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Massive Blood Transfusion Practises: A Survey Of Level 1 Trauma Centers

Rebecca C. Parker
Southern Adventist University

MASSIVE BLOOD TRANSFUSION PRACTISES:

A SURVEY OF LEVEL 1 TRAUMA CENTERS

by

Rebecca Catherine Parker

Frances Johnson, DNP, APRN, NNP-BC, Scholarly Project Advisor

Beth Scott, Ph.D., MSN, RN, Scholarly Project Second Reader

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Abstract

Background: Traumatic injury is the leading cause of death for individuals under the age of 45 years old, regardless of race, origin, or sex (CDC, 2019). Among patients who sustain traumatic injury, hemorrhage remains the leading cause of death (American College of Surgeons [ACS], 2014). Hemodynamic stability may be achieved through administration of blood products such as packed red blood cells (PRBC), plasma, and platelets (PTL). Patients with severe exsanguination may require administration of blood products in large quantities, also known as a massive blood transfusion (MBT).

Local Problem: Nationally, traumatic injury accounts for over 150,000 deaths annually (American Association for the Surgery of Trauma, 2020). Management of MBT at trauma facilities as well as massive transfusion protocols (MTP) vary among trauma centers. While traumatic injury and exsanguination remains a burden on the healthcare system, there is no standardized approach to facilitate administration of MBT. Hypocalcemia can result as citrate is used as a preservative in blood products, causing chelation of endogenous calcium and placing the patient at risk for tetany, cardiac arrythmias, acidosis, worsening coagulopathy, and death.

Intervention: To evaluate how level 1 trauma facilities manage MBT, to determine if a protocol is utilized, and to evaluate perceptions and experiences related to MBT practice, a qualitative study was performed. Utilizing interpretive description, a survey was administered to healthcare providers working within either the trauma department or blood bank.

Results: Massive transfusion protocol (MTP) initiation and MBT administration vary across the board. The approach to laboratory management as well as calcium monitoring and replacement is highly variable among level 1 trauma centers.

Conclusion: Evaluating how level 1 trauma centers manage MBT practices has shown the need for further research to promote the development of a standardized MTP with the goal of improving outcomes among trauma patients.

Search Terms: Massive blood transfusion, massive transfusion protocol, hemorrhagic shock, MBT and trauma, MBT and hypocalcemia.

Dedication

I would first like to dedicate this work to my mother, without whom I would not be here today. Your love and support have carried me through the most difficult times in my life and your resilience and dedication to motherhood has given our family an incredible life. I am forever grateful for what you have done for us mom. You are my true hero and I love you. I am eternally grateful God gave me to be yours.

I would also like to dedicate this project to my amazing dad. I know that no matter what I do in this life, you will be my biggest fan. I can count on you to be proud of me no matter what. Without you, I would not have made it this far. You are consistently there for me when I need you and never fail to show up. You are a light in my life, and I love you so much. I am forever proud that you are my dad.

To my sister Rachel, you are my inspiration. I can say with certainty that if it were not for you, I would never have accomplished what I have. You are the reason I became a nurse. My desire to be in the medical field has always been because of you. I want you to know that you are at the heart of what I do. You are beautiful, brave, strong, and the best person and friend I have ever known. I love you more than words can express.

To my baby sister Sarah, without whom I would not know true friendship and happiness. You are the best friend a sister could have, and I would not have made it this far if you were not here. I cannot imagine a moment in my life that I wouldn't want and need you by my side. Thank you for everything you have done for me and for always supporting me. I love you more than life.

Lastly, I want to dedicate this scholarly project in memory of my grandmother, Sue Stuart. I miss you every day and know that you would be proud of me if you were still with us. I love you, Nana.

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Chapter 1: Introduction

Hemorrhage is the most common cause of death within the first hour of a patient arriving at a trauma facility. An alarming fact is that almost 50% of deaths occur within the first 24 hours of injury. These deaths are almost always attributed to exsanguination and coagulopathy (American College of Surgeons [ACS], 2014). Ultimately, the goal is hemodynamic stability. Thus, the administration of blood products such as packed red blood cells (PRBCs), platelets (PLT), fresh frozen plasma (FFP), or whole blood products will often be required. In cases of massive hemorrhage or in patients at risk for exsanguination, trauma teams will commonly initiate what is known as massive blood transfusion (MBT).

Massive blood transfusion, historically defined as >/= 10 units of packed red blood cells (RBCs) in <24 hours' time, does not have a standardized definition (Jennings & Watson, 2021). A more recently used description of MBT is either three units of PRBCs in one hour, or any combination of four blood component units in thirty minutes (Hess, 2020). Hence, there remains a practice problem which will be explored and discussed within this project. Even though this paper will focus on the trauma patient population, there are implications for many areas within healthcare where patients may experience massive hemorrhage or are at risk for exsanguination.

As evidenced by the various definitions used to describe MBT, there is a gap in the literature and potentially in the practice of MBT administration. This scholarly project aims to evaluate MBT protocols and how they are utilized at various level 1 trauma care facilities in the United States (U.S.). Provider's experiences within the practice of MBT administration will be examined along with how calcium levels are evaluated and managed during this process.

Background and Significance

Unintentional injury is the leading cause of death for individuals between the ages of 1 and 44 years and is the fourth leading cause of death for individuals of all ages in the United States (US) (Centers for Disease Control and Prevention [CDC], 2020). In 2017, the third overall cause of death for males of all ages, race, and origin were attributed to injury, while for females it was the sixth overall cause of death, and the most common cause of death for both males and females of all race and origin under the age of 45 (CDC, 2019). Traumatic injuries account for over 150,000 deaths annually and more than three million non-fatal injuries each year in the US (American Association for the Surgery of Trauma, 2020). In patients with traumatic injuries, hemorrhage is the leading cause of death and accounts for fatality in up to 40% of these injuries (Jones & Frazier, 2017).

Compelling events such as war often result in penetrating or blunt trauma with massive hemorrhage. Early research during times of active combat demonstrated the need for damage control resuscitation. Damage control resuscitation can be described as a method to provide rapid hemorrhage control by early administration of blood products in a 1:1:1 ratio of plasma to platelets to red blood cells (Holcomb et al., 2015).

Military practices for management of massive hemorrhage are dependent upon type of injury, state of health of the patient, availability of blood products, and additional provider and facility factors (Hsu et al., 2016). Concerns such as availability of blood products, facility resources, and patient specific factors must also be considered when practicing at civilian trauma care facilities. Availability of blood products will vary among institutions, but it should be acknowledged that even if a small number of patients require administration of an MBT, it will still utilize a large amount of blood products at the facility. An estimated 3% to 5% of civilian

trauma patients and 10% of military trauma patients will receive a massive transfusion (Jennings & Watson, 2021), however these patients will end up utilizing up to 70% of the blood supply that is stored at that hospital (ACS, 2014).

The practice of damage control resuscitation is what helped to form what is commonly referred to as MBT and as rates of traumatic injury have increased, these practices have been used in civilian settings as well (Holcomb et al., 2015).

Massive blood transfusion, while lifesaving, does not come without risk. Increased mortality risk after blood transfusion can be attributed to multiple factors, including coagulation abnormalities, immunosuppression, lung injury, and hypothermia (Guerado et al., 2016). Further risks include electrolyte abnormalities, for example, hypocalcemia. Patients who present with blood loss are already at a high risk for experiencing hypocalcemia, and MBT can further exacerbate this problem, as is seen in previous studies (Ditzel et al., 2019). Citrate is used in stored blood products as an anticoagulant and is necessary for the safety and efficacy of these products. This citrate binds to endogenous calcium, chelating calcium from the body, resulting in hypocalcemia, placing the patient at risk for adverse effects such as tetany, cardiac dysrhythmias, neuronal irritation, and coagulopathy (Byerly et al., 2020).

There is a concept within trauma that is known as the “lethal triad of trauma”, a term that is used to describe three potential conditions associated with traumatic injuries. They include acidosis, hypothermia, and coagulopathy. While this lethal triad is well studied and well understood, there is additional sequela to trauma that should not be overlooked, including electrolyte derangements such as hypocalcemia (De Robertis et al., 2015). Hypocalcemia in the patient receiving MBT can further exacerbate trauma-induced coagulopathy and places the patient at an increased risk for mortality (Ditzel et al., 2019). Delays in recognizing

hypocalcemia in patients receiving greater than ten units of PRBCs in 24 hours, three units of PRBCs in one hour, or four units of any blood product in thirty minutes can lead to progression from hypocalcemia to severe hypocalcemia. Early recognition and management of hypocalcemia can decrease the risk of worsening coagulopathy, acidosis, neuronal irritation, tetany, cardiac arrhythmias, and ultimately, mortality.

Problem Statement, Purpose, and Project Inquiry (question)

Despite the need for massive blood transfusion among the trauma population, and massive transfusion protocols existing at individual facilities, there is currently no standardized approach to managing these patients. For example, European guidelines for the management of major bleeding and coagulopathy in trauma patients recommend following one of two strategies to manage a massive transfusion; the first is to provide fresh frozen plasma (FFP) to RBCs in a ratio of at least 1:2 or to provide a dose of fibrinogen concentrate with RBC's transfused (Spahn et al., 2019). These guidelines state that while some studies show evidence for administering equal ratios of RBCs to plasma to platelets, there is additional strong evidence to give factor concentrates such as fibrinogen, as the initial line of coagulation resuscitation and recommend the use of goal directed resuscitation measures utilizing laboratory coagulation values (Spahn et al., 2019). In contrast, many institutions in the U.S. follow the Trauma Quality Improvement Guidelines (TQIP) set forth by the American College of Surgeons (ACS), which recommend that plasma and RBCs be transfused in ratios between 1:1 and 1:2, with 1 pooled or single doner apheresis platelet given per 6 units of RBCs (ACS, 2014). In the TQIP guidelines, laboratory testing is recommended to start in the ICU and includes international normalized ratio (INR), activated partial thromboplastin time (aPTT), Fibrinogen, Platelets, hemoglobin & hematocrit (H&H), ionized calcium (iCa++), arterial blood gas (ABG), and point of care (POC) testing to

include thromboelastography (TEG) and rotational thromboelastography (ROTEM) while the transfusion ratio of 1:1 or 1:2 continues (ACS, 2014).

The differences between these two sets of guidelines highlights the lack of standardization across the board for MBT. For example, one concern with the TQIP guidelines includes the lack of recommending laboratory testing or point of care testing be done upon initiation of MBT. This protocol was last updated in 2014, which may mean that newer evidence exists on optimal management of patients receiving MBT. Development of a standardized approach (protocols) for the treatment and management of MBT may be used to ensure consistency of patient care and utilization of current best practices.

Clinical Question

P: Population of Interest: Level 1 Trauma Care Facilities who would utilize MBT's to treat trauma patients in need

I: Intervention: Survey to evaluate the how MBTs are managed

C: Comparison of Interest: Other level 1 trauma centers throughout the U.S. regarding MBT management

O: Outcome of Interest:

1. To discover how facilities manage massive blood transfusions
2. To discover if a protocol is being utilized for this practice
3. To explore perceptions and experiences related to this practice
4. To evaluate calcium management during MBT

The purpose of this project is to evaluate how level I trauma care facilities manage MBT and if a protocol is being utilized, as well as to evaluate perceptions and experiences related to

the efficacy of MBT practice. In addition, this study aims to examine the processes which are used to evaluate and manage calcium levels during MBT.

Theoretical Framework

To create change in the current standard of care for patients receiving MBT it is of paramount importance that the full scope of the problem be presented and understood by the intended audience. Learning theories can provide a useful framework for promoting learning and the advancement of education.

The Cognitive Load Theory of Learning explains that the mind's ability to store new information is based on two basic underpinnings, short term memory and long-term memory (Schilling, 2016). The way that information is delivered is crucial to the individual's ability to learn and to the mind's ability to store information.

Extraneous information, intrinsic information, and germane cognitive processing influence cognitive load (Schilling, 2016). By understanding how the mind interprets this information and stores it into either working (short term) or long-term memory, we can better present information to utilize a higher intrinsic cognitive load and increase the efficiency of learning.

Intrinsic information is known as essential information and is typically not presented in isolation, but rather with elements that require interactivity. The degree of cognitive load that this type of information requires depends on both the nature of the information as well as the complexity of it (Schilling, 2016). This study aims to use the Cognitive Load Theory by presenting the information gained in this study to the learners, i.e., trauma physicians, advanced practice providers, blood bank personnel, and trauma team personnel, by introducing the new knowledge gained with a rehearsal of key elements. It is the goal that the full scope of the

information gained in this study will be understood by the audience. This will be accomplished by provision of written material detailing the outcomes of this study. Ultimately, the end goal of this DNP project is to articulate a need for evidence informed MBT practice change that establishes a standardized protocol.

The Neuman Systems Model was adopted for this DNP project to help define the framework. This theory was a logical choice related to the invasion of a structural line of defense that surrounds the individual. Within this model, the individual is composed of variables. These variables include physiological, psychological, sociocultural, developmental, and spiritual. The individual's core contains what is known as the survival factor which is protected by lines of defense that surround it (Hannoodee & Dhamoon, 2020). Breakdown of these lines of defense occur as stressors are introduced into the individual's environment. This can be seen in the case of a critical bleeding patient as primary prevention has failed and the trauma team is required to initiate a secondary prevention of damage by finding ways to mitigate the risk of hemorrhage.

In a healthy individual, the flexible line of defense is intact, but in the case of a traumatic accident which has caused trauma, this defense has been broken and resistance lines must be triggered to achieve reconstitution. Reconstitution is the attempt for stabilization in an individual whose resistance line has been broken (Hannoodee & Dhamoon, 2020). In the case of massive blood loss, this is accomplished by stopping the bleeding and by repletion of the blood loss. This study will also use the Neuman Systems model to outline and explain how preventing and treating hypocalcemia in patients receiving MBT will allow for reconstitution of these flexible lines of defense and provide the patient with the optimal chance for survival.

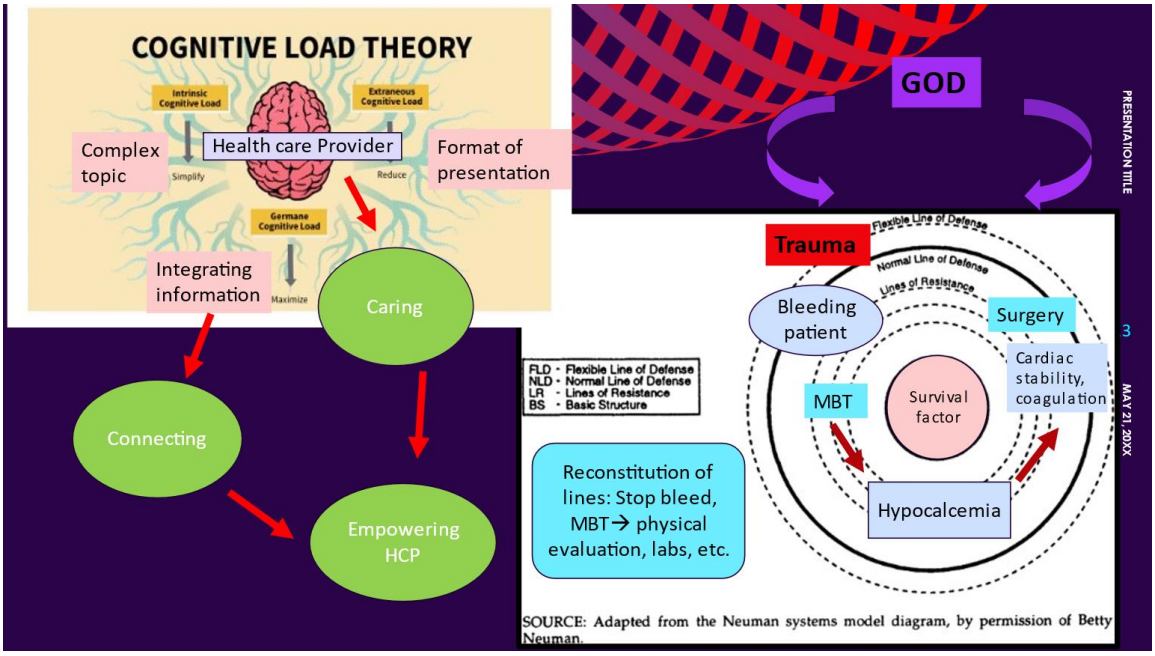
In the setting of trauma and for a patient receiving MBT, these flexible lines of defense will require delicate balancing. As a reaction to the stressor, i.e., the traumatic event, healthcare

providers initiate MBT. Throughout the course of this, many interventions will take place to maintain the line of defense and help achieve reconstitution. Interventions include things such as drawing labs, evaluating hemodynamic stability, and physical evaluations of the patient. In the setting of this study, because of the stressor and the reaction, patients may experience hypocalcemia because of the initial intervention. Without reversing hypocalcemia, the patient is placed at further risk for damage in their line of defense as calcium is integral in maintaining many physiological processes including cardiac stability and normalizing coagulopathy.

The Seventh Day Adventist Model will be included as this framework encompasses a whole person foundation for treating the individual. As providers we are responsible to care for each individual as a complex unit, influenced by their environment and ultimately surrounded by God, who is all encompassing of life. Caring will be achieved through this study by aiming to prevent morbidity and mortality for trauma patients with critical bleeding. Connecting will be accomplished by connecting the healthcare provider with evidence-based knowledge that will hopefully affect change in practice. Empowering healthcare providers in trauma services will be achieved by presenting them with the information and tools needed to mitigate potentially catastrophic side effects of MBT. Putting into practice the concepts of caring, connecting, and empowering will create an environment in which the patient is most likely to thrive and achieve the optimal outcome.

