You are eligible to take part in this project because you are a member of the Anesthesia Department in Mount Sinai Medical Center.

If you decide to participate in this project, you will be asked to complete and sign a consent form for participation. Next, you will complete a pre-test questionnaire, which is expected to take approximately 5 minutes. You will then be asked to view an approximately 15 minute long educational presentation online. After watching the video, you will be asked to complete the post-test questionnaire, which is expected to take approximately 5 minutes. No compensation will be provided.

Remember, this is completely voluntary. You can choose to be in the study or not. If you'd like to participate or have any questions about the study, please email or contact me at esube003@fiu.edu or 941-979-0991

Thank you very much.

Sincerely,

Eduardo Subero, SRNA, BSN, CCRN

Appendix B: Informed Consent

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CONSENT TO PARTICIPATE IN A QUALITY IMPROVEMENT PROJECT

Improving Anesthesia Provider Knowledge and Competence in Patient Blood Management

SUMMARY INFORMATION
Things you should know about this study:

- **Purpose:** Educational module to improve knowledge in utilizing Patient Blood Management concepts as means minimize perioperative packed red blood cells (PRBC) transfusions.
- **Procedures**: If you choose to participate, you will be asked to complete a pretest watch a voice PowerPoint and then a post test
- **Duration:** This will take about a total of 20 minutes total.
- **Risks**: The main risk or discomfort from this research is minimal. There will be minimal risks involved with this project, as would be expected in any type of educational intervention, which may have included mild emotional stress or mild physical discomfort from sitting on a chair for an extended period of time, for instance.
- **Benefits:** The main benefit to you from this research is increase the participants knowledge in utilizing evidence-based alternative to minimize perioperative packed red blood cells (PRBC) transfusions.
- **Alternatives:** There are no known alternatives available to you other than not taking part in this study.
- **Participation:** Taking part in this research project is voluntary.

Please carefully read the entire document before agreeing to participate.

PURPOSE OF THE PROJECT
You are being asked to be in a quality improvement project. The goal of this project is to improve health care provider knowledge on the use of Patient Blood Management in order to reduce the utilization of red blood cell transfusions.

DURATION OF THE PROJECT
Your participation will require about 20 minutes of your time.

PROCEDURES
If you agree to be in the project, we will ask you to do the following things:
If you agree to be in the study, we will ask you to do the following things:
1. Complete an online 10 question pre-test survey via Qualtrics, an Online survey product for which the URL link is provided
2. Review the educational PowerPoint Module lasting 10 minutes via Qualtrics, an Online survey product for which the URL link is provided.

3. Complete the online 10 question post-test survey via Qualtrics, an Online survey product for which the URL link is provided.

RISKS AND/OR DISCOMFORTS
The main risk or discomfort from this research is minimal. There will be minimal risks involved with this project, as would be expected in any type of educational intervention, which may have included mild emotional stress or mild physical discomfort from sitting on a chair for an extended period of time, for instance.

BENEFITS
The following benefits may be associated with your participation in this project: An increased understanding on the Patient Blood Management.
The overall objective of the program is to increase the quality of healthcare delivery and improve healthcare outcomes for our patients.

ALTERNATIVES
There are no known alternatives available to you other than not taking part in this project. However, if you would like to receive the educational material given to the participants in this project, it will be provided to you at no cost.

CONFIDENTIALITY
The records of this project will be kept private and will be protected to the fullest extent provided by law. If, in any sort of report, we might publish, we will not include any information that will make it possible to identify you as a participant. Records will be stored securely, and only the project team will have access to the records.

PARTICIPATION: Taking part in this research project is voluntary.

COMPENSATION & COSTS
There is no cost or payment to you for receiving the health education and/or for participating in this project.

RIGHT TO DECLINE OR WITHDRAW
Your participation in this project is voluntary. You are free to participate in the project or withdraw your consent at any time during the project. Your withdrawal or lack of participation will not affect any benefits to which you are otherwise entitled. The investigator reserves the right to remove you without your consent at such time that they feel it is in the best interest.

RESEARCHER CONTACT INFORMATION
If you have any questions about the purpose, procedures, or any other issues relating to this research project, you may contact Eduardo Subero at 941-979-0991 at esube003@fiu.edu and Arturo Gonzalez at 305-975-7774/ artgonza@fiu.edu

IRB CONTACT INFORMATION
If you would like to talk with someone about your rights pertaining to being a subject in this project or about ethical issues with this project, you may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu.

PARTICIPANT AGREEMENT
I have read the information in this consent form and agree to participate in this study. I have had a chance to ask any questions I have about this study, and they have been answered for me. By clicking on the "consent to participate" button below I am providing my informed consent.

Appendix C: Letter of Support

Miami Beach Anesthesiology Associates, Inc.