Figure 1 (Appendix F):

Theoretical Framework



Definition of Terms

Hypocalcemia

Hypocalcemia is typically defined as total calcium <2.1 mmol/L or an ionized calcium (iCa++) <1.1 mmol/L (Leung, 2019). If using a total calcium level to determine true hypocalcemia, albumin must also be measured and factored into the equation (4 – serum albumin x 0.8 + total calcium level), to achieve a corrected calcium (Leung, 2019). In a review of the literature regarding MBT and hypocalcemia, severe hypocalcemia, with iCa++ levels of <0.90 mmol/L, is noted as an increased risk factor for mortality (Ditzel et al., 2019).

Level I Trauma Care Facility

Trauma centers are not only verified by the American College of Surgeons (ACS) but also by designated municipalities which may vary from state to state (American Trauma Society [ATS], 2022) and are verified separately from pediatric trauma care facilities. To become a level

1 trauma facility, the hospital must show that they have the resources needed to provide the optimal level of care to a trauma patient as well as provide proof that the hospital has the capability for teaching and research toward trauma care (ATS, 2022). Capabilities such as 24-hour surgery and coverage to include care specialties such as neurosurgery, orthopedic surgery, critical care, plastic surgery, anesthesiology, internal medicine, emergency medicine, radiology, and oral/maxillofacial surgery as well as proof of improvement performance processes are necessary for this designation (ATS, 2022).

Massive Blood Transfusion (MBT)

Massive blood transfusion (MBT) is commonly defined as greater than ten units of PRBCs in a 24-hour period (Jennings & Watson, 2021), etc. Another commonly accepted definition of MBT is three or more units of PRBCs in one hour, or four or more of any combination of blood components in thirty minutes (Hess, 2020). It is important to mention that there is not a standardized definition for what constitutes MBT, but rather some commonly accepted practices that may vary from facility to facility.

Massive Transfusion Protocol (MTP)

Massive transfusion protocol (MTP) is a set of guidelines that is utilized in the setting of uncontrolled hemorrhage or critical levels of bleeding, to help guide resuscitation efforts. There are a variety of algorithms which have been studied and utilized for MBTs and these protocols will vary among institutions (Hsu et al., 2016).

Chapter 2: Integrated Review of Literature

The purpose of this literature review was to evaluate the existing knowledge regarding the relationship between massive blood transfusions (MBTs) and hypocalcemia and the effect this has on mortality for patients with critical bleeding related to trauma. The Southern Adventist University Mckee library database was used to review the Cumulative Index for Nursing and Allied Health Literature (CINAHL) and PubMed using the following search terms: Massive blood transfusion, massive transfusion protocol, critical bleeding, MBT and trauma, hemorrhagic shock, MBT and electrolyte derangements, and MBT and hypocalcemia.

Out of the numerous results, there were only a limited number of articles applicable to the topic of hypocalcemia related to MBT. Initially, search was limited to dates within the past 5 years (2017-present), however, this search was eventually expanded to include studies performed within the last 7 years (2014-persent) to include literature that contributed significantly to the knowledge of this topic. Search of dates within the past 7 years (2014-present), full text, peer reviewed, evidence-based, and English language resulted in a total of 96 articles found on CINAHL, and 55 articles found on PubMed related to the search terms.

After reviewing the literature available, 23 articles were selected because of their inclusion of massive blood transfusion, massive transfusion protocols, and hypocalcemia related to massive blood transfusion or trauma. One of the articles that was selected to represent the literature was dated from 2011, which was outside of the 7-year window, however it was included due to the contribution it makes to the existing body of knowledge regarding transfusion related hypocalcemia.

Presentation of Literature

Common findings within the literature were that MBT ratios were generally regarded as being performed in either a 1:1:1 or a 1:1:2 ratio. Another common finding was that there are no current recommendations for best practices regarding the initiation of obtaining levels of ionized calcium throughout the process of MBT. Despite evidence-based literature to suggest the importance of calcium management during MBT, there are few studies which include hypocalcemia as an independent risk factor for morbidity and mortality.

Massive Blood Transfusion Definition

As previously stated, while there is not one standardized medical definition for what constitutes an MBT, it is commonly defined among medical professionals as ten or greater units of PRBCs administered within a 24-hour period (Jennings & Watson, 2021). Another more recently accepted definition of this is either three units of PRBCs in one hour, or any combination of four blood component units in thirty minutes (Hess, 2020). The ACS (2014), states that hemorrhage is the most common cause of death within the first hour of a patient arriving at a trauma facility. In addition to that, almost 50% of deaths that occur within the first 24 hours of injury are attributed to exsanguination and coagulopathy (ACS, 2014).

The most widely used criteria for what define MBT in the literature was administration of >/= 10 units of PRBC's in twenty-four hours. (Bui et al., 2016; Ho & Leonard, 2011; Holcomb et al., 2013; Jennings & Watson, 2021; Jones et al., 2019; Passerini, 2019; Sturgill & Gillard, 2017). Ten units administered within 24 hours is considered an estimation of replacing the patient's entire blood volume and is also used as a definition for MBT by the Association for the Advancement of Blood and Biotherapies (AABB), formerly known as the American Association of Blood Banks (Hinrichsen, 2019; Sturgill, 2017). Hinrichsen (2019), also stated that while 10

units in 24 hours is the most accepted definition, an alternative of 3 or more units of PRBCs in six hours can be adopted to identify critical bleeding in patients earlier thus allowing for prompt initiation of MTP.

As stated above, there are some additional definitions that have been developed because of the need to define critical bleeding at an earlier point than 24 hours. Due to this need, additional measures of critical bleeding may include a patient who needs >/= 3 units of RBCs in one hour (Dzik et al., 2016), or >/= 4 units PRBCs in 1 hour (Akaraborworn et al., 2021; Broxton, 2018). Another study described MBT as either greater than 4 units of RBCs in one hour or administration of >50% of the patient's total blood volume in three hours as accepted definitions (Guerado et al., 2016).

Commonly followed guidelines in the U.S. for massive blood transfusion come from the AABB as well as the Trauma Quality Improvement Program (TQIP), which both support a definition for MBT as >10 units PRBCs in 24 hours (AABB, 2022 & American College of Surgeons [ACS], 2014). This definition for MBT is also used in guidelines from other countries. Australian guidelines set by National Blood Authority of Australia (2011), define MBT as 10 units transfused within 24 hours, blood loss of 150 ml/min, and/or one half of the total blood volume lost in 4 hours. In the United Kingdom (UK), the definition of major hemorrhage is loss of more than one blood volume in 24 hours, which they define as > 5 liters in a 70 kg adult, loss of 50 % blood volume in < 3 hours, or bleeding > 150 ml/min (Joint United Kingdom (UK) Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee [JPAC], 2020).

Scoring systems are a helpful tool that can be used to predict or determine if a patient needs MBT. The Assessment of Blood Consumption (ABC) score, which is commonly used in

the U.S., is made up of 4 variables: pulse >120, systolic blood pressure (SBP) <90, + Focused Assessment with Sonography (FAST), and penetrating torso injury (ACS, 2014). Another tool that can be used to help identify a patient who needs MBT is the Shock Index (SI), which is calculated as heart rate (HR)/SBP (Day et al., 2021). The ABC scoring system has been a validated measurement tool for predicting patients who may need the initiation of MTP and is cited in numerous studies (Akaraborworn et al., 2021; Day et al., 2021; Horst et al., 2022; Passerini, 2019).

It is important to recognize a patient who is at risk of critical bleeding, and who may end up needing an MTP, so that there is a more minor delay in activation of MTP. Scoring systems such as the ABC and SI are crucial to rapidly identifying these patients. With awareness of trauma induced coagulopathy (TIC) and need for quick identification of patients who may need intervention, other scoring systems have been developed and studied. One example of this would be the modified Trauma-Induced Coagulopathy Clinical Score (mTICCS), which was developed for early detection of patients at need for MBT. This protocol was created from the concept that there was a need for a less complex scoring system that did not need laboratory or diagnostic capabilities, such as the ABC score, the Emergency Room Transfusion Score (ETS), Traumatic Bleeding Severity Score, or the Massive Transfusion Score (MTS), which all use FAST to score patients (Horst et al., 2022).

The mTICCS is based on three variables: the need for emergency room services, blood pressure, and extent of bodily injury, and is intended to be a simplified diagnostic tool (Horst et al., 2022). Of note, early identification of patients needing MBT can be challenging in areas where there is a lack of resources including poor prehospital care, which prompted a diagnostic prediction study in Thailand to develop a better tool that could be used in these settings

(Akaraborworn et al., 2021). The Massive Blood Transfusion for Trauma (MBTT) is a scoring system that uses four parameters for measurement to include age >/= 60, base excess (BE) </= -10 mEq/L, lactate > 4 mmol/L, and HR >/= 105/min (Akaraborworn et al., 2021). This study did show that MBTT had high prediction of patients needing MBT when compared to other scoring systems such as ABC score, Prince of Whales Hospital (PWH) score, and the Trauma-Associated Severe Hemorrhage (TASH) score (Akaraborworn et al., 2021).

Rapid recognition of coagulopathy, hypothermia, acidosis, and ultimately hemorrhagic shock can help decrease the risk of mortality in critical bleeding patients (Passerini, 2019). Scoring systems and massive transfusion protocols (MTP's) can aid in the appropriate treatment of trauma patients. Having an MTP can provide a guideline for blood products to be administered efficiently and safely and is an essential part of treating trauma patients with critical bleeding levels.

Development of Transfusion Protocols

It is important to consider which patients may need massive transfusion protocol (MTP) to be activated to avoid delay in patient care as well as to appropriately designate resources. This can be accomplished by using a scoring system or a set of criteria that would trigger MTP. One retrospective study mentioned four indicators of massive bleeding found in the electronic medical record (EMR), which were triggers for initiating an MTP. These four indicators included administration of uncrossmatched PRBCs, administration of tranexamic acid (TXA), four or more units of PRBCs transfused in one hour, or 10 or more units transfused over 24 hours (Broxton et al., 2018). These same four indicators for initiating MBT were previously identified in a study that was being done to help develop an evaluation tool for MTPs (Broxton et al., 2017). According to Barasch, (2017) & Benthin, (2018), Establishing an MTP is an important

practice for quickly getting products from the blood bank to patients with massive hemorrhage because it utilizes a predetermined set of guidelines to be followed.

The Prospective, Observational, Multicenter, Major Trauma Transfusion (PROMMTT) Study examined mortality in trauma patients using transfusion ratios of plasma to RBCs as well as platelets to RBCs among ten different level 1 trauma facilities as variables (Holcomb et al., 2013). Results of the PROMMTT study found that ratios to plasma and platelets to RBCs given in the first 24 hours was inconsistent among these facilities ($P<0.001$) and that up to 30 minutes after admission, 67% of patients hadn't received plasma, and 99% had not received platelets, but that with each hour that followed, they were more likely to have been given both platelets and plasma (Holcomb et al., 2013). Patients who received earlier administration of plasma and platelets, and at a higher ratio to RBCs, had a lower mortality, especially in the first 6 hours of admission (adjusted hazard ratio = 0.31; $P<0.001$), indicating a significant relationship between early and increased transfusion of platelets and platelets to decreased mortality (Holcomb et al., 2013). This is important because it shows evidence that there may be significant benefit to having a standardized protocol, in which plasma and platelets are given in equal ratios to PRBCs when administering MBT.

Following the PROMMTT study, the Pragmatic, Randomized, Optimal Platelet and Plasma Ratios (PROPPR) was performed. The PROPPR trial evaluated effectiveness and safety of massive blood transfusion ratios of 1:1:1 when compared to 1:1:2 of plasma to platelets to RBCs in trauma patients (Holcomb et al., 2015) & (Baranuik, 2014). Within the first 24 hours, there was a lower death rate due to exsanguination, for patients who received blood products in a ratio of 1:1:1, and there was not a significant difference in mortality for trauma patients who received blood products in ratios of 1:1:1 compared to ratios of 1:1:2 at 24 hours or thirty days

(Holcomb et al., 2015). Following this, Zhu et al. (2016), assessed protocol adherence using the PROPPR trial ratios. A significantly (<0.0001) higher proportion of blood product transfusion errors in the group receiving a ratio of 1:1:2 plasma to platelets to RBCs was found, when compared with the 1:1:1 ratio group. This proportion of errors indicated that the product transfusion ratio of 1:1:2 was harder to accomplish (Zhu et al., 2016).

Historically, patients presenting with massive bleeding were treated with high volumes of PRBCs as well as crystalloid fluids and the administration of either plasma or platelets was employed (Gaasch, 2021). Both Gaasch (2021) and Hyatt (2019), explain reasons why this was problematic, including the resulting dilutional coagulopathy that occurs when PRBCs are administered without plasma and platelets. Since plasma contains all the blood's coagulation factors such as Factor V, Factor VII, Factor VIII, and von Willebrand factor, it is essential that plasma is administered in patients experiencing critical blood loss to replenish not only clotting factors, but also platelets which are decreased, especially those at greater risk for coagulopathy such as trauma patients (Hyatt, 2019; Gaasch, 2021). Increasing plasma ratios is a concept that has elicited controversy. Plasma transfusion has been associated with a higher incidence of developing acute respiratory distress syndrome (ARDS). Increasing transfusion ratios of plasma does place the patient at a higher risk for developing ARDS, despite the trends of lower mortality rates with increased plasma to RBC ratios (Bui et al., 2016). Another researcher explains that plasma used in large quantities has been associated with dilution of both RBC's and platelets (Spahn et al., 2019).

Much of the data on MBT that is used in civilian trauma settings is a result of research that originated from the military who has utilized a guideline known as damage control resuscitation (DCR) since 2004 (Holcomb et al., 2015). Damage Control Resuscitation (DCR) is

a method for treating trauma patients in which the aim of therapy is to stop hemorrhage, restore blood volume, and halt or correct the triad of trauma (Passerini, 2019). Since military operations, especially during times of war, may need mass amounts of blood products to be given, most of the available research on MTP has been done in this setting, and the ideal ratios for blood transfusion was suggested first through this avenue. As a result of this data from the military it became evident that administration of plasma and platelets both earlier and more frequently, in addition to PRBCs may improve patient outcomes (Treml et al., 2017).

One notable difference when considering civilian treatment of uncontrolled hemorrhage versus military is that evidence from studies performed within the military have suggested transfusion of fresh whole blood to provide positive outcomes among trauma patients, although this is not as easily achieved in civilian populations due to availability of fresh whole blood products (Jennings & Watson, 2021). In lieu of whole blood products, a common practice is to achieve the same effect with administration of PRBCs, platelets, and fresh frozen plasma (FFP) in varying ratios (Jennings & Watson, 2021).

Passerini (2019) discussed the concept of a massive transfusion protocol (MTP) and explains that the current literature suggests that while the presence of a protocol may vary from hospital to hospital, that utilizing a protocol has shown to increase survival outcomes as well as decrease waste of blood products. While protocol utilization for MBT does show benefit, it does not come without challenges. Researchers from one facility noticed a tenfold increase in MTP activation in 2015 (142 activations) when compared to 2008 (approximately one activation per month). They initiated a root cause analysis (RCA) in an effort to reform their MTP (Adkins et al., 2021). What they discovered is that the excessive usage of the MTP could be attributed to lack of education about which patients required MBT, decreased stewardship of ordering blood

products, and process issues, such as clinicians having low confidence in ordering blood through routine pathways due to slow turn-around time (Adkins et al., 2021). Through this RCA and the subsequent changes and education, the facility was able to reduce unnecessary usage of MTP (down to less than 50 annually), and in turn decrease blood product wastage and significantly decreased MTP stress levels of transfusion services staff members. In addition to this, they saw an increase in units of RBC transfusion per MTP, indicating a more appropriate usage of MTP activation (Adkins et al., 2021). The goal of establishing a protocol is to allow for early recognition of critical bleeding, early surgical intervention when possible, and to address complications as they arise through resuscitation efforts (Guerado et al., 2016).

Thorn et al., (2021) sought to validate a previously published scoring system for predicting coagulopathy known as the Coagulopathy of Severe Trauma (COAST) score, which is scored based on INR and aPTT laboratory values. Data from a four-year period of time was analyzed, of patients admitted in both Germany and Austria who were placed on the trauma registry and who had an injury severity score (ISS) of >/= 16. What they discovered was that the COAST score was highly specific for identifying patients with clinically relevant trauma induced coagulopathy (TIC), with sensitivity of 21.6% and specificity 94.2%. The positive predictive value, which is the likelihood that those patients predicted to have coagulopathy had it, was 31.3%, while the negative predictive value, which is the probability that patients who did not have coagulopathy, were predicted not to, was 90.7% (Thorn et al., 2021). What this suggests is that the COAST score was a specific tool for identifying patients with clinically significant coagulopathy, which may allow for goal directed treatment to occur sooner.

Utilizing tests such as thromboelastography (TEG) may provide a way to quantify fibrinolysis, which could allow for targeted utilization of cryoprecipitate and fibrinogen

concentrate during MBT, (Bostian et al., 2022). Fibrinolysis (LY30) at 30 minutes on TEG results was found to be associated with mortality (p=0.0002), PRBC transfusions (p=<0.0001), and total blood product transfusion (p=<0.0001) (Bostian et al., 2022). This shows a significant association of LY30 results on TEG to increased blood loss, increased blood transfusions, and increased mortality, suggesting that TEG laboratory testing may be an important tool to help guide MBT practices.

Throughout review of the literature available on massive transfusion protocol (MTP), there were no consistent guidelines for laboratory evaluation during massive blood transfusion (MBT). Although this is largely since patient care in these scenarios is intuitive, there is evidence to show that having routine monitoring of labs could be instrumental in improving outcomes. One example of this, which will be discussed in the next section, is that of hypocalcemia. While the adverse side effects of hypocalcemia are widely understood and researched, there is still no standardized protocol in place for monitoring and repletion of calcium in patients receiving MBT. This has created a knowledge gap, and to create a more effective approach to treating critical bleeding, it would be beneficial to develop a protocol for earlier identification of patients who present with hypocalcemia at baseline or who are at risk for developing severe hypocalcemia throughout the course of treatment.

Massive Blood Transfusion Related Hypocalcemia

Hypocalcemia places the patient at risk for many adverse effects including neuronal irritation, tetany, cardiac dysrhythmias, and impairment of the coagulation cascade, and although not well studied as a primary outcome, it has potential to greatly affect patients receiving MBT (Byerly et al., 2020).

Stored blood products contain citrate, which is utilized as an anticoagulant and is known to chelate the circulating calcium in patients receiving large amounts of blood products, or blood products that are administered over a short period of time (Passerini, 2019; Spahn et al., 2019). This occurs as citrate binds to calcium, rendering it ineffective. It is due to this physiology that patients receiving MBT are at a much higher risk of developing systemic hypocalcemia. Spahn et al. (2019), noted that in a healthy patient, the liver typically metabolizes citrate, but in the setting of trauma with patients who are experiencing hemorrhagic shock, liver function may be impaired therefore leading to increased levels of citrate in the blood further placing the patient at risk for hypocalcemia.

Up to 97% of patients requiring MBT will experience some degree of hypocalcemia, and of these patients, up to 71% will have severe hypocalcemia with ionized calcium (iCa++) of less than 0.90 mmol/L (Ditzel et al., 2019). Despite the risk for hypocalcemia in this patient population, there is no standardized approach for treating this condition. Without a protocol for checking iCa++ levels in these patients, providers risk not identifying hypocalcemia as it occurs or administering empiric calcium without knowing the calcium level. Checking calcium levels is important for ensuring adequate replacement of calcium, as well as for preventing overcorrection, which also increases risk of mortality (Ditzel et al., 2019). Due to the adverse effects of hypocalcemia and the risk that accompanies MBT, further investigation of this relationship is needed so that evidence-based research can target ways for providers to mitigate morbidity and mortality in trauma patients who present with critical bleeding.

As explained by Cornelius (2020), it can be concluded that there is a significant risk of hypocalcemia that accompanies patients receiving MBT. For optimal outcomes of trauma patients experiencing critical bleeding, it is crucial to recognize the role hypocalcemia plays in

mortality and to identify the connection between this condition and MBTs. Further research is needed to determine ways to reduce this risk and prevent life saving measures such as MBT, from causing further harm to the patient, as well as on how best to manage and replete calcium levels in the trauma patient.

While there has been no randomized control trial performed to determine the significance of hypocalcemia in massive blood transfusion, there is literature that supports the claim that this may play a crucial role in outcomes of trauma patients receiving MBT. Calcium is a cation that functions as a co-enzyme responsible for various processes including muscle contractions, neuronal activity, coagulation cascade, platelet aggregation, as well as prolongation of the QT interval which places patients at a high risk for ventricular arrhythmias (Ho & Leonard, 2011). In addition to this, calcium plays a large role in coagulation by anchoring coagulation factors to phospholipids as well as helping to convert fibrin to fibrinogen, therefore it is crucial for clot formation (De Robertis et al., 2015).

Monitoring calcium levels in trauma patients is crucial for improving outcomes related to critical bleeding. The European Surgical Association (ESA) guidelines recommend that management of severe bleeding by MBT should include maintaining a serum iCa++ level of >/=0.9mmol/L, which should be accomplished by administration of replacement calcium in the effort to achieve normocalcemia (De Robertis et al., 2015). The importance of measuring iCa++ as opposed to total calcium levels is that hemodilution will occur during MBT, skewing the numbers of a total calcium count. This author also stressed the importance of monitoring and replacing serial arterial iCa++ levels on patients receiving MTP as complications of hypocalcemia may include tetany, prolonged QT interval, decreased cardiac contractility,

hypotension, narrow pulse pressure, elevated left ventricle pressure, and elevated central venous pressure (Guerado et al., 2016).

The fifth edition of the European guideline on management of major bleeding and coagulopathy following trauma was outlined and recommendations were formulated and supported by the Task Force for Advanced Bleeding Care in Trauma. Monitoring calcium levels and maintaining normocalcemia should be included in an MTP (Grade 1C). Calcium chloride is the recommended corrective medication for hypocalcemia (Grade 2C) (Spahn et al., 2019). It should be noted that grade 1C evidence is considered a strong recommendation, with low-quality evidence, however benefit outweighs the risk, while grade 2C evidence is considered a weak recommendation, with low quality evidence and uncertainty regarding benefit when compared to alternative treatment (Spahn et al., 2019).

Byerly et al. (2020), noted that patients who developed severe hypocalcemia had received more blood products before an ionized calcium level was obtained [PRBC (8 vs 0, $p<0.0001$), plasma (4 vs 0, $p< 0.0001$), and platelets (0 vs 0, $p<0.0001$)] as well as having more blood products administered during the first 24 hours and during the total length of stay. This provides clinically significant findings which indicate that ionized calcium levels may decrease in a dose-dependent fashion with transfusion of PRBC units. In addition to this, this researcher describes that the highest proportion of citrate (90%) is found in plasma and platelets due to citrate's affinity for plasma during separation of whole blood product, which suggest that as the amount of plasma and platelets increase, so does the risk of developing hypocalcemia (Byerly et al., 2020).

In a pilot study by DiFrancesco et al. (2019), that evaluated a level 1 trauma center's employees' knowledge of calcium monitoring and repletion during the process of massive

transfusion protocol (MTP) it was noted that there is a knowledge gap present among trauma team members regarding calcium monitoring and replacement during MTP. It was also noted that there was a lack of standardization of monitoring ionized calcium levels and for replacement of this deficit.

It has been well established that coagulation is considered a crucial element to the "lethal triad" of trauma, therefore indicating that calcium may play a large role in this process. De Robertis et al. (2015), discusses what is known as the lethal triad of trauma; acidosis, hypothermia, and coagulopathy, stating that hypocalcemia is an often unrecognized and neglected predisposing factor to coagulopathy. Both Spahn et al. (2019) and DiFrancesco et al. (2019), have discussed the importance of maintaining normocalcemia in improving survival of the trauma patient. DiFrancesco et al. (2019) & Cornelius (2020), both explain that decreased levels of calcium can significantly disrupt normal coagulation, increase neuromuscular irritability, muscle spasms, and increase risk for cardiac arrhythmias as well as cardiac arrest. Cornelius (2020), further expresses the importance of calcium as it helps with platelet adhesion, and is needed for clotting factors II, VII, IX, X, protein C, and protein S.

The relationship between low levels of ionized calcium and mortality in patients with critical bleeding was assessed to determine the possibility of a concentration-dependent relationship between these risk factors that affects mortality rate, (Ho & Leonard, 2011). When ionized calcium levels were measured for patients receiving MBT over a 24-hour period, these levels were found to be well below normal limits, with a mean concentration of 0.8. It should also be noted that the only two factors related to severe hypocalcemia included the amount of fresh frozen plasma (FFP) transfused ($P=0.02$) and acidosis ($P=0.01$) (Ho & Leonard, 2011). Additionally, a significant association was found between severely low levels of ionized calcium

and mortality, even after adjustments were made for other covariates (P=0.02), and a higher relationship to mortality existed with hypocalcemia than low fibrinogen, low platelet count, or acidosis. This shows that this study found the association between hypocalcemia and mortality to be statistically significant since a *p* value of </= 0.05 indicates strong evidence against the null hypothesis (Ho & Leonard, 2011).

Mackay et al. (2017) determined that mortality was significantly increased in patients who exhibited severe hypocalcemia (60% vs 4%; P < .01). In addition to this, it was noted that patients who displayed hypercalcemia received more PRBC, FFP, PLT, and overall total units of blood product transfused and likewise had a much higher rate of mortality (78% vs 9%; P < .01). This would indicate that any calcium derangement, whether high or low, could potentially affect mortality rates. An interesting finding by Mackay et al. (2017), was that patients with both extreme hypocalcemia and hypercalcemia had a mortality rate of 75%, which did not differ from the mortality rate of patients who had only one of these calcium derangements, however, the mortality rate was much greater than patients who did not exhibit any calcium derangement.

In a pilot study which was performed to examine hypercalcemia as well as hypocalcemia for patients receiving MBT, it was discovered that out of the 41 patients that were analyzed for this study, 35 exhibited hypocalcemia during the first 24 hours of admission, 15 of which exhibited extreme hypocalcemia and 9 of which showed hypercalcemia. Additionally, this studied found that patients receiving a higher amount of fresh frozen plasma (FFP) and platelets when compared to packed red blood cells (PRBCs), were more likely to experience extreme hypocalcemia. This being attributed to the fact that FFP and platelets contain higher levels of citrate than PRBC's (Mackay et al., 2017). This researcher also noted that patients showing extreme hypocalcemia were typically more severely injured and therefore received more

PRBC's, FFP, platelets, and total units of product transfused, and mortality was significantly increased in patients who displayed extreme hypocalcemia (60% vs 4%, p=<0.01) (Mackay et al., 2017).

Systemic hypocalcemia is best measured using iCa++ in critically ill patients and is therefore the lab value used to determine calcium levels in patients receiving MBT. Ionized calcium (iCa++) is considered the most accurate measurement for calcium levels as roughly 10% of available calcium is bound to anions such as sulfate, citrate, and phosphate (Byerly et al., 2020). In a retrospective study that was performed to examine the relationship between blood transfusion and calcium levels, 7,341 participants who had iCa++ levels checked within 48 hours of admission, were evaluated. Independent predictors of severe hypocalcemia which were analyzed using logistic regression with an adjusted odds ratio (AOR) with a 95% confidence interval included penetrating wounds (AOR 1.706), increased injury severity score (ISS) (AOR 1.029), higher PRBC administration (AOR 1.343), and higher plasma administration (AOR 1.097) (Byerly et al., 2020). These findings suggest that the more units of both PRBCs and plasma that are transfused, the higher the likelihood that the patient will experience hypocalcemia. While previous research studies had reported an association of increased units of PRBC administration with hypocalcemia, this study showed that even four units of combined PRBCs and plasma was associated with risk of severe hypocalcemia with an adjusted p value of <0.000, which indicates a significant relationship between these two factors (Byerly et al., 2020). In addition to these findings, the researcher also found that patients with hypocalcemia incurred longer hospital stays, longer intensive care unit (ICU) stays, higher mortality rates, and were less likely to be discharged home than those who did not experience severe hypocalcemia (Byerly et al., 2020).

While it has been established that calcium exhibits an important role in the physiology of the lethal triad of a trauma patient, it has yet to be determined as to what extent this factor alone plays in affecting morbidity and mortality. At this time, more research is needed to definitively determine the role that early identification of, and replacement of calcium might play in affecting the mortality rate of trauma patients presenting with critical bleeding. Determining this could provide evidence that would support adding parameters for monitoring and treating hypocalcemia in patients requiring MBT.

Summary and Synthesis of Evidence

The aim of this project is to evaluate massive blood transfusion (MBT) practices at various level 1 trauma care facilities to see what is currently being done and whether they utilize a protocol. In addition, the aim was also to determine how calcium is being managed at these facilities. This literature review provided evidence to support the variability of MBT practices and massive transfusion protocol (MTP) among facilities.

Massive blood transfusion is commonly defined as administration of > 10 units PRBCs in 24 hours, however some more recently adapted definitions may include > 3 to 4 units PRBCs in 1 hour, >50% total blood volume administered, or acute blood loss of > 150 ml/min (Akaraborworn et al., 2021; Broxton et al., 2018; Bui et al., 2016; Dzik et al., 2016; Guerado et al., 2016; Ho & Leonard, 2011; Holcomb et al., 2013; Jennings & Watson, 2021; Jones et al., 2019; Passerini, 2019; Sturgill & Gillard, 2017).

The PROMMTT trial showed evidence to support that increased ratios of plasma and platelets given earlier in the blood transfusion process may decrease mortality in trauma patients receiving MBT (Holcomb et al., 2013). The PROMMTT study was followed by the PROPPR trial, which looked at mortality rates among trauma patients receiving MBT in ratios of either

1:1:1 or 1:1:2 (Holcomb et al., 2015). The results of this study showed that there was no significant difference in rates of mortality between these two groups (Holcomb et al., 2015).

While there are several methods for checking coagulation profiles on patients, there is not one method that is being used across the board. While most protocols include testing such as PT/PTT and fibrinogen, there are only a few who have begun to use more specific methods of identifying trauma induced coagulopathy (TIC) such as TEG and ROTEM. One example of this knowledge gap includes hypocalcemia. Citrate is an anticoagulant that is used in stored blood products, which places the patient receiving large quantities of blood product at risk for hypocalcemia. As evidenced by multiple studies, hypocalcemia can have a significant effect on mortality rates and should be recognized and treated promptly (Byerly et al., 2020; DiFrancesco et al., 2019; Ho & Leonard, 2011; Mackay et al., 2017; Spahn et al., 2019).

Chapter 3: DNP Project Methodology

The goal of this project was to create a clinical understanding of emerging themes and concepts related to how massive blood transfusions (MBT's) are performed and evaluated at level 1 trauma care facilities throughout the U.S. While there is no current standard of practice that reaches across the board for administering and monitoring massive blood transfusions, there are various facility-based protocols that are being followed.

Study Aims

One primary aim of this study was to determine if facilities utilize a massive transfusion protocol (MTP) as well as to provide a new knowledge base for understanding providers perceptions and experiences related to patient outcomes and efficacy of MBT practice.

A secondary aim of this project was to determine if during the process of MBT, these facilities are obtaining and replacing calcium levels as part of their MTP.

A qualitative study was performed using an interpretive description (ID) design method to promote the research being done within this field, as well as to increase the body of knowledge and understanding of themes regarding massive blood transfusion protocols.

Type of Project

This qualitative study utilized an interpretive description (ID) design method to help provide a clinical understanding of how MBT's are performed and evaluated as well as provider's experiences with utilizing MTP's at level I trauma centers. ID is a flexible and non-traditional approach to qualitative research in which the researcher addresses experiential questions posed to the subject in an effort to discover answers and draw conclusions which lead to practical outcomes. The primary goal of ID is to facilitate a clinical understanding that will be relevant to applied practice settings. One benefit to this type of qualitative design is that by

utilizing an interpretive description design, the researcher can explore a topic in way that may go beyond a previously established methodology to portray insight into the phenomena of interest (Thorne et al., 2004).

This study utilized a gap analysis technique to show the gap in existing literature as it pertains to massive blood transfusions (MBTs) and massive transfusion protocols (MTPs). By evaluating what is currently being done at varying level I trauma centers and discussing clinicians' experiences related to this process, themes developed to support the knowledge that there is currently no standardized approach to managing MBTs. Evidence in the literature should be utilized to encourage further research in this area to establish a standardized approach to managing MBT. The goal of this research study is to benchmark what is currently being done and to show what providers experience throughout this process in an effort to encourage further research to support protocol development.

Stakeholders and Champions

The largest stakeholders in this project include the personnel who are involved in the clinical care of trauma patients who present with critical bleeding. Providers in the emergency room and emergency medical service personnel are the first people who encounter patients needing a massive blood transfusion (MBT). Since initiation of a massive transfusion usually occurs in either the emergency room or the operating room, emergency room and trauma providers are the ones who will have the most exposure and therefore the most experiencing in treating these patients and initiating these protocols. Following the emergency room, surgeons, critical care as well as general and a variety of other specialties, will also be included on the list of clinical experts in MBT. Although penetrating traumas are the primary consumers of massive

blood transfusions, included on this list should also be OBGYN physicians and advanced practice providers.

Without blood bank personnel and transfusion specialists, MBTs would not be possible, therefore they are also key stakeholders in this project as well as trauma department managers and nursing managers who are responsible for managing staff and therefore the execution of the various aspects of caring for trauma patients.

While there are challenges with contacting the people, who oversee practice change at level 1 trauma care facilities, including physicians, surgeons, and department managers, this can be done easily using email, which is how contacts were made during the process of this scholarly project.

Project Assumption

It is assumed that upon interview of level I trauma care facilities, that there is not a consistent protocol being followed for massive blood transfusions. This is problematic as patients who present with critical bleeding need to be assessed and treated in a timely fashion. By following a predetermined set of guidelines that is backed up with evidence-based research, providers in trauma facilities can provide their patients with the optimal chance for survival. It is assumed that this is not currently the case among level 1 trauma centers in the United States.

Project Objectives

The role of this project as it relates to the doctorate of nursing practice (DNP) is to provide insight into the perceptions and experiences of the provider in a trauma setting regarding the use of MBT. The role of the advanced practice nurse is to provide research that can be translated into practice. Utilizing evidence-based research, the DNP can help enact change in policy and procedure for prescribing and administering MBT.

Objectives of this study included providing an overview of perspectives and experiences of providers at level 1 trauma centers regarding massive blood transfusions (MBTs). By interviewing providers involved in the care of trauma patients, and by comparing and analyzing their experiences, the reader is presented with perspective and insight into the importance of massive transfusion protocols in the treatment of trauma patients. Since providers involved in this study are integral in the process of developing these massive transfusion protocols (MTPs), the information obtained throughout this study will help aid this process. Providing evidence of what is currently being done, and perceptions of what could be improved will provide firsthand evidence of changes that may need to be made at an organizational level regarding MTP.

The goal of this project is to create a clinical understanding of emerging themes and concepts related to how massive blood transfusions (MBT's) are performed and evaluated at level 1 trauma care facilities throughout the U.S. utilizing an interpretive descriptive design. While there is no current standard of practice that reaches across the board for administering and monitoring massive blood transfusions, there are various facility-based protocols that are being followed.