Mount Sinai Medical Center • Division of Anesthesia

S. Howard Wittels MD
Chairman

Hector Davila MSS, MD
Executive Director

Guillermo Garcia MD
Vice Chairman

Rick Hasty MD

Sebastian Baquero MD

Christopher Bauer MD

Vicente Behrens MD

Jayanand D'Mello MD
Research Coordinator

Laura Foster MD

Pablo Fumero MD

Pedro Garcia MD

Howard Goldman MD
Obstetrics Chief

Jason Hoyos DO
Residency Program
Co-Assistant Director

Flor Marin MD

Gerald Rosen MD
Residency Program
Director

Jason Wigley MD
Residency Program
Co-Assistant Director

Alexander Volsky MD

Jennifer Wright MD

J.P. Mato DNP, CRNA
CRNA Director & SRNA
Coordinator

Paula Schultz DNP, CRNA
OB-Chief CRNA

February 1, 2022

Dr. Arturo Gonzalez, DNP, APRN, ANP-BC, CWCN-AP
Assistant Professor
Florida International University

Dr. Gonzalez,

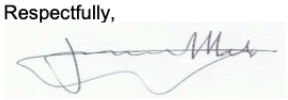
Thank you for inviting Mount Sinai Medical Center to participate in Doctor of Nursing Practice (DNP) project conducted by Eduardo Subero entitled "Improving Anesthesia Provider Knowledge and Competence in Patient Blood Management: An Educational Module" in the Nicole Wertheim College of Nursing and Health Sciences, Department of Nurse Anesthesiology at Florida International University. I have given the student permission to conduct the project using our providers.

Evidence-based practice's primary aim is to yield the best outcomes for patients by selecting interventions supported by the evidence. This proposed quality improvement project seeks to investigate and synthesize the latest evidence.

We understand that participation in the study is voluntary and carries no overt risk. All Division of Anesthesia providers are free to participate or withdraw from the study at any time. The educational intervention will be conveyed by a 15-minute virtual PowerPoint presentation, with a pretest and posttest questionnaire delivered by a URL link electronically via Qualtrics, an online survey product. Responses to pretest and posttest surveys are not linked to any participant. The collected information is reported as an aggregate, and there is no monetary compensation for participation. All collected material will be kept confidential, stored in a password encrypted digital cloud, and only be accessible to the investigators of this study: Eduardo Subero and Dr. Gonzalez.

Once the Institutional Review Board's approval is achieved, this scholarly project's execution will occur over two weeks. Eduardo Subero will behave professionally, follow standards of care, and not impede hospital performance. We support the participation of our Division of Anesthesia providers in this project and look forward to working with you.

Respectfully,



Jampierre (J.P.) Mato, DNP, CRNA, APRN
Executive CRNA Director
SRNA Coordinator/Supervisor
Electronic Mail: Jampierre@bellsouth.net
Mobile Phone: 954-668-6080

4300 Alton Road, Suite 2454, Miami Beach, FL 33140
Office (305) 674-2742 • Facsimile (305) 674-9723

Appendix D: IRB Approval

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Office of Research Integrity
Research Compliance, MARC 414

MEMORANDUM

To:	Dr. Arturo Gonzalez
CC:	Eduardo Subero
From:	Elizabeth Juhasz, Ph.D., IRB Coordinator EJ
Date:	April 11, 2022
Protocol Title:	**"Improving Anesthesia Provider Knowledge and Competence in Patient Blood Management"**

The Florida International University Office of Research Integrity has reviewed your research study for the use of human subjects and deemed it Exempt via the **Exempt Review** process.

IRB Protocol Exemption #:	IRB-22-0147	**IRB Exemption Date:**	04/11/22
TOPAZ Reference #:	111542		

As a requirement of IRB Exemption you are required to:

1) Submit an IRB Exempt Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved prior to implementation.
2) Promptly submit an IRB Exempt Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.
3) Submit an IRB Exempt Project Completion Report Form when the study is finished or discontinued.

Special Conditions: N/A

For further information, you may visit the IRB website at http://research.fiu.edu/irb.