The purpose of this study was to:

1. Determine how facilities manage massive blood transfusions
2. Explore providers perceptions and experiences related to the efficacy of MBT practice
3. Examine the processes used to evaluate and manage calcium levels during MBT

Financial

Regarding MTP, the most pressing cost concern is with blood product waste. In a survey of 213 facilities regarding blood transfusion costs, it was found that the cost of one unit of packed red blood cells (PRBCs) costs approximately $US 210.74 +/-37.9 to the hospital, and

$US 343.63 +/-135 to the patient. In addition to this, the mean prices for fresh frozen plasma (FFP) were $US 60.70 +/-20 and apheresis platelets were $US 533.90 +/-69 (Toner et al., 2011). According to the American Red Cross (2022), the U.S. is facing a blood shortage crisis amid and due to the COVID-19 pandemic. They state that approximately 10% less people have donated blood since the start of the pandemic and that this raises serious concerns about the availability of blood products for patients who need them (American Red Cross, 2022).

Since large quantities of blood are being requested from the provider for the patient and given in bulk by the blood bank, if MTP is not followed as ordered or if for some reason the patient either doesn't need the product sent to the bedside or they don't end up consuming the total amount provided, the issue of waste becomes a concern. One of the financial implications of establishing a standardized approach for initiating and carrying out MBT would be that it could significantly decrease waste of blood products. A secondary impact that MTP could have on reducing waste includes the decrease in overuse of initiating MBT. By utilizing a set protocol for initiating this process, it would decrease the risk of provider abuse of MBT.

A standardized approach to massive blood transfusion (MBT) could impact not only patient outcomes but could also be a sustainable way to display good stewardship over precious resources that we have, such as blood products.

Policy

Having a standardized approach to managing massive blood transfusions (MBT) could have an impact on facility policy by providing the facility with a more streamlined approach to managing MBT, as well as by potentially improving outcomes. Projects such as this one contributes to further research toward developing an MBT protocol by showing the current

variability of massive transfusion protocols among level 1 trauma care facilities as well as by sharing the risks and concerns that accompany MBT practice.

Sample

For the purposes of this study, sample characteristics included facilities with level 1 trauma center designation. In addition to this, interviews were directed at providers who were involved with the process of MBTs at that trauma department.

Ten to twelve level 1 trauma care centers were identified across the United States using an internet search. Dividing the United States into five regions, including Northeast, Southeast, Midwest, Northwest, and Southwest, four to eight facilities in each region were chosen at random from a list of verified level 1 trauma centers provided by the American Trauma Society [ATS] (2022). Criteria used to target which facilities were chosen included that they were a level 1 trauma center. In the U.S. there are a total of 190 level 1 trauma centers. A standard email was sent to multiple facilities and all responses that were received were interviewed. All individuals that were interviewed were employees at a level 1 trauma care facility. Out of the interview participants, there were four transfusion services physicians/pathologists, one trauma surgeon, two trauma program directors, and one blood bank manager. One of the interviews performed was a dual interview of both the trauma program director as well as the blood bank manager together.

The initial goal for sample size was 10-12 as qualitative research suggests that 10-12 participants are needed for saturation of data. This was not possible as most facilities that were emailed did not respond. After the initial round of emails sent to each facility yielded few responses, an additional round of emails was sent to two to four facilities in each region, which yielded more responses than the first round, resulting in the sample size of N=7.

Inclusion/Exclusion Criteria

The sole inclusion criteria for this study included level I trauma care facility designation with capability of performing MBT.

Protection of Human Subjects

The Institutional Review Board of Southern Adventist University (SAU) reviewed and approved this project (Appendix A). Interviews were conducted throughout the spring of 2022. Dividing the U.S. into five regions, including Northeast, Southeast, Midwest, Northwest, and Southwest, facilities in each region were randomly chosen from a list of level 1 trauma care facilities found on the American College of Surgeons website. These facilities were contacted through email.

Protection of human subjects was maintained during this scholarly project by maintaining privacy throughout the process. Prior to interview, an information email with informed consent was sent to each participant. After mutual agreement with participants was obtained, an interview time was set up. The participant was informed prior to the start of the interview that it would be recorded. After recording phone call on a secure/password protected device, interviews were then transcribed on a secure, password protected computer that was accessible solely to the researcher. Anonymity was maintained by leaving out identifying information in the write up such as participants and facility names.

Measurement Tools/Instruments

The tool~~s~~ utilized for this study included a survey that was provided via telephone interview to one clinical member at each facility. Once contact was established and permission obtained from each facility, a single survey of 13 open-ended questions (Appendix B) was administered via telephone while simultaneously being recorded. Open-ended questions were

asked to each participant and time was given for response. Survey questions were developed in collaboration with scholarly project advisor.

For survey, there was a set of fixed questions which were asked initially during the interview process, Questions were asked to gather information related to massive blood transfusion (MBT) definition and process of administration to meet the objectives of evaluating providers perceptions and experiences of MBT.

Procedure and Data Collection

After selection of facilities, an email explaining the research study was sent to each provider, requesting a phone interview. Once contact was established and the study was explained, participants were asked to participate in a recorded phone interview and verbal consent was requested (Appendix C).

Upon receipt of this email and reply was received, a meeting time was scheduled for the telephone interview. Each phone interview was recorded and subsequently transcribed into a word document (Appendix D). Qualitative data was collected from 6 different level 1 trauma care facilities.

An interview with a survey was chosen as the method of data collection so that an in-depth perspective on the approach to MBT could be conceptualized by using descriptive interpretation of participants answers to questions. During the interview, the researcher listened to the words that the participants stated and after transcription of the interview, data was extracted, and analysis was performed on the words that were spoken from each participant.

Implementation phase of this project began in January 2022 and lasted through March 2022. One of the major barriers identified in this study was connecting with providers at level 1 trauma care facilities who were willing to participate in the interview process. This was

addressed by casting a wider net than original and by asking for contact information of people who might be interested in participating from other facilities, at the end of the early interviews. For people who responded that they would participate and then didn't respond back, I sent follow up enquiries to fulfill the agreed upon interview.

Data Analysis

Qualitative analysis utilizing an interpretive description (ID) method was performed in five phases to analyze the data collected.

Phase 1

The first phase included reviewing all transcribed interviews, looking for emerging themes and noting first impressions.

Phase 2

The second step included utilizing constant comparative analysis, during which transcripts were repeatedly and alternately analyzed until distinct emerging themes became evident. Comparative analysis as well as repeated analysis are methods used within ID to describe a concept or phenomena of interest by utilizing themes and recognizing patterns (Ghorbani & Matourypour, 2020). This second step in data analysis included highlighting sentences, quotes, words, and phrases that are found to be significant, recurring, or unique.

Phase 3

The third step started once these themes began to emerge. They were then divided into categories based on similarity and coded using a language signifier, for example: Categories A, B, C, & D were used as language signifiers early in the coding process. Initial coding was open and became more refined over time as theorizing took place and the phenomenon became better

understood. The coded transcripts were then divided into separate folders and arranged according to category.

Phase 4

The fourth step included labeling categories, determining how they were related to each other, and describing the connections that were discovered to provide new knowledge to the reader from the perspective of the study participants.

Phase 5

The fifth and final step of analysis included discussion of the interpretation and results, comparing with previous studies and theories that exist within the field. Associations were then expanded upon, outliers were investigated, and relationships that were discovered were tested. The goal of this analysis process was to expand on critical reflection of the context and interpretation of the interview results and to share patterns in experience as well as to benchmark the experiential phenomena that was revealed.

Chapter 4: Results

The purpose of this scholarly project was to discover how facilities manage massive blood transfusions (MBTs) and to determine if a protocol is being used for this practice. In addition, the aim was to evaluate how calcium is managed throughout this process.

Based on responses from emails that were sent out to these facilities, Seven interviews were scheduled resulting in a sample size of N=7. Seven facilities were interviewed, and their responses were then analyzed using an interpretive description (ID) design method. ID is a qualitative method of research which can provide a common ground by which to link concepts within healthcare (Thorne et al., 2004). Three facilities were located in the Southwest region and four in the Northeast region of the U.S. Within this study, this researcher aimed to generate knowledge for the reader by answering clinical questions relevant to massive blood transfusion (MBT) practices.

In the following section, these outcomes will be addressed based on the interview questions and findings will be evaluated utilizing ID.

Defining MBT

The answer to "how massive blood transfusion (MBT) was defined" varied greatly across all facilities. Interviewee 1 explained that their facility considers massive blood transfusion as more than the first two units of whole blood given. Interviewees 6 and 7 did not describe a formal definition for MBT, interviewees 2 and 5 stated that they consider ten or more units of product in a twenty-four-hour period to be considered MBT. Interviewee 4 stated their definition as four or greater units in an hour, or ten units within twelve hours, and lastly, interviewee 3 explained that the definition they use is greater than one total blood volume replacement in twenty-four hours.

Utilization of a Protocol

When asked if their facility utilized an MBT protocol, all seven interviewees stated that they did utilize a protocol, which will be described in greater detail at a later point in the interview.

Criteria

Criteria used to determine the patient's need for MBT varied among the seven facilities interviewed, however all of them used the terms of either uncontrolled active bleeding, massive hemorrhage, or acute blood loss. Facility 1 stated that the criteria included a patient who was actively hemorrhaging and requiring more than two units of whole blood initially given. Interviewees 1, 3, 5 and 7 stated that the criteria which determined a patient's need for MBT was determined at bedside by the ordering clinician. Interviewee 4 stated the use of vital signs including low systolic blood pressure and low pulse rate to help determine a patient's need for MBT initiation, and interviewee 2 stated that criteria for initiating MBT is based on the patients presenting condition and complaint. Lastly, interviewee 6 stated a more specific definition of acute blood loss as thirty to fifty percent of the total blood volume, 1300-1800 cc's total blood loss, or greater than 150 cc per minute blood loss as the criteria for initiating MBT.

Table 1 (Appendix E):

Definitions and Criteria

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
Definition	More than the first two units of whole blood given	Greater than ten units, in 24 hours	Greater than one total blood volume replacement in twenty-four hours	Four or greater units in an hour, or ten units within 10-12 hours	Ten or greater units within 24 hours	Any order placed by provider for MTP	No formal definition. Electronic order placed by provider for MTP requesting 5 units PRBC, 5 plasma,

							and 1 platelet
Use Protocol	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Criteria	Based on physician judgement; actively hemorrhaging and requiring more than two initial units of whole blood	No criteria specified in protocol guidelines Patients presenting condition and complaint	Provider discretion for initiation of massive transfusion; Patient bleeding rapidly, amount of blood lost	Protocol for activation based on clinical indicators such as vital signs, including systolic blood pressure, pulse rate, and elevated lactate	Based on bedside clinical judgment by physician	Acute blood loss of thirty to 50% of total blood volume; 1300-1800 CC's blood loss; or greater than 150 cc per minute blood loss	Provider discretion: Evidence of active bleeding with the expectation of bleeding that cannot be controlled

Description of Protocol or Guidelines Used

The MBT protocol description varied across the facilities that were interviewed. A 1:1:1 ratio of red blood cells to plasma to platelets was used at four facilities, stated by interviewees 3, 4, 5 and 6. Interviewee 1 described their facilities protocol as blood provided in boxes, with each box containing 6 units of PRBCs, 6 units of plasma, and one pooled unit of platelets. This facility also utilizes asparaginase (ASP) therapy, 10 units of cryoprecipitate, tranexamic acid (TXA) and in dire circumstances, factor seven in patients with critical bleeding. Interviewee 2 explained their protocol as starting with a 1:2 ratio of plasma to RBCs in the first round, with the addition of one unit of platelets per every round following. The blood bank typically suggests cryoprecipitate as needed for this facility. Interviewee 7 described their MBT blood coolers as containing five units of PRBCs, five units of plasma, and one apheresis platelet each with one unit of apheresis platelets provided in every odd number of coolers that is sent from the blood bank. Interviewee 6 stated that they are using O negative blood for females of childbearing age until blood type has been determined. Interviewee 5 stated that each round of blood sent from the

blood bank during MBT includes six units of O positive RBCs, six units of thawed plasma type A, and one apheresis platelet to each male patient, and that each female receives the same product ratio, however O negative blood is used regardless of the age of the female.

Evidence

When asked about the guidelines or evidence that was used in the development of these MBT protocols, three interviewees provided a specific resource that was utilized in the development of the protocol that is currently used at their facility. Interviewees 2 and 3 mentioned massive transfusion guidelines from a large level 1 trauma care facility in the Northeast U.S., while interviewee 5 mentioned the PROPPR study as the basis for their current guidelines for using a 1:1:1 ratio. This same facility explained that they had been using the 1:1:1 ratio prior to the PROPPR trial, and that even though the PROPPR trial did not show any statistical difference between the use of 1:1:1 and 1:1:2 ratios, their facility stayed with the use of 1:1:1 administration of blood products. Interviewee 1 mentioned that their MBT protocol was developed with the blood bank using the current literature approximately ten years ago, but that it has since been modified based on the American College of Surgeons (ACS) and Transfusion Quality Improvement Program (TQIP) guidelines. Interviewee 4 stated that they used a standard resuscitation protocol but did not expand on this topic further. Interviewee 7 described their MBT protocol as being developed internally with hospital-based committees and the use of current guidelines, however these guidelines were not named specifically. Lastly, interviewee 6 stated that they were unsure of which guidelines were used, but that it was taken from various studies and practices.

Length of Time Protocol Has Been Used

When asked about how long they had been using their current MBT protocol, each facility had a different answer. Interviewee 1 stated that they had been using their current protocol for at least eight to ten years, while interviewee 7 stated at least ten years of use and interviewee 6 stated that it has been within the past eight to ten years that they had been using their current protocol. Interviewee 2 mentioned that their protocol had been in use since 2008 or 2009, while interviewee 3 mentioned that theirs had been used since February of 2017 and interviewee 5 stated that they had been using their current protocol for more than 15 years. Lastly, interviewee 4 mentioned that their current MBT protocol has been used for at least twenty years.

Consistency of Usage

When asked about consistency of use of this massive blood transfusion (MBT) protocol, interviewees 2, 3, 4, 5, 6 and 7 stated that they felt as if their massive transfusion protocol (MTP) was consistently used. Interviewee 4 mentioned a concern with misuse of ordering the MBT protocol as opposed to not using consistently enough, and interviewee 5 mentioned that sometimes MTP is ordered inappropriately. These situations of misuse were described as physicians ordering a MBT initiation when it was not indicated for the patient. Interviewee 6 also mentioned that while their protocol is consistently used, the biggest challenge they experience is with proper documentation during the process of MBT. There was one interviewee for which there is not an answer to this question.

Table 2 (Appendix E):

Protocol and Evidence

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
Protocol	Blood Box: 6 units PRBCs, 6 units plasma,	First cooler: 4 units PRBCs and 2 units plasma. 1 dose	1:1:1 ratio of PRBCs to plasma to platelets; Blood cooler: 6 units	1:1:1 ratio of RBCs to plasma to platelets	1:1:1 ratio of RBCs to plasma to platelets; O	Each round: 5 units PRBCs, 5 units plasma, and	First cooler: 5 units red blood cells, 5 units plasma, I unit

	1 pooled unit platelets, 1 ASP or 10 units of cryo Routine use of TXA, DCC, rare use of Factor VII	of platelets in each round from 2nd cooler on. Cryoprecipitate given with every 4th cooler (i.e., every 6 units of plasma).	PRBCs, 6 units plasma, 1 unit of platelets		positive RBCs for men, O negative for women of all ages 2 rounds issued initially, each with 6 units RBCs, 6 units thawed plasma type A, and 1 unit apheresis platelet	one apheresis platelet; plasma either liquid or thawed; RBCs leukocyte reduced; O negative for males, O positive for females of childbearing age until blood type established	of platelets; platelets with every other cooler
Evidence	Not stated; Reviewed literature with blood bank approximately 10 years ago Modified based on ACS and tquip data and guidelines	Technical manual from AABB	Massive transfusion guidelines from Bethesda Maryland Also- Recommendations from the technical manual by the Association for the Advancement of Blood and Biotherapies (AABB)	Not stated; "It's a pretty standard resuscitation protocol"	PROPPR study	Unknown; Stated that it was taken from various studies and best practices	Facility based decision with representatives from trauma committee, anesthesia, surgery, emergency department, and OB
Developed	8-10 years ago	2008 or 2009	February of 2017	20 years or greater	Greater than 15 years	Within the last 8-10 years	At least 10 years
Consistency of usage	N/A	Consistent with identification of patients who need MBT and administering it	Consistently	Consistently used; Greater risk of overuse rather than underuse	Steps in the blood bank are consistently used; Physicians sometimes order inappropriately	For the most part it is consistently used; Biggest challenge is with documentation	Very consistent

Recent Cases

Interviewee 5 described a recent case where MBT was used because of massive hemorrhage due to vascular trauma from a splenic injury. Interviewee 1 told of a recent case where a patient sustained a chest wall and retroperitoneal injury from vehicular trauma. This patient unfortunately did not survive. Interviewee 6 described a case of gunshot wound to the neck in which MBT was initiated and the patient's outcomes were relatively good. Interviewees 2 and 4 were unable to describe a recent case where MBT was utilized, while interviewee 7

explained that they activate their MTP approximately 53 times a month, so they were unable to give a specific example of a recent case. Lastly, interviewee 3 told of a recent case where a trauma patient presented with a cardiac stab wound, who ended up requiring MBT, but they did not specify his outcome as either good or poor.

Monitoring of Labs

Out of the seven facilities interviewed, there were no consistent answers to which labs were routinely monitored, why, and how often they were monitored, however all seven interviewees stated that they checked either a complete blood cell count (CBC), or hemoglobin and hematocrit (H&H), as well as coagulation markers to include PT/PTT and INR. Interviewee 2 explained that these labs are usually monitored hourly, but at a minimum, every eight hours depending on the patient's condition. In addition to this, they also do point of care testing for H&H at bedside. Interviewee 5 explained that while they don't have any labs built into their protocol, they typically do a CBC every half hour as well as a PTT and fibrinogen, however it really depends on the acuity of the patient. Interviewee 1 stated that they check platelet count, lactate, and thromboelastography (TEG) levels in addition to Hgb, PT/PTT, and fibrinogen levels, while interviewee 6 mentioned the addition of a D dimer and TEG to a CBC, PT/PTT, and fibrinogen during the first round of MBT. This interviewee also stated that they check an ionized calcium after that in between rounds of MBT. Interviewee 7 mentioned that they standardly check a CBC, PT/PTT, fibrinogen, and TEG every thirty to sixty minutes, while interviewee 4 mentioned that they standardly check a CBC, chemistry panel, rotational thromboelastography (ROTEM), and TEG. Lastly, interviewee 3 mentioned that while they did not require specific labs as a part of their protocol, they typically try to perform two type and screens as soon as possible in addition to CBC for platelet count and H&H, follow coagulation

markers such as PTT, INR, and fibrinogen. In addition to this, the interviewee mentioned that they find it valuable to follow ionized calcium, electrolytes including potassium, BUN, and pH. It was stated that checking the potassium is recommended as there is extra potassium found in older units of blood, blood urea nitrogen (BUN) is checked so that it can be ensured that there are no platelet defects caused by high nitrogen, and pH is recommended so that acidosis can be identified as it can lead to worsened coagulopathy.

Table 3 (Appendix E):

Labs Monitored during MBT

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
CBC		Yes 60 min	Yes	Yes	Yes 30 min	Yes	Yes
H&H	Yes	Yes 60 min	Yes	Yes		Yes	
PT/PTT	Yes	Yes 60 min	Yes		Yes 30 min	Yes	Yes
INR			Yes				
Fibrinogen	Yes	Yes 60 min	Yes		Yes 30 min	Yes	Yes
BUN			Yes				
pH			Yes				
Potassium			Yes				
Ionized Calcium	Yes		Yes	Yes		Yes (between rounds after the first round)	
D-Dimer						Yes	
TEG	Yes			Yes	No	Yes	Yes 30-60 min
Platelets	Yes		Yes				
Lactate	Yes						
Type and Screen			Yes		Yes		
No labs required by protocol			Yes		Yes		
CMP			Yes	Yes			
ROTEM				Yes			

Calcium Management

When asked about their approach to calcium management during MBT, each of the participants mentioned that they either check, or treat calcium derangements, but none of them

mentioned calcium management as being built into their massive transfusion protocol (MTP). Interviewee 2 mentioned that they were not sure about the approach to calcium management, while interviewee 5 mentioned that the anesthesiologist typically oversees checking calcium levels, but that it is not part of their protocol. Interviewee 6 explained that they treat hypocalcemia with calcium chloride when it results low on labs, while interviewee 4 mentioned that calcium was replaced based on ionized calcium that was being checked routinely at least every six hours. Interviewee 7 mentioned that an ionized calcium is checked with each blood gas and then replaced accordingly if it is less than 1.0. While interviewee 3 mentioned that they follow ionized calcium and replace accordingly, they explained that they do not empirically treat for hypocalcemia. Finally, interviewee 1 mentioned that on average, one amp of calcium is empirically given per box of blood to patients during MTP.

Concerns Related to Calcium Derangement

When asked about concerns related to calcium derangements, interviewees 4, 5 and 6 stated that they were either not extremely concerned with calcium as there are other things that they are more concerned about, or that they are not concerned with calcium at all. While interviewee 2 was unable to answer this question, interviewees 3 and 7 stated concerns with calcium derangements since anticoagulating preservatives like citrate are used in blood components which can lead to hypocalcemia. Interviewee 7 mentioned that because of the risk of hypocalcemia, they monitor calcium levels, and replenish calcium as needed. Interviewee 3 also stated that they are concerned with hypocalcemia because it may contribute to worsening coagulopathy.

Table 4 (Appendix E):

Calcium Management

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
Approach to Manage-ment	Managed by anesthesiology; Routine administration of calcium; On average, 1 amp calcium per box; Check iCa ++ on istat or empirically give Ca++	Does not know	Follow Ca++ and replace per lab values	Replaced based on iCa++, checked at least Q 6 hours	Not part of protocol, managed by Anesthesiologist	Treat low Ca++ with calcium chloride	Monitor iCa++ with each blood gas, if iCa++ is <1, treat with additional calcium
Concerns about derangements	N/A	N/A	Follow iCa++ because of products preserved with citrate which can cause hypocalcemia in patients getting lots of products during MBT. Hypocalcemia can cause coagulation factors to work poorly, which may contribute to coagulopathy. Concern with awareness of physicians regarding hypocalcemia.	Concerned when calcium is low, but stabilization of patient is more important	Not been a major problem. Issue such as hypocalcemia or hyperkalemia, related to rapid plasma transfusion are more likely a problem in a pediatric setting	Haven't had any issues with it, when there is a critical lab value, it is addressed.	Expect hypocalcemia during massive transfusion because of citrate in blood components, expect calcium to be monitored and that calcium supplementation will be needed.

MBT Outcomes, Mortality, Morbidity

Regarding outcomes among trauma patients, interviewees 5 and 6 mentioned that they could not answer this question due to the variability of factors that influence outcomes. Interviewee 7 stated that outcomes largely depend on the nature of the injury and a variety of other factors, but that approximately two thirds of people who need and receive MBT at their facility survive, while interviewee 4 mentioned good survivability overall at twenty-four hours. Interviewee 3 described morbidity and mortality outcomes as ranging from severe to excellent. Interviewee 2 stated that their outcomes for MBT was at 4% mortality rate, which is under the acceptable maximum of 5%. Lastly, interviewee 1 described outcomes for trauma patients receiving less than five boxes of MTP as having around 70-80% survival rate, while those who may receive hundreds of units would drop down to more of a 10-20% survival rate due to the severity of their condition and extent of injury, organ failure, and dysfunction that accompanies it.

Table 5 (Appendix E):

MBT Outcomes, Mortality, Morbidity

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
Outcomes	"It depends on how extensive the MTP is. I mean for the large majority of our MTP's that don't require greater than five boxes. I would say the survival is pretty good, probably upwards of seventy or eighty	"Outcomes are pretty good. Our mortality rate is very low here at the hospital. We're about 4% mortality rate, which is under the Acceptable maximum of 5%".	"Outcomes range from severe morbidity and mortality to, you know, excellent outcomes without morbidity and mortality. And that seems to vary a lot with severity of injury or on the cause of the bleed,	"Most of our patients survive. If you're talking about survival at 24 hours, it's actually very good". "The problem is, you know, in what condition, right"?	Unable to answer	"Difficult to match outcomes with MTP".	"I would say probably two-thirds of the people who have a massive transfusion. They truly get massively, transfused, not just where they ask for a cooler, and they end up sending it back

	percent survival. For the patients that, you know, go on to true, massive, massive transfusion and, you know, a hundred units of cells, that kind of thing, it's probably more of ten to twenty percent Survival".		and the ability to treat somebody versus not".				because it's not as bad as what they thought it was going to be. But if you're truly massively transfused, where they've, they've taken say, two coolers or more, but at least two-thirds of them survive and it's probably more than that, but I'm not exactly sure about what happens in the long-term".

Recommendations for Improved Outcomes

When asked how these facilities felt about their massive blood transfusion (MBT) protocol, interviewee 1 stated that because of changes that have been made to their massive transfusion protocol (MTP) through the years, they have been able to significantly decrease wastage of blood products. Interviewees 5 and 7 explained that they felt as though their current protocol works well. Interviewee 7 also mentioned that having one standardized protocol throughout the institution has been very beneficial in helping to get the blood to the patient as quickly as possible, however, one recommendation for improvement that was mentioned included wanting labs to be ordered more frequently such as every 30 minutes instead of every 60. Interviewees 4 and 6 mentioned wanting to eventually transition to using whole blood

products in the future, but that it is not feasible right now due to blood shortages. Additionally, interviewee 6 suggested that it would be beneficial if staffing could be arranged to make it easier and quicker to get blood delivered from the blood bank to the patients by using a runner.

Interviewee 3 mentioned that some of the literature supporting a 1:1:1 ratio has some challenges, so if they were able to change the ratio to 2:1:1 they would prefer that. In addition to this, the same facility mentioned that they would also consider adding automatic lab orders to the protocol. Lastly, interviewee 2 mentioned that they have a hospital wide policy that is used among trauma, obstetrics, and gastrointestinal patients. They stated that they would recommend the development of a trauma specific protocol that could be used in that specific specialty patient population.

Table 6 (Appendix E):

Recommendations for Improved Outcomes

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
How do you feel about the protocol? Rec. for improvement?	"We tend to focus mostly from a quality standpoint, not only on lived or died outcomes, but we also look at wastage very carefully. And if anything, our implementation of MTP and how we've refined it over the years, we've reduced our wastage".	Development of a massive transfusion policy or guideline specific to trauma	"I think personally that in the literature some of the studies supporting a 1:1:1 transfusion ratio have a few challenges, so I actually prefer a 2:1:1 transfusion ratio. If it were up to me to redesign,	"In times of shortage, we have to monitor some of the components. We are possibly going to move to whole blood units instead of replacing components, but the blood shortage has not allowed us to do that yet".	"I think overall it works well for our hospital. I think that ours is consistent with current standard of practice. Clinicians seem happy with it. And when it goes well, it goes really well". Recommendations for improvement: -Designated person to communicate with blood bank	-Designated runner to bring blood products to the patient -Improved documentation "I think our ratios are good. We've started using whole blood in our hospital, but only for a very limited subset: male trauma patients in the ED. Maybe in the future.	"I think the protocol that we have is good. When I first came here, we had a different MTP in every area, like the ED had one, the OR had one, and so, having one standard protocol througho

			I might consider changing the ratio to 2:1:1". "It might be really nice to include within the massive transfusion protocol automatic lab orders".		-Reduce over-ordering/abuse of MBT	we'll go to whole blood in the MTP".	ut the institution is something that has really helped us to get the blood out the door quickly and respond to what the patient's needs are. We also have whole blood available in the ED for people who initially come in and need to be quickly transfused while we're getting a cooler. ready". "I don't think that I would change it at this point. If anything, I would just want them to maybe get their

							labs a little more often, like order a TEG closer to every 30 minutes rather than every 60 minutes”.

Evaluation

The aim of this project was to interview level 1 trauma centers related to massive blood transfusion (MBT) administration and to evaluate experiences among providers. The success of this project was linked to the ability to provide a clear understanding of these experiences related to MBT process and protocols among these facilities. While this project was performed on a small scale, each facility that was interviewed had level 1 trauma center designation as well as use of MBTs. The shared experiences of those interviewed at these facilities provide valuable insight into a larger scale issue that could have potential implications for trauma patient outcomes that should encourage further research regarding massive transfusion protocols (MTPs).

Incidental Findings

Throughout the course of this scholarly project there were a couple of findings that were unexpected. When asked how they felt about their protocol, one interviewee mentioned that they found some challenges with the literature supporting a 1:1:1 ratio of transfusing PRBCs to plasma to platelets. Although the individual did not describe what they felt like these challenges were, they did specify that they would prefer a ratio of 2:1:1 instead. When asked about concerns

related to calcium derangements, another interviewee stated that issues such as hypocalcemia or hyperkalemia related to rapid plasma transfusion are more likely to be problems in the pediatric population as opposed to adults.

Unintended Consequences

There were a few notable comments made by participants during the interviews that indicated some very unexpected, but promising consequences of this project. A trauma program director stated that because of this scholarly project and the interview questions, that they now feel like they needed to create a trauma specific MBT guideline. Additionally, another medical director of transfusion services/pathologist stated that one concern they have with calcium derangements is that they feel like there needs to be more awareness among training trauma practitioners regarding the relationship between citrate, hypocalcemia, and worsened coagulopathy. In addition to this, the individual at this facility stated that this interview caused them to think about the benefit of possibly adding automatic lab orders into their MTP.

Conclusion

All interviewees shared that their facility utilizes a massive blood transfusion (MBT) protocol, most interviewees feel as though their massive transfusion protocol (MTP) works well, and none of the facilities utilize a protocol that has been updated within the past five years or more.

Something that became evident as the data was analyzed is that while most people felt that their protocol worked well, there was a variety of suggestions regarding improvement to the protocols. In addition to this, it was noted that there was a lot of variation in what was being performed concerning lab monitoring and calcium management. Overall, the amount of variation

in interview responses gives further evidence of the lack of standardization in MTP and MBT practices.

Chapter 5: Discussion

Observations and Limitations

This project provided valuable insight into the experiences of providers regarding MBT and MTP, however, there were some barriers. The first barrier in this study was obtaining contact with individuals who were directly involved in the care of patients and the oversight of MBT. This negatively impacted the ability to obtain as many participants as was originally desired. After significant effort to establish contact, the interview process worked very well, and each person interviewed was happy to discuss the topic and answer interview questions.

One limitation to this study included the variation among the position of interviewees among establishments. For example, some of the individuals interviewed were in clinical roles, while others were in management roles, so the experiences and information available to them was not consistent across the board. In addition to this, experiences varied greatly as some of the individuals were in direct patient care while others were in a blood bank setting, so it was noted that emphasis on certain aspects of the MBT protocol varied.

One of the biggest challenges to this project included the definitions that each participant applied to the questions that were asked. For example, there was a lot of variety among the description of the criteria used to determine the need for MBT. In addition to this, there tended to be confusion related to the question about consistency of use. One way that this was addressed was by clarifying what was intended by the question, however it seemed to generate some confusion among interviewees as to the purpose of the question.

One lesson that I learned would be to make some of the interview questions more specific with more descriptive terms so that the intent of the question is clearer. In addition to this, I would consider giving more information regarding the topic of interview prior to the telephone

call, so that the interviewees would have the chance to obtain the information that is necessary to answer the questions. In future qualitative studies, I would also have another designated individual, such as the interviewee, read my transcript and interpretation of the interview to validate meaning.

Implications for the Doctorate of Nursing Practice

This scholarly project is important for providing insight into the process of MBT and to inform healthcare providers about the experiences that those within level 1 trauma centers have regarding MBT. This is beneficial as it highlights the variability of practices that are being performed among institutions and provides evidence to support the research and development of a standardized practice for a massive transfusion protocol. By showing what is currently being done at various facilities to manage patients undergoing MBT, it supports the need for a streamlined approach to this practice, but more importantly at this stage, it provides proof that to have evidence informed practice, there needs to be further research done in this area.

Application to Theory

The cognitive load theory was used in this scholarly project to explain that the mind's ability to store new information is based on both short-term and long-term memory as well as how information is delivered (Schilling, 2016). The goal of this project was to ensure that the audience understood the information that was presented to them and upon completion, to provide written material which outlined the outcomes of this study. Throughout the process of interviews, I believe that the information was understood properly, and the interviewees were each informed that the results of the study would be shared with them to help reiterate the purpose and results of my study.

In addition to this, the Neuman Systems Model was used throughout the study to support the goal of highlighting the need for a standardized protocol as the goal is to improve safety in the administration practices of MBT and ultimately to improve patient outcomes. Central to the Neuman Systems Model are flexible lines of defense around the patient (Hannoodee & Dhamoon, 2020). By showing that the current practice does not provide the optimal scenario for maintaining or restructuring these flexible lines of defense after a patient sustains a massive hemorrhage, evidence for further research can be confidently recommended.

Evidence Informed Practice

The purpose of this project was to evaluate massive blood transfusion (MBT) practices at various level 1 trauma care facilities throughout the United States to see what is currently being done and whether they utilize a massive transfusion protocol (MTP). In addition, the aim was also to determine how calcium is being managed at these facilities. After reviewing the literature, a knowledge gap was identified among providers regarding optimal MBT practices and protocol development, especially regarding laboratory monitoring for patients during this process.

As a result of this scholarly project, these findings related to MBT could lead to evidence-based change. By sharing these results with the facilities which were interviewed, it provides them the information they might need to change the way they are practicing MBT. One interviewee stated during the discussion of their current practices regarding lab orders, that once it had been brought to their attention, they thought that addition of routine lab collection to their MTP would be a good idea. This project promotes the importance of having an MTP as well as honestly portrays the experiences of the providers with MBT among trauma patients. As a result of this, it is the hope that there will be interest in pursuing future projects to help further validate the need for change in the current practice.

Key stakeholders include all personnel who are involved in the development and administration of massive blood transfusions. While the primary groups that would be affected by this would be the trauma department, surgery, obstetrics and gynecology, gastrointestinal medicine, and transfusion services, the true stakeholders for the results of this type of evidence-based change would be the patients. Plans for dissemination of this scholarly project include providing results of this study to the participants in an electronic written format such as an emailed brochure.

Implications for Future Projects

This scholarly project provides insight which supports the theory that there is a lack of standardization in protocol for administration of MBT and patient management throughout the process, from determining when a patient needs MBT to what products should be transfused, to which labs should be routinely monitored and how often. This lack of standardized practice could be contributed to by the fact that there is very little representation in the literature regarding best practices for MBT.

Throughout this project, it became evident that each facility is basing their protocol from a variety of recommendations and guidelines. This scholarly project can be used as the basis for furthering this body of knowledge for quantitative analysis on a larger scale. This is important because without investigation of evidence informed practice it will be difficult to propose change to the current standards of practice. Having a standardized protocol could improve patient outcomes as well as provide insight regarding areas of weakness throughout the MBT process. The potential implications of presenting this knowledge gap to various facilities, includes the opportunity to present this information at a higher level to additional governing bodies of healthcare policy. This could potentially lead to policy change at a state or even national level.

Conclusion

Massive blood transfusion (MBT) is an intervention that is performed in the setting of uncontrolled hemorrhage or acute blood loss. One of the most affected populations includes trauma patients. The literature review provided a variety of definitions for what constitutes MBT, but ultimately there is not one standard definition identified. In addition to this, the literature review supported the idea that hypocalcemia is a possible side effect of MBT and that if left untreated, can lead to adverse outcomes and even death for patients during MBT.