EJ

Appendix E: CITI Certificate

Completion Date 12-Jan-2022
Expiration Date 11-Jan-2025
Record ID 46601569

This is to certify that:

Eduardo Subero

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Basic/Refresher Course - Human Subjects Research
(Curriculum Group)
Social/Behavioral Human Research Course
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Florida International University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wf3f06d09-126a-43a9-82dc-5e1b78fc4ff7-46601569

Appendix F: Florida Association of Nurse Anesthesiology Poster Presentation

Reducing Negative Outcomes Associated with Blood Transfusions by Utilization of a System Wide Patient Blood Management System: A Review of the Latest Evidence

Eduardo Subero, MSN, RN, CCRN; Arturo Gonzalez DNP, APRN-BC, ANP-C, CWCN-AP; Yasmine Campbell, DNP, CRNA, APRN

Introduction

- Blood transfusions are overprescribed in elective surgeries.[1–5]
- In the United States, blood transfusions are the most common medical procedure performed in hospitals, totaling 30 million units of blood transfused yearly.[4]
- Growing consensus affirms that blood transfusions are overutilized, result in poor outcomes in surgical patients when administered prematurely or unnecessarily, and are a significant financial burden to health systems.[1]
- Allogeneic blood transfusions are crucial life-saving interventions for perioperative management when used appropriately.
- There is an apparent lack of guidelines for ordering blood transfusions during the perioperative period.[1]
- The use of blood transfusions should be based on safety, efficacy, and quality of treatment in perioperative management.
- This evidence-based review aims to increase nurse anesthesiologists' knowledge of blood alternatives and patient blood management.

Purpose

- Analyze literature featuring Patient Blood Management (PBM) utilization and efficacy in reducing unnecessary allogenic blood transfusions.
- This evidence-based review aims to increase nurse anesthesiologists' knowledge of blood alternatives and patient blood management.

Clinical Significance

- **Over Utilization**: Blood transfusions are the most common medical procedure performed in hospitals.[1]
- **Inappropriate Use**: Only 12% of transfusions are administered appropriately.[2]
- **Limited Supply**: In in January 2022, the Red Cross declared a national blood crisis for the first time. [3]
- **Financial Costs**: $10 Billion cost to the US Healthcare system.[4]
- **Poor Outcomes**: Major multiplier of morbidity and mortality in surgical patients.[5]

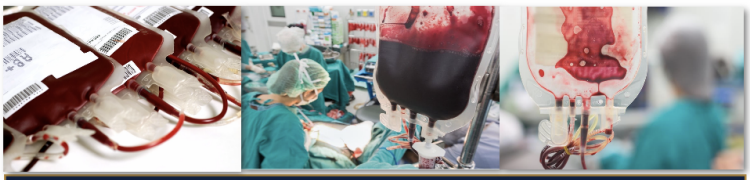
Methodology

- An expansive analysis was conducted as facilitated by MEDLINE, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL).
- **Keywords**: Patient Blood Management, Bloodless Surgery, Perioperative, restrictive transfusion strategy, and anesthesia provider.
- **Inclusion criteria:**
  - Literature published since 2015.
  - Full text articles.
  - Adult population.

Study Designs:

- Systematic review/ meta-analyses, cohort studies, clinical focus review.
- N = 8

FIU Nurse Anesthesiology
Florida International University



PICO Question

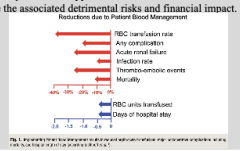
(P) In adult surgical patients (I) does an educational module on the utilization of Patient Blood Management as a guideline to reduce inappropriate allogenic red blood cell transfusions (C) versus no educational module (O) increase anesthesia provider knowledge and attitudes in utilization Patient Blood Management strategies?