This scholarly project utilized an interview that was conducted at level 1 trauma care facilities throughout the United States and asked questions regarding MBT practices, massive transfusion protocol (MTP), and highlighted the experiences of the providers within this setting. The results of this study showed that MBT practices vary greatly regarding initiation of and administration of MTP as well as specific guidelines for laboratory monitoring throughout. Evaluating these experiences and outcomes will hopefully lead to further research to promote the development of a standardized approach to MBT administration in an effort to improve patient outcomes across the board for trauma patients.

One of the most prominent and important findings related to this project is that to the researcher's knowledge there have not been any large, multicenter, randomized clinical trials performed to evaluate survival with use of optimal massive transfusion practices with the inclusion of laboratory monitoring. In addition to this, there are currently no guidelines for monitoring and replacing calcium during MBT, which creates a gap in caring for the trauma patient who is already at a high risk for coagulopathy. As a result of this gap, most facilities garner evidence for product transfusion ratios and massive blood transfusion practices from varying institutions and guidelines. These findings support the need for more research regarding

optimal transfusion practices and protocol development for the efficient and safe practice of MBT.

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Appendix A

IRB Approval:

August 31, 2021

Principal Investigator: Rebecca Catherine Parker

Research Project: Level I Trauma Centers and Experiences in Massive Blood Transfusions

IRB Tracking Number: 2020-2021

Dear Rebecca Parker,

It is a delight to inform you that your research protocol titled "Level I Trauma Centers and Experiences in Massive Blood Transfusions" has been approved by the Southern Adventist University Institutional Research Board according to the proposal. You are now authorized to proceed with the project as outlined. This approval expires August 31, 2022.

As a principal researcher, you have the ultimate responsibility for the conduct of the study, adherence to ethical standards, and protection of the rights and welfare of human participants. As you proceed with your research, you are expected to:

1) Conduct the study according to the approved protocol.

2) Make no changes to the approved study. If changes are necessary, proceed with one of the following:
   a) For minor changes to this protocol, please notify IRB by submitting an IRB Form B and proceed after its approval.
   b) For substantial changes, submit a new IRB Form A and proceed after its approval.

3) Use the approved procedure and forms for obtaining informed consent and data.

4) Promptly report any significant adverse events to the IRB within five working days of occurrence using an Adverse Report Form.

All forms must be submitted to irb@southern.edu.

We wish you many blessings as you move forward with this study and look forward to reading your findings when they are ready. If there is anything else we can do to assist you with this research study, please contact us.

Always in His service,

Robert L. Overstreet, Ph.D

Robert L. Overstreet

Director, Center for Teaching Excellence,

Southern Adventist University

4871 Taylor Circle, Collegedale, TN 37315

robertoverstreet@southern.edu

www.southern.edu/cte

423.236.2085

Individualization – Developer – Empathy – Achiever - Harmony

Appendix B

Interview questions/survey:

Scholarly Project Massive Blood Transfusion Survey

I. How is massive blood transfusion (MBT) defined in your facility?

II. Do you utilize an MBT protocol?

III. What criteria do you use to determine the need for MBT?

IV. Describe for me the protocol or guidelines that you use.

V. What evidence or guidelines were used to develop your protocol?

VI. How long have you been using your current protocol?

VII. Tell me about the consistency of use of this protocol.

VIII. Tell me about a recent case where MBT was required.

IX. Which labs you are monitoring during MBT, why, and how often?

X. Tell me about the approach to calcium management during MBT?

XI. Share any concerns you may have about calcium derangements during MBT.

XII. Describe for me the outcomes among trauma patients receiving MBT.

XIII. How do you feel about the massive transfusion protocol you have in place, and do you have any recommendations for improvement in the management of MBT?

Appendix C

Informed consent/email:

To Whom it May Concern,

I am a doctorate of nurse practitioner (DNP) student at Southern Adventist University, and I am conducting a research study to examine how massive blood transfusions are performed and evaluated at level I trauma facilities throughout the United States. Participation in this study will involve a telephonic interview and will require approximately thirty minutes of your time.

Please be advised that there is a potential for psychological risk during participation in this study. Emotional distress is possible as participants may be required to recall an event or situation with a patient that was difficult while answering interview questions. Although this study may not directly benefit you, we hope that our results will add to the clinical understanding of how massive blood transfusions are performed and evaluated as well as to highlight the experiences of trauma providers regarding these interventions.

All interview responses will be anonymous. Only the researchers involved in this study and those responsible for research oversight/institutional review board (IRB) will have access to the information you provide. The responses will be audiotaped and transcribed into a document that will be stored on a locked computer in possession of the researcher.

Participation in this study is completely voluntary. You are free to decline to participate, to end participation at any time for any reason, or to refuse to answer any individual question. Your decision whether to participate in this study will not affect your relationship with Southern Adventist University. Each participant will receive a copy of the findings from my scholarly project once it has been completed.

If you would kindly agree to participate in this study, please contact me via email or phone as listed below. I am planning to conduct interviews starting now and continuing until March 15, 2022. I look forward to speaking with you further.

Sincerely,
Rebecca Parker, BSN, RN
Cell: (423) 435-1679
Email: Rparker@southern.edu

Appendix D

Transcribed interviews

Interview 1:

2/18/22 @ 11:20 am EST with California facility (telephonic interview)

00:00
Speaker 1
Can you hear me now?

00:00
Speaker 2
Now I can hear you. Yeah,

00:00
Speaker 1
Okay. I'm sorry about that. Yeah, it's no problem. I really appreciate that you are taking the time to talk to me.

00:00
Speaker 2
Sure

00:00
Speaker 1
So, thank you. So, I just wanted to give you a little bit of introduction here. So, this is my DNP research study. I am a DNP student at Southern Adventist University, and this is part of that. So, I wanted to let you know that the phone call will be recorded and of course if anytime you need to go or wish to end the call, that's perfectly fine, just let me know. Okay?

00:00
Speaker 2
Okay. Sure. No problem.

00:00
Speaker 1
Okay, great. Thank you. Any questions before we get Started?

00:00
Speaker 2
I don't think so. Hopefully I can answer what you need me to answer.

00:00
Speaker 1

Okay. Alrighty. Well, I will go ahead and get into it. So, I guess the first question I wanted to ask would be how massive blood transfusion would be defined at your facility?

00:01
Speaker 2
Yeah, so typically it is defined for MTP activation by the trauma attending surgeon, on call, based on judgment. So that may mean that it's, you know, patient comes in actively hemorrhaging and requires more than just the first two units of whole blood that we give. And usually if they're still unstable, we activate MTP at that point.

00:01
Speaker 1
Okay all right. So, there is no specific criteria used to determine whether they need it or not. It's more of a, like a judgment call in the situation?

00:01
Speaker 2
That's correct. I mean, we, you know, we're familiar with some of the general guidelines and tools that others have used, but I think in our place, there's a lot in this situation that becomes very dynamic and so we've decided to leave it to the discretion of the trauma attending, um, it helps, it helps us sort of mobilize the MTP quicker and makes it more efficient with less wastage.

00:02
Speaker 1
Perfect. Okay, gotcha. I understand. All right. So, is there a particular protocol that you use or any guidelines that you use in particular?

00:02
Speaker 2
You mean for activation?

00:02
Speaker 1
Yes, correct, or for the actual administration of the protocol, like is there a protocol I guess is what I'm asking?

00:02
Speaker 2
Yeah, we have developed an internal protocol in association with our blood bank staff at least prior to this last, you know, Omicron round of covid, included 6 units of packed cells, 6 of plasma, a pooled unit of platelets and at least an asp or 10 units of cryo for each box. And then, I guess to answer your question a little bit better, there's sort of the clinical protocol and then there's also an internal blood bank protocol for how they're prepping units, you know when they're converting to cross match units, that kind of thing.

00:03
Speaker 1
Ok great, that does answer my question. As far as the clinical protocol, Do you know where those guidelines were developed or based from? Like, which evidence?

00:03
Speaker 2
Yeah, It's been a long time.

00:03
Speaker 1
That’s Okay

00:03
Speaker 2
We sat down probably ten years ago with our blood bank folks and reviewed the literature at that time.

00:03
Speaker 1
Sure okay. Okay, so it's been quite a while. It sounds like that you've been using the current protocol that you have. One of my questions is, how long have you been using the current protocol?

00:04
Speaker 2
I would say at least eight years and maybe even ten years.

00:04
Speaker 1
Okay, perfect. And then, I wanted to know about the consistency of the use of the protocol. As far as I'm sure it varies from patient to patient, but do you feel like the protocol is consistently used each time?

00:04
Speaker 2
Yeah, I would say that we have a couple unique features to our protocol. So, it's activated and then continues, you know, one box at a time until it's discontinued by the trauma surgeon. And then, you know, at any point you can decide to discontinue the MTP, either the patient expires, or the bleeding has slowed down and you can convert to lesser quantities of products of one particular type. The other thing that sort of terminates things for us sometimes is if we get a TEG back and it says, you know, we need this or that and in lesser amounts than we may just sort of target our therapy, rather than blindly giving large quantities of everything

00:05
Speaker 1

perfect. Okay, that actually leads well into my next question, which was which labs are you monitoring during MBT?

00:05
Speaker 2
Yeah, we have I guess lots, you know hemoglobin, usual PT/PTT, the platelet count, the fibrinogen level. Okay, then of course, probably most importantly, is our TEG, For all of the functional aspects of things, you know. We're also looking at sort of general markers of resuscitation like, base absent lactate, um, to help guide if we continue an MTP or not, and then clearly bleeding from the field.

00:06
Speaker 1
Okay. Gotcha. And I have about, about three or four more questions. My next one is about calcium management. I'm wondering about your approach to calcium management during the massive blood transfusions.

00:06
Speaker 2
Yeah, it is, you know, particularly in the operating room our anesthesiologists are pretty good with managing the MTP with some help from our nursing staff, but they will routinely give calcium. Definitely beyond the first box, kind of repeating. So, probably for each box I would say on average, they give an amp of calcium depending on how the patient's doing, but that's, you know, that's sort of part of our routine protocol that the anesthesiologist does.

00:06
Speaker 1
Okay. I understand. So, it's more of a giving calcium. Is there any part of the protocol where you check calcium?

00:07
Speaker 2
We're getting point-of-care istats that have an ionized calcium on them. But if we don't have an opportunity to do that, for whatever reason and especially if the patient's hypotensive, then we'll just empirically give the calcium.

00:07
Speaker 1
Sure. Okay. Could you describe the outcomes among trauma patients that received MBT at your facility?

00:07
Speaker 2
just in general? You mean?

00:07

Speaker 1
Yes, in general, just from what you've seen?

00:07
Speaker 2
So, it depends on how extensive the MTP is. I mean for the large majority of our MTPs that don't require greater than five boxes. I would say the survival is pretty good, um probably upwards of seventy or eighty percent survival. For the patients that, you know, go on to true, massive, massive transfusion and, you know, a hundred units of cells, that kind of thing, it's probably more of ten to twenty percent survival. Um, if that. Those patients are obviously much sicker and have, you know, the organ failure and all the other dysfunction that goes along with, you know, a massive resuscitation.

00:08
Speaker 1
Sure, Okay. Gotcha. Alright.

00:08
Speaker 2
We also use TXA routinely, umm, we frequently use DCC and even Factor 7 sometimes to reverse anticoagulants as part of our MTP. You know Factor 7, we use pretty much in dire circumstances when we don't have anything else to give, but TXA is a routine part, really at the onset of when we activate MTP. I should have told you that before. Sorry.

00:08
Speaker 1
No, that's fine. That's fine. All right. How do you feel about the transfusion protocol that you have? Would there be any recommendations you would have for improving the management of MTP at your facility?

00:09
Speaker 2
I think in general, it works extremely well, you know, I think we when we originally designed it based on, you know, the triggers of whatever, I can't remember the name of the trial at the moment, but it was um, the penetrating trauma, the hypotension, but then we've modified it since then based on some of the ACS and tquip data and their guidelines that have come out, just to get your question from before, I forgot about that. And then, you know, I say it works pretty well. We tend to focus mostly from a quality standpoint, not only on lived or died outcomes, but we also look at wastage very carefully. And if anything, our implementation of MTP and how we've refined it over the years, we've reduced our wastage because we don't get in that situation where people are calling for, you know, "bring six units of packed cells to the room and let's just have them there just in case". All our MTP's come in a refrigerated box with a timer with warning signs, you know, you're getting close to the three-hour limit on the temperature, you need to get the box back to the blood bank. So, we have a bunch of processes in place to minimize wastage. And we're able to do that fairly well with wasting, maybe on average one or two units of packed

cells a month, which for the, you know, we probably do, I want to say, maybe 10 MTP's a month.

00:10
Speaker 1
Okay. Okay

00:10
Speaker 2
Yeah, something on that order.

00:10
Speaker 1
Okay, very good. Alright, well I actually was going to see if you would be able to tell me about a recent case where MBT was required.

00:11
Speaker 2
Okay. Umm Yeah.

00:11
Speaker 1
And if you can't, it's okay. If it's been a while or if you don't have any recent, it's ok.

00:11
Speaker 2
It's a matter of picking which one I guess

00:11
Speaker 1
Ah, okay.

00:11
Speaker 2
You know? Like we had a young man last week that had some psychiatric illness and stabbed himself under the under the jaw, hit his facial artery off his carotid and was literally exsanguinating through his mouth and, um, out the side of his neck. And so, we activated MTP fairly early for that. After two units of whole blood went in, we were able to get the bleeding controlled with a combination of surgery and interventional radiology taking care of it, MTP didn't go on very long cause we were able to do those things fairly expeditiously, so probably used no more than three boxes for him. And he's, you know, awake, and doing just fine in the ICU getting ready to move out today. So, good outcome. I think, you know, getting the right product to patients, particularly if they're TEG directed, the earlier we're able to do that, I think the better the outcome and, you know, clearly there's, you know, to give you an example, we've had other patients where there's just so much damage. I had a patient that was crushed by a car, actually. Sorry it was a an 18-wheeler tractor-trailer where he was working on it or something

the brake released somehow, as kind of a reflex he got behind it and tried to stop it from rolling backwards and got crushed between the tractor trailer and a wall and he had such extensive injury to his left chest wall and left retroperitoneum that it was really bleeding everywhere. We gave probably six boxes of MTP. We gave all the, you know, TXA, we gave factor 7 to that patient. He was fairly young, so we tried to be as aggressive as possible. But we ended up losing him later that night to just continued coagulopathic bleeding and that lethal triad. So, sometimes it works. Sometimes, you know, the patient's physiology and extent of injury is just too extensive and there's not things you can do to physically stop the bleeding cause it's literally bleeding everywhere. So, some good outcomes, some bad outcomes.

00:13
Speaker 1
Definitely. Okay. All right. Well, I genuinely appreciate the time that you've given and that was my last question for you and that concludes the study questions. But do you have any contacts that you would suggest that I could reach out to for this study?

00:14
Speaker 2
Sure, what kind of, is there a specific kind of center you're looking for? I mean, is it high volume users or is it, you know, someone that's just starting out?

00:14
Speaker 1
So, my criteria really is that it has to be a level one trauma facility, but a high volume user would be ideal. Just, I guess because of ability to answer the questions, would maybe be easier, but really besides the level one trauma care facility I don't have a particular criterion other than that.

00:14
Speaker 2
Ok, umm, I know [redacted]. They're fairly high-volume users of their MTP as well. She's fairly approachable. Her name is [redacted], she's been doing this about ten or fifteen years also.

00:14
Speaker 1
Okay. Wonderful.

00:14
Speaker 2
She's a fairly senior person over there. I might try her.

00:14
Speaker 1
That would be great.

00:14

Speaker 2
There's someone named [redacted]. They probably see less MTP, but they do have a protocol and everything.

00:14
Speaker 1
Okay, wonderful.

00:15
Speaker 2
But you might, I don't have their contacts in front of me, but you might try reaching out to them.

00:15
Speaker 1
Ok that's perfectly fine. Okay all right. I appreciate it very much. Thank you [redacted].

00:15
Speaker 2
Sure, good luck with your study.

00:15
Speaker 1
Thank you so much. Have a good day,

00:15
Speaker 2
You too bye-bye,

00:15
Speaker 1
Bye.

Interview 2:

Interview 2
3/2/22 @ 12:14 pm EST with Massachusetts 1 Facility (telephonic interview)

00:00
Speaker 1
Okay, can you hear me?

00:00
Speaker 2
Yes.

00:00
Speaker 1
Okay, perfect. Okay. So, thank you again. Just to reiterate what I'm doing; this is a DNP research project for Southern Adventist University and it's part of part of the research towards that degree. And if you are okay with being recorded and you don't have any questions, we can go ahead and get started.

00:00
Speaker 2
I'm fine with it. And I would like to jump right ahead.

00:00
Speaker 1
Sure.

00:00
Speaker 2
We can back up. Let me jump right ahead to number thirteen. Okay, how do I feel about my MTP that we have in place, and do I have any recommendations for improvement in the management of it? Yes, I do.

00:01
Speaker 1
Awesome. That's great.

00:01
Speaker 2
So, what about your call and the timing is pretty good in that, cause I'm reviewing all of my trauma policies, you know, policies have to be reviewed and updated every three years and I don't have a massive transfusion policy per se for the trauma department. We have one that's basically hospital wide. If you think of the services that would use it of course would be trauma, obstetrics, and GI. Those are our big bleeders. and what we use, you know, and I can only speak for trauma. That's my department. We use something called, and it's not a guideline that we have written, but it comes from the American College of Surgeons, it's called the American College of Surgeons Massive Transfusion in Trauma Guidelines. So, it's specific to that cohort of patients. If you want, I could send you a copy of it.

00:01
Speaker 1
Oh, that would be excellent. Yeah.

00:01
Speaker 2
Yeah. Let me while we're thinking of it I'll dig it up and send it to you right now. Just so I don't forget.

00:02
Speaker 1
Okay, great. Thank you

00:02
Speaker 2
As soon as we hang up I'm off to a meeting.

00:02
Speaker 1
Okay.

00:02
Speaker 2
I go to lots of meetings. Are you in [redacted] now?

00:02
Speaker 1
I just moved here from [redacted]. Yes. I'm here. Now,

00:02
Speaker 2
Yeah, well, what part of the city do you live in?

00:02
Speaker 1
I actually live in [redacted] so I'm not really in [redacted] per se. But, yeah, or [redacted]

00:02
Speaker 2
Yeah. I live in [redacted].

00:02
Speaker 1
Okay. Okay.

00:02
Speaker 2
So, Let's see. I need to find. What was your email address? I want to do a search and just attach on.

00:02
Speaker 1
Sure, it is [redacted].

00:03
Speaker 2
There we go. Okay. I think that's the right one. Yep, that's it. Okay.

00:03
Speaker 1
Okay.

00:03
Speaker 2
So, what I'm sending you is the practice management guidelines. Are you familiar at all with trauma?

00:03
Speaker 1
I am, I actually came from a neuro trauma ICU in [redacted]. So yeah, I'm familiar with it.

00:03
Speaker 2
Okay, so I've been in program management for about twenty years. I moved here from [redacted], and I worked in [redacted]. You may have heard of one or both.

00:03
Speaker 1
I have, both, yeah.

00:03
Speaker 2
and I did a lot of work with [redacted], you know, in state, you know, the [redacted] because we worked with [redacted], what have you. But, anyway this ACS Tquip massive transfusion guideline is pretty good. And in the back of it, I think there's going to be, you know, there's references to where they got their information as best practices. And so with your list of questions, and I was reading over it with my PI coordinator, [redacted] and you know some of these things we can't answer cause we just don't know, right? So yes, I do have that my protocol in place is adequate. However, going back to like number one, these questions in my opinion, should be some of these, if not all, should be addressed in the protocol that we have. So, okay, So the question is, you know, how do we define a massive blood transfusion, and it's greater than ten units in 24 hours, and that's how we would do it. But for a Tquip purpose, they have a little different, Tquip is trauma quality improvement. It's a benchmarking program that every ACS verified center participates in. So, what they do is, they see, you know, they look at patients. They can know the traumatic mechanism and they have shock. Cause what we do is we put in their first set of Vital Signs. Say they have a pulse less than 90 and a heart rate of 160, they're in shock. And then, you know, by answering the question that way, the algorithm is kind of anticipating that you're going to give blood or some type of damage control surgery or the patient dies, because you have to do something. You're probably familiar with the program "Stop

the Bleed". Yeah so, we want to stop the bleed. You can't just keep putting blood and fluid and what-have-you into a box with a hole in it, and to kind of really dumb it down for nurses. I'm a nurse myself, not that they're dumb. But these, the baby nurses.

00:06
Speaker 1
Oh, I know. Yes. Right, right.

00:06
Speaker 2
So, I just put everything in simple terms. So, this algorithm predicts that you're going to give blood. So, you know, we have a trauma registry, it's a database that I have a team of people that work on. And you know, we track the blood use as well. So, we put it in not only as a procedure code but we also put it in in the Tquip module and Tquip on the back end runs data off that and then we get a benchmarking report. So, you know how many shock patients in all the participating hospitals in Tquip, and there's about 800. So, all the shock patients, shock's been identified, the algorithm knows who that is, how many received blood? And then the next line would show my hospital and shock patients and if they received blood. And there's a, there's an anticipated percentage like, you know, nationally, it might be, you know, say three and a half percent are anticipated to have received blood, but your hospital only gave one and half percent. You might be an average high or low outlier for that. So, then I would go back in. Look at that data. Look at these patients that we included in the list. Let me go back say hey, this patient met shock guidelines. Did we give blood? Yes or no? If we did, how much did we give? And we track MTP. We get a report monthly from the blood bank about MTP use. So, we look at it, you know, the thirty-thousand-foot view is looking at the MTP you know, if we have it in place. The five-thousand-foot view is, did we give the right ratios? The right ratio is like ideally, you're going to give 1: 1: 1. One RBC, one platelet, or one FFP and one platelet. And we rarely meet that ratio. Not because we're bad at it, it's because timing, you know, fresh frozen plasma has to be thawed, you might have you know, blood ready to go, So they give four to six units initially, then when the FFP is thawed you give it to them. Then you never really catch up. We look at things like that. So, I'm going to open up one of my database records and go to the Tquip module because I think there's two ways to answer this and this is going back to the original question. How do we define an MTP massive transfusion policy or infusion? And I put just started answering the questions and I had greater than ten in twenty-four hours, but I want to see if the Tquip answers different. Yeah, so they want to know how, if we gave blood products, how much did we give in the first four hours? And that's all we collect for the benchmarking tool. So, there's two ways for me to answer that and I hope I'm not going to cause confusion and I'm going to go back to your questions here. Have you spoken to other people and gotten responses yet?

00:09
Speaker 1
So, you're actually only my second response. I've only spoken to one other facility about it. Yeah, I've had a little bit of trouble, you know, just kind of reaching out and getting direct contact information. So yeah, you're actually, you're at the beginning of the study.

00:10

Speaker 2
If you'd like I can give you a couple of referrals

00:10
Speaker 1
That would be amazing, and I would greatly appreciate that. That would be wonderful.

00:10
Speaker 2
Sure. What I'll do is when I hang up, let me make myself a note, okay? Referrals. [redacted], these are two of my former colleagues from [redacted] one's at a level 1 Trauma Center in [redacted].

00:10
Speaker 1
Okay.

00:10
Speaker 2
And the other one is at a level two, that's becoming a level one in [redacted].

00:10
Speaker 1
Okay. Wonderful. That's great.

00:10
Speaker 2
You'll probably get more help from the one in [redacted]. She is the program director. My contact in [redacted], she was my trauma coordinator when I was her manager, but she's typically very helpful. And of course, you know, I'll send you her name. Reach out to her and say that you were referred to her by me. And if she could help great, if she can't, she can't right?

00:11
Speaker 1
Right, definitely that's very helpful. Thank you for offering that

00:11
Speaker 2
my pleasure. So, here's how I'm going to answer number one, greater than ten units, in 24 hours.

00:11
Speaker 1
Okay. All right, very good.

00:11
Speaker 2

And for number two. Yes, we use one and it's used for trauma, GI and obstetric patients. And not exclusively, but those were our three big ones. And criteria. What criteria do we use for the need for MBT? That's kind of a, that's an interesting question. That's where I kind of got hung up. Okay. So, looking at it from a trauma perspective, if we have a patient that has a penetrating injury or blunt injury with a positive FAST ultrasound, they have a pulse less than 90, that patient is going to go directly to the OR. You know? And that doesn't mean we're going to start giving blood right away. But if they're in their sixties and their hypertensive, not hypertensive, tachycardic, they're probably going to get some blood. Okay, specific criteria, like we're not drawing the labs initially to guide our massive transfusion policy. What they're going to do is base it on the patients presenting condition and complaint. Okay, so that that's kind of a tough one to answer. I would like to say, well, they had a hemoglobin of seven or below. You know, their INR was wackadoo, PTT was bad, you know, but I can't. Because it's not in our guidelines.

00:13
Speaker 1
Right, understandable. Okay.

00:13
Speaker 2
For number 4. The protocol guidelines that were used. Again, we have a hospital-wide massive transfusion policy protocol actually. If you want, I can send you a copy of that too.

00:13
Speaker 1
Okay? Yeah, I would appreciate that. Anything that you have would be appreciated. Yeah.

00:13
Speaker 2
Sure, I have it. I just sent it to [redacted] my PI coordinator, and I should have it right here. Forward, [redacted]. Okay I just sent that one to you.

00:13
Speaker 1
Okay. Thank you

00:13
Speaker 2
And you'll see if, you know, once I read it,

00:14
Speaker 2
It doesn't help me at all. And I know, so for a trauma perspective and like, you're married to a physician

00:14
Speaker 1

Correct.

00:14
Speaker 2
As am I. My, my, my physician wife is a trauma surgeon. Trauma fellow, and she's a critical care doctor and we were discussing this when we were on vacation out in [redacted] and I said uh, do we have an MTP? She goes. Yeah, I don't I don't look at that thing. She didn't even know we had one. She knows we should have one. But the point I'm trying to make, is she looks at the patient when they arrive.

00:14
Speaker 1
Sure, sure.

00:14
Speaker 2
They have a penetrating injury or blunt injury with a positive FAST, and they're in shock or, hypotensive and tachycardic, they could even be, you know, they could even have a low heart rate. She's going to treat the patient and resuscitate them. Give them blood, get them to the OR to fix whatever's bleeding quickly. Or if they had, if they had a vascular injury or bleeding, she's going to tourniquet it, give blood if necessary and then fix the injury.

00:15
Speaker 1
Okay.

00:15
Speaker 2
So, what criteria do we use. That's a hard one. describe the protocol or guidelines? I just sent you the protocol we have in hospital. We more, the doctors are more familiar with the practice management guideline massive transfusion for trauma patients. Okay. Yeah, what evidence or guidelines were used to develop your protocol? The protocol that we have that's hospital wide, it references the technical manual from Bethesda Maryland from the American Association of blood banks and it's from 2008. That's old. Okay. So, if anything this is going to prompt me to relook at how we do things. I know we're doing it right, but the way we have it in a protocol doesn't really address what we do in trauma. So, thank you.

00:16
Speaker 1
Okay. Oh, yeah, wonderful.

00:16
Speaker 2
So how long have we been using the current protocol with the hospital? I would have to go, I couldn't see the date on it for the last time it was updated, but I would say it's been here since

2008 at least or 2009. Okay, just going by that reference of the blood bank association for 2008. The Tquip massive transfusion guidelines, they came out in 2014.

00:16
Speaker 2
And you'll see that in the document I sent you. It's at the bottom, right. It says released 2014.

00:16
Speaker 1
Okay.

00:17
Speaker 2
6 or 7. Consistency of use for our protocol. I mean we are very good at identifying patients who need it and administering it and other things that happen with that is just like in our trauma bay we have a blood refrigerator that has four units of uncrossmatched blood, we have two units of o positive and two units of o-negative, we also have four units of FFP in there, and there's no delay in getting the blood. Once the MTP is activated, you know, we call the blood bank and say MTP activated by Doctor [redacted] and they prepare a cooler and a runner goes up there and grabs the cooler, comes down and the blood is administered and everything's, you know, monitored and evaluated. And then, once the MTP is stopped, we have to call the blood bank and they stop preparing blood, but they're preparing blood until we call them and say stop. So, it's an ongoing process. Okay, number eight, a recent case. Yeah, that's where I would have [redacted] involved, but we were talking about it. And what we do is like, I was telling you, we get monthly e-mails on MTP use and they ask us were there any problems identified with this case and we have not had any. So, it works quite well and we're not a knife and gun club here. We don't get a lot of penetrating trauma. We don't get a lot of that blunt trauma where some would need the MTP. So, we're not a high-volume blood transfusion, or massive transfusion administrator if you know what I mean.

00:19
Speaker 1
I do. Yes. Okay. I understand.

00:19
Speaker 2
And I say that cause there's [redacted] level one trauma hospitals here in the city of [redacted]. We're all within about [redacted] of one another, so.

00:19
Speaker 1
Right. Right.

00:19
Speaker 2

I don't want to say there’s competition for the trauma patients, but you know, EMS has many places to go.

00:19
Speaker 1
Right, lots of options. Yeah.

00:19
Speaker 2
Number nine, labs we monitor? Your normal labs, CBC, h&h, INR, PT, PTT. You were asking about calcium also, I don't know. I know it is used but I don't know when or how. I'm not bedside anymore, you know, it's been six or seven years and I'm not a critical care nurse. I’m an ED/trauma nurse, so our job is to treat them and street them.

00:20
Speaker 1
Right, right. Understandable.

00:20
Speaker 2
Let's see. Number 10. Well, the frequency of labs serially, they're going to do them at least probably at minimum every eight hours, but they're going to do them as the progression of care takes place. If they're stabilized, they have good vital signs, they will back off on drawing labs. But you know, they could do them up to every hour. We also have point of care testing where they can check an H&H pretty quickly.

00:20
Speaker 1
Okay, very good.

00:20
Speaker 2
Number 10. I can't answer.

00:21
Speaker 1
That's okay. That's perfectly fine.

00:21
Speaker 2
Number 11, again, I can't answer that. But what I will do is I'm actually meeting with my wife at 1:00 to go over a different project. Okay. She works right down the hall from me, and I will ask her about ten and eleven.

00:21

Speaker 1
Okay wonderful, Wonderful. Thank you.

00:21
Speaker 2
Sure number 12. Oh, outcomes, you know outcomes are pretty good. Our mortality rate is very low here at the hospital. We're about 4% mortality rate, which is under the acceptable maximum of 5%. Some hospitals are higher, you know they're going to get sicker patients. You know like [redacted]. They're the knife and Gun Club here in [redacted] and they probably have a higher mortality rate, but they also have a higher trauma volume too, so I don't know how many they have. uh, Let's see.

00:22
Speaker 1
Is that I'm sorry, was that percentage you shared, was that like trauma related outcomes or hospital-wide outcomes?

00:22
Speaker 2
I can only speak for trauma. So, I'm going to make it very myopic in my view.

00:22
Speaker 1
That's actually fine. Because that's what I'm wondering. But I just wanted to make sure I understood correctly.

00:22
Speaker 2
Yes. Good question. Let's see, number 13. Well, number 13 like I mentioned in the beginning, I think we have some opportunities for improvement. Okay and you know, the hospital transfusion protocol is fine as it is, and if you, if you can appreciate the differences between protocols, policies, guidelines and directions, the protocol is something you're supposed to follow without deviating. And, you know this protocol is easy to follow. Now, contrast that with the ACS Tquip massive transfusion and trauma guidelines, It's a guideline. So that's two steps away from our protocol. So, what we try to do rather than writing in trauma protocols, because there's no cookie-cutter way to treat patient A compared to Patient B. You have two gunshots to the belly that come in at the same time, You can't treat them the same way because you don't want to, you don't know what vessels they've hit. Two, one could be a pregnant woman, one could be a ninety-year-old man.

00:23
Speaker 1
Right

00:23
Speaker 2

You know that 90-year-old man could have a bunch of comorbidities, the pregnant woman could be otherwise healthy, and it's how they react, you know, what kind of vital reserve do they have? You know, like a lot of old people are on beta blockers. They're not tachycardic and I said, I bet they're on a beta blocker, while their pressure's 80 and their heart rate's 65. I'm going they're in shock or they're in pain, you know, one of those types of things. So, I think for trauma, what I probably need to do is discuss with my leaders, you know, the trauma surgeons, is the development of a massive transfusion policy or guideline specific to trauma, that would refer back to the hospital's massive hemorrhage transfusion protocol.

00:24
Speaker 1
Okay.

00:24
Speaker 2
So, if anything, you know, if you're making comments, you know, one trauma program director, felt that he needed to create a guideline trauma specific.

00:24
Speaker 1
Okay. Wow, yeah, definitely. That's actually really awesome to hear that. I feel like I have found the right person to speak with for this. So, I really appreciate your effort and your time for this.

00:25
Speaker 2
Sure, and feel free to reach out to me for anything else, you know, I say it's a small community. You know, I'm always glad to help or connect people and you know, it does more for me than it does for the other people typically, because I like to help. So.

00:25
Speaker 1
That is wonderful. And you have been an extreme help for me. So, thank you again.

00:25
Speaker 2
I'm glad to hear that. So, I'm going to send, let's see. I'll call them first to make sure it's okay. Okay, I will send you their contact information if they agree and I'll let you know either way.

00:25
Speaker 1
That sounds wonderful. All right. Thank you.

Interview 3:

3/3/22 @ 11:00 am EST with Massachusetts 2 Facility (telephonic interview)

00:00
Speaker 2
Hey, this is [redacted].

00:00
Speaker 1
Hello, [redacted]. Hi, this is Rebecca Parker. I spoke with you via email about doing the interview. do you have time for that?

00:00
Speaker 2
Well, yep, I sure do. I sure do, now works well.

00:00
Speaker 1
Wonderful. Thank you so much for being willing to participate in this research study. It's really appreciated. Just to reiterate, I am Rebecca Parker and I'm a DNP student at Southern Adventist University. And what I'm doing today, this interview is part of my doctoral research towards that degree. So, I just wanted to say one more time. I know I mentioned in the email, but the phone call will be recorded as long as you're okay with that. Okay, perfect. Perfect. Do you have any questions before we get started?

00:00
Speaker 2
Nope, I don't

00:00
Speaker 1
Okay, great. So, what is your position at [redacted]?

00:01
Speaker 2
I'm the associate medical director of transfusion medicine and cellular therapy.

00:01
Speaker 1
Okay, great. Okay. And so, this will be about massive blood transfusions. My first question is, how are massive blood transfusions defined at your facility?

00:01
Speaker 2
At our facility, we define patients requiring more than one total blood volume in 24 hours as massive transfusion.

00:01

Speaker 1
Okay. Perfect.

00:01
Speaker 2
And of course, you don't have to have bleed that much to initiate a massive transfusion protocol.

00:01
Speaker 1
Okay. Okay. All right, very good. So that actually leads well into my next question. Do you utilize a protocol for your massive blood transfusions? It sounds like you do.

00:02
Speaker 2
We do, we have a blood, It's called The blood bank massive transfusion policy, so that's an internal policy for the blood bank, regarding selection of products, cross-matching and administration of products.

00:02
Speaker 1
Okay. All right, very good. And my next question is, what criteria do you use to determine if a patient needs the massive blood transfusion?

00:02
Speaker 2
We leave that up to the floor clinicians. So, you know, we define rather, what I defined earlier was a massive hemorrhage. You know, we define that as needing more than one blood volume in 24 hours, but it's for clinicians who suspect that they're patient is bleeding rapidly enough or has lost enough blood that they are at risk. We allow the floor physicians to initiate a massive transfusion.