Literature Review

Author	Purpose	Design	Conclusion
Althoff et al. (2019)	• The purpose of this study was to determine the effectiveness of PBM implementation in reducing morbidity, mortality and improving clinical outcomes in patients throughout the perioperative period.	• Systematic Review and Meta-analysis • Level I • 17 studies were included with a large sample size of participants (n= 235, 779).	• PBM significantly reduces the incidence of transfusion by 39%. • Decreased the number of RBC units transfused per patient, length of hospital stay, and number of total complications, and decreased mortality rates.
Ferraris et al (2015)	• This study sought to determine if there are an identifiable set of patient characteristics that are correlated with adverse patient outcomes and positive patient outcomes when given an allogeneic blood transfusion.	• Retrospective Observational Cohort Study • Level III • Sample size was large (n= 470,407). • Data were pooled from patients between 2010 to 2012. The database excluded trauma and pediatric patients, the authors further excluded patients on cardiopulmonary bypass.	• > 1 allogeneic blood transfusion within 72 hours of surgery had a respective mortality or serious morbidity of 11.3% and 55.4%. Compared to non-transfused patients, associated mortality and morbidity was, 1.3% and 6.1%, respectively. • Patient considered to be low risk for adverse surgical outcomes has the highest mortality and morbidity rates of transfused patients.
Manzini et al (2018)	• This study assesses clinicians' knowledge of PBM principles and practices in 7 hospitals via a multi-site survey.	• Multi-Site Cohort Study • Level IV • Participants included surgeons, anesthesia providers, and medical specialists. • The survey was sent to 4,953 clinicians resulting in 788 (16%) responses.	• 24% of respondents did not associate preoperative anemia with perioperative morbidity and mortality. • Half of the clinicians did not treat preoperative anemia. And those who did treat, 38% chose to treat with red blood cell transfusion.
Meybohm et al (2020)	• The study sought to conduct a thorough cost-benefit analysis of the financial benefit of implementation of comprehensive PBM programs through meta-analysis	• Metanalysis • Level I • 17 studies were included with a large sample size of participants (n= 235, 779).	• PBM yielded a saving of €150.64 per patient. Overall savings were €21.60 per patient. • Patients under PBM have less transfusions, decreased LOS, and less units transfused in total.
Sadana et al (2018)	• This study reviewed the latest transfusion practice guidelines and evidence supporting these guidelines. The goal of this publication is to promote the utilization and development of PBM programs and provided specific methods for optimal transfusion practices.	• Systematic Review • Level I • All studies were RCTs and published in the last 10 years at the time of publication. Seven of the eight most cited trials were included, four of which were published in the last four years at the time of publication (n=12, 587).	• Red Blood cell transfusion is not indicated in hemodynamically stable patients with hemoglobin levels of 7 g/dl or greater.
Spahn et al (2020)	• The authors sought to affirm the use of PBM and summarize its clinical application throughout the perioperative periods, its limitations, and potential for future use.	• Clinical Focused Review: Literature Review • Level V • The authors narrate the biometric values, tools, and interventions supported in P3M and detail the evidence to support their endorsement.	• Preoperatively, suggests the use of IV iron and erythropoietin. • Intraoperatively, measures such as reducing transfusion thresholds, novel surgical techniques, cell savage, and normovolemic hemodilution. • Postoperatively, endorses the use of restrictive transfusion thresholds, minimization of laboratory blood drawn, and goal-directed coagulation algorithms.
Trentino et al (2020)	• This study aimed to synthesize the outcomes of restrictive and liberal transfusion strategies on patient mortality by reviewing systematic review and meta-analyses.	• Systematic Review and Meta-analysis • Level I • A final 19 studies were included in the qualitative synthesis.	• 12 meta-analyses (75%) reported no difference in mortality between liberal and restrictive transfusion practices. • 4 meta-analyses (25%) supported significantly lower mortality for patients where restrictive transfusion practices were utilized.
Wu et al (2018	• This study retrospectively assessed the recurrence of and mortality among colorectal cancer patients who have red blood cell transfusion.	• Retrospective Cohort Study. Level IV • 4,030 were reviewed with a median follow-up time of 46.1 months. Propensity score matching was used to mitigate difference in patient characteristics and cox regression analysis was utilized.	• Analysis demonstrated that red blood cell transfusions were associated with shorter disease-free status and lower overall mortality. Larger transfusion amounts with associated with even higher rates of overall mortality.

Results

- **Blood transfusions increase/prolong:**
  - Hospitalization,
  - Intensive care admissions,
  - Infections,
  - Thromboembolic events,
  - Morbidity and mortality,
  - Financial burden to health systems.
- High-quality evidence supports the utilization of PBM in health systems to mitigate the associated detrimental risks and financial impact.

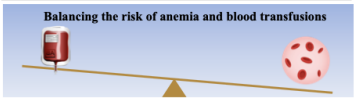


Clinical Recommendations

- **Iron and Erythropoietin**
  - PO for surgeries greater than 6 weeks away, IV Iron for surgeries < 6 weeks
  - EPOP at least 4 week before surgery
- **Hemoglobin Thresholds**
  - **Hgb > 10g/dL**: No transfusion needed.
  - **Hgb 8g/dL:** Patient with cardiac comprise likely to benefit from transfusion.
  - **Hgb 7 g/dl:** Transfusion may not be required in well compensated patients.
- **TXA and Aminocaproic Acid**
  - Can be preventative in cardiac, spine practice, large total joint procedures, or liver surgery.
  - Hyperfibrinolysis is common in surgical, and trauma patients and associated with poor outcomes.
- **Normovolemic Hemodilution**
  - Start before incision.
  - Minimizes loss of "good" RBCs.
  - Reinfuse RBCs after surgical insult.
- **Cell Savage**
  - Applicable to vascular, OBGYN, orthopedic, and urological surgeries.
  - Decreases infections, transfusions, and LOS.
- **Phlebotomy**
  - 50 ml of blood draws increases anemia risk by 15%.
  - Discontinue arterial lines when no longer needed for clinical monitoring

Conclusion

- Patient Blood Management has great potential to prevent negative sequalae associated with allogenic blood transfusions.
- The novelty of PBM and the state of the current national blood supply denotes the importance of, and likely knowledge deficit of, PBM among anesthesia providers.
- New standardized guidelines could help decrease the incidence of morbidity and, and decrease healthcare costs.



References

References available upon request
Contact: Eduardo Subero, esube003@fiu.edu