00:03
Speaker 1
Okay, Okay, very good. Could you describe for me? The protocol that you guys use?

00:03
Speaker 2
Yes, absolutely. So, first of all, we request that the ordering clinician contacts the blood bank, and the blood bank staff. They can verbally order, or they can send a paper order, but they do eventually need to loop back around into our computer system at a later time and place a physical order. Okay. At that time, the blood bank will contact the pathology resident, or the medical director, just to loop them in. Okay, at that time we begin to issue coolers and the first cooler contains blood and plasma and a packed red blood cell. We use here, a one to one, to one ratio.

00:04

Speaker 1
Okay.

00:04
Speaker 2
So that first cooler contains six red cells, six plasma, and one platelet.

00:04
Speaker 1
Okay. Okay, very good.

00:04
Speaker 2
And then, of course, that's sent to the floor, we remain in contact with the floor, and if they need additional units, we'll send other coolers with those same ratios therein and then we the blood bank will suggest cryoprecipitate administration as needed.

00:04
Speaker 1
Okay, perfect. Very good. My next question is, which guidelines or what evidence was used in the development of this protocol?

00:05
Speaker 2
We use gracie et al. guidelines for massive transfusion from Bethesda, Maryland and then we also used recommendations in technical manual by AABB Technical manual.

00:05
Speaker 1
Okay, very good. And how long have you guys been using this current protocol?

00:05
Speaker 2
That's actually a good question. Let me see if my document here contains an initial implementation date. The last major revision to this policy, I've been here for about a year. So, I don't know the whole history of everything, the last major revision to this document was in February of 2017, Okay, so I guess you could say since 2017, although preceding that was probably relatively similar.

00:06
Speaker 1
Okay. Okay, very good. And let's see here. The next question I have is, do you have any data or know any information about the consistency of the use of this protocol?

00:06
Speaker 2

I guess that your question would be how consistently the blood bank gives out the same number of units?

00:06
Speaker 1
Correct Yes.

00:06
Speaker 2
We use it Consistently. So, if a massive transfusion is ordered, to my knowledge, unless there are sort of major constraints, we proceed with those same ratios.

00:06
Speaker 1
Okay, perfect. Yes, that actually, that's exactly what I was asking. Perfect. Could you tell me about a recent situation where massive blood transfusion was required for a patient?

00:07
Speaker 2
Yes. We had a patient transported in, he was a trauma patient who had a cardiac stab wound and he was taken to the OR for an emergent thoracotomy to repair the laceration. And then he also had cardiac ischemia due to vessel damage in the laceration there. So, because of blood loss and challenges with end organ perfusion, cause of the reduced ejection fraction, a massive transfusion was ordered.

00:07
Speaker 1
Okay, very good. And during the massive blood transfusion, which labs are routinely monitored, and how often are they routinely monitored.

00:07
Speaker 2
Currently, specific labs are not required by our protocol. Of course, we need two type and screens as soon as possible. We don't need to have those type and screens resulted to release the massive transfusion cooler. But, if at all possible, we prefer to have them drawn before the massive transfusion begins because we don't want to be testing the transfused product. We'd rather be testing on you know, the patient's own physiologic blood for ABO and Rh and other antibodies. We do Stay in close contact with the floor, and we recommend a number of other labs be followed. So certainly, a CBC mainly for hemoglobin hematocrit and platelet counts. Okay, we recommend that they follow coagulation markers. So, we do PT, PTT, and INR. We recommend they follow fibrinogen closely and order as needed based on those levels. And then additionally, we find it valuable to follow the patient’s ionized calcium and ph. We like to follow the ionized calcium just because when you're getting so many products and they're preserved with citrate or a citrate solution, that can cause hypocalcemia. And when you have hypocalcemia, then your coagulation factors tend to work more poorly. So, we see sometimes we’ll see patients who are hypocalcemic, and that very well may be contributing to a

coagulopathy. We also sort of keep an eye on other electrolytes. You want to make sure you're not giving someone a potassium overload because there's a little bit of extra potassium in some of the older units we transfuse. We like to follow blood urea nitrogen, to make sure there's no sort of platelet defect caused by high nitrogen. And then we also follow pH because if you get more acidotic, that can lead to coagulopathy also.

00:10
Speaker 1
Okay, awesome. Okay, perfect. That leads really well into my next question, which was actually about calcium management. If you could, which you already have kind of explained this to me, but the approach you guys take to calcium management during massive blood transfusion. As in like, is it empirically treated per red blood cells given, or is it checked and then replaced accordingly? That's what I'm wondering.

00:10
Speaker 2
We follow the laboratory values and replace accordingly. So, it's not empirically treated, although, that might be a reasonable thing to think about.

00:11
Speaker 1
Okay, very good. Very good. Yeah, so, that was, that was a big part of my initial plan with this project was about calcium derangements. So that's why a couple of these questions are geared towards that. So, you have already answered this next question, but if you have anything to add, my next one is to share any concerns you have about calcium derangements, which I know you've already spoken to that, as far as the coagulopathy. Are there any other concerns that you have regarding calcium derangements?

00:11
Speaker 2
I guess, one concern along those lines is not specifically about the treatment but just about awareness. So, it's great that you're focusing your project on this topic. I think, I, it seems just in my experience. I don't have any data, but in my experience, it's trainees and even sometimes trauma teams or OR teams, usually trauma teams, anesthesiologists, seem pretty good at following ionized calcium at our institution, but sometimes it feels like trauma trainees don't have calcium and calcium derangements foremost in their mind during the treatment of a trauma. And certainly, you know, blood counts are probably a little more important if I had to have beautiful iCal, or, you know, a hemoglobin of nine, I'd probably pick a hemoglobin of 9. Right? Right. It's, it's very, it's very important and I think it can be, iCal and fibrinogen might be the things I see teams not thinking about as often as I would like them to.

00:12
Speaker 1
Okay, great. Perfect. Could you describe for me the outcomes among trauma patients that received massive blood transfusion at your facility?

00:13
Speaker 2
I don't have precise data in front of me, obviously outcomes range from severe morbidity and mortality to, you know, excellent outcomes without morbidity and mortality. And that seems to vary a lot with severity of injury or on the cause of the bleed, and the ability to treat somebody versus not.

00:13
Speaker 1
Perfect. So variable, very good. This actually is my last question for this study, but how do you feel about the protocol that you have in place? And do you have any recommendations for improvement in the management of these transfusions?

00:14
Speaker 2
I think personally that in the literature some of the studies supporting a 1 to 1 to 1 transfusion ratio, are, have a few challenges, so I actually prefer a 2 to 1 to 1 transfusion ratio with either two units of packed red cells, providing oxygen-carrying capacity to one unit of plasma to 1/6 of an apheresis platelet. Okay. So, I think if it were up to me to redesign, I might consider changing the ratio to 2 to 1 to 1. And as we discussed, it might be valuable, you've sort of made me think a little bit like, oh, it might be really nice to include within the massive transfusion protocol automatic lab orders. Okay, at least in patients who do require a significant amount of product. It's kind of interesting because, you know, as teams order, you know, they may order a massive transfusion protocol, but a large number of teams that order them don't end up using much or sometimes any of the products. So that that's something I'd have to think through, but maybe, okay. Maybe automatic lab ordering would be a valuable addition.

00:15
Speaker 1
Okay, great. Well, I really appreciate you answering these questions. That was extremely helpful for me and that actually concludes all of my interview questions. So, if you have any questions for me, I'd be happy to answer them. If not, then we're actually through.

00:16
Speaker 2
Well lovely and very best of luck with your research and with your degree.

00:16
Speaker 1
Thank you so much [redacted], I really appreciate it. I hope you have a wonderful day. Okay.

00:16
Speaker 2
Thank you so much, you too.

00:16

Speaker 1
Okay.

00:16
Speaker 2
Yep. By Rebecca.

Interview 4:

3/8/22-11:17 am EST with Maryland Facility (telephonic interview)

00:00
Speaker 1
Oh hello, [redacted].

00:00
Speaker 2
Yes.

00:00
Speaker 1
Yes. Hello. This is Rebecca Parker.

00:00
Speaker 2
Yes. Yes. I'm a physician on call it's been a little tricky. And so, I apologize. I didn't realize you didn't have my number.

00:00
Speaker 1
Oh, no problem at all. I didn't realize until today either. So, it's my fault I should have checked sooner. So, no problem. I really appreciate that you have agreed to participate in this study, and I really am grateful for your time. So, just to reiterate, what I sent in my email. I'm a DNP student at Southern Adventist University. And this research project is part of that degree, and this phone call is being recorded. So, I just wanted to make sure to mention that one more time and make sure you didn't have any questions before we got started.

00:01
Speaker 2
No, it's good. So, you said it's about 30 minutes, right? Just want to make sure.

00:01
Speaker 1
Yes, they have typically been less time than that anywhere from 15 to 30 minutes.

00:01

Speaker 2
Okay. Okay. Go ahead.

00:01
Speaker 1
Okay. So, what exactly is your position at the facility where you work?

00:01
Speaker 2
I am the medical director of the transfusion service. And I'm a professor of pathology and medicine at the [redacted].

00:01
Speaker 1
Okay. Wonderful. Okay. So, my very first question here is how, how are massive blood transfusions defined at your facility?

00:01
Speaker 2
So they are, so there is an order. Are you talking about the actual clinical situation? Or are you talking about the, the provider ordering, you know, a certain amount of blood to support a patient, who is bleeding? So, I really need a little bit more information on your question.

00:02
Speaker 1
I understand, completely. Yes. Let me see.

00:02
Speaker 2
Are you talking about the patient, or you know?

00:02
Speaker 1
The units of blood, like how many units of blood given in a specific amount of product or given in a specific amount of time would constitute a blood transfusion for you guys.

00:02
Speaker 2
Yeah. So, uh, it's usually so I'm going to pull out because we have an exact definition. And if you'll bear with me on that. I'm going to actually open it up.

00:02
Speaker 1
Okay, no problem.

00:04

Speaker 2
Yes, so the number of units we have a blood component resuscitation module. Okay? That teaches physician what is exactly resuscitation. So, I want to give you the exact number for ours because it may vary from institution to institution and to make sure I don't give you, you know, so it's basically two units, more than two units in an hour. I just want to make sure I give you that exact number.

00:04
Speaker 1
Sure. Thank you.

00:05
Speaker 2
I don't know it on top of my head. I'm not, you know, I'm not at the bedside. Right? So, I'm going to also because I'm on call and I don't, I usually have an intern with me and he's not here today. But to answer your question, it's at least 4 units in an hour or ten units within ten to twelve hours.

00:06
Speaker 1
Okay. Perfect. That answers my question. That's great.

00:06
Speaker 2
Okay. Can you hold on one second because I did get paged.

00:06
Speaker 1
Absolutely. No problem.

00:06
Speaker 2
It’s going take two minutes okay. Sorry.

00:06
Speaker 1
No problem. Yeah, no problem.

00:08
Speaker 2
Rebecca. Sorry.

00:08
Speaker 1
That's perfectly fine.

00:08

Speaker 2
Yeah, I'm sorry. It may happen again, but it shouldn't take too long. Hopefully.

00:08
Speaker 1
No problem at all.

00:08
Speaker 2
Okay. Go ahead, what's your next question?

00:09
Speaker 1
Okay. So, my next question, which I think you've pretty much already answered it, but my next question was, do you utilize a protocol and it sounds like you guys do.

00:09
Speaker 2
Right, so, whenever we have a patient who's you know, who has the requirements. You know, it may also be a patient coming in the emergency room. We have the largest trauma center in the country. So, they have their own protocol to activate it, as well which is based on, you know, vital Signs, no systolic blood pressure, no pulse, you know, basically it's lower lactate. High lactate sorry, usually above three. I mean those are clinical indicators that they're depending on the clinical situation for the initiation of units.

00:10
Speaker 1
Very good. That actually leads really well into my next question, and you may have already answered that, but what criteria is used to determine the need. Like a clinical scenario for a patient, what criteria would be used. You mentioned vital signs, lactate, and you know, I just wanted to see if you could describe that criteria for me.

00:10
Speaker 2
Uh, yep. Just gave it to you. Okay, so, you got that.

00:10
Speaker 1
Yes, ma'am. I have that. Okay, so then the next one here. What evidence or were there any specific guidelines that were used in the development of the protocol your facility uses?

00:10
Speaker 2
I'm sorry. Can you repeat the question, please?

00:11

Speaker 1
Yes, what evidence or guidelines were used to develop this protocol that you guys used? Was there a particular study or a particular guideline that you guys used if you know.

00:11
Speaker 2
Yeah, it's a pretty standard resuscitation protocol, you know across the practice of transfusion resuscitation. Okay, so it's pretty much standard and it follows the rule of one to one. So having, you know, a normal, an equal ratio of red cells, plasma and platelets which are the three major components of the peripheral blood.

00:11
Speaker 1
Okay. Okay, very good. And do you know how long you guys have been utilizing this protocol?

00:12
Speaker 2
At least twenty years

00:12
Speaker 1
Okay, very good. And could you tell me about the consistency of use of this protocol?

00:12
Speaker 2
So, it is consistently used. There's always a need for education. There is sometimes abuse of it because they are not necessarily meeting the clinical requirement and a patient needs blood right away but are not massively bleeding…that can be a little bit of an abuse of ordering this to get blood faster. And we just like the physicians not to do that. It's more of a risk of abuse rather than, you know, consistency and using it when it's needed.

00:12
Speaker 1
Very good. Okay, that makes sense. So, I know that you mentioned you were not in the clinical setting right now, if you cannot answer this next question, that is perfectly fine, but it is to tell me about a recent case where massive blood transfusion was required.

00:13
Speaker 2
Yes, so all I can tell you, is that in the blood bank, we get a call about, you know, a patient. And most of them are going to be trauma, motor vehicle accident. They activate a massive transfusion event immediately upon evaluating the patient in trauma resuscitation unit. And then the blood sometimes, you know, they will use up to fifty, a hundred units of blood to save a patient and in less than 24 hours.

00:13

Speaker 1
Okay. Wow. Yeah, okay. And during the massive blood transfusion, which labs are routinely monitored, and how often?

00:14
Speaker 2
So yeah, that's hard for me to answer technically. It's going to be you know, the CBC, there's a regular lab, chemistry. And then we usually also use a ROTEM, you know, basically thromboelastography to understand how solid the clot is.

00:14
Speaker 1
Okay. Very good. Okay, Could you tell me about the approach to calcium management during the massive blood transfusion?

00:14
Speaker 2
Yes. So, calcium management is administered based on ionized calcium levels, you know, so it is monitored with routine labs. Usually every 6 hours, at least.

00:15
Speaker 1
Okay, very good. That answers my question perfectly. So, I was wondering about concerns that you guys have regarding calcium derangements during massive blood transfusion.

00:15
Speaker 2
You know, we're worried about it. But there's a lot more to worry about than the calcium. Okay? We worry about it if we see that it's low, but more importantly, we want to stabilize the patient. So, he stops using blood.

00:15
Speaker 1
Understandable. Okay. I have a couple more questions. The next one is, if you could describe the outcomes among the trauma patients that receive massive blood transfusion.

00:15
Speaker 2
Are you talking about survival?

00:15
Speaker 1
Survival? Yes, or if you have any information regarding morbidity, it's okay. If you do not, I guess it's a vague question. I understand that.

00:16

Speaker 2
I mean most of our patients survive, you know, it's like trauma. The problem is, you know, in what condition, right? So, our patients are in the hospital for a long time, right? But see if you're talking about survival at 24 hours. It's actually very good.

00:16
Speaker 1
Okay, great. My last question would be, how do you feel about the protocol that you guys have in place? And do you have any recommendations for improvement in the management of a massive blood transfusion?

00:16
Speaker 2
You know, our protocol is really it's pretty good. I mean, we feel like in times of shortage, we have to monitor some of the components. We are possibly going to move to whole blood units. Okay, instead of replacing components. But the blood shortage has not allowed us to do that yet. So, number of products to send, instead of doing a 6 units Red Cell to six units of plasma and one, you know platelets, you could just send a unit of whole blood.

00:17
Speaker 1
I understand, okay.

00:17
Speaker 2
Or four units of whole blood instead, which would be a lot easier to prepare and less, and faster.

00:17
Speaker 1
Okay. Great. Okay, that's good information to have. All right. Well, [redacted], I really can't thank you enough for your time. That actually concludes all of my questions and I appreciate it. The only other question I have is actually just if you know of anybody else, if you have any contacts, within this area that you think might be interested in participating in this study, I would be very grateful for that.

00:18
Speaker 2
Okay, great. I will.

00:18
Speaker 1
Okay. All right, and when I'm finished, I'll be sending everybody, a copy of what I did, in case you wanted to look at that, but otherwise, we're done, and I really appreciate your time.

00:18
Speaker 2

Yeah, I'd like to see it to make sure, you know, there's no edits.

00:18
Speaker 1
Of course. Yeah, of course, of course. Yeah. So this, what, what I'll be doing with this information? Just, I am basically doing a survey of level one trauma facilities and I'm just asking these questions to get like a just to get like a survey of what people are doing. What, what there are they using the protocol? If they are using a protocol just to describe it for me. But yeah, I will send you what I do, and that way you'll, you'll know and all personal and identifying information is going to be left out of that as well. Just to let you know.

00:18
Speaker 2
Okay, great. Thank you so much. All right.

00:18
Speaker 1
Thank you. Have a nice day,

00:19
Speaker 2
bye-bye

00:19
Speaker 1
bye-bye.

Interview 5:

3/9/22 @ 2:00 pm EST with Massachusetts 3 Facility (telephonic interview)

00:00
Speaker 2
Hi, this is [redacted].

00:00
Speaker 1
Hi [redacted]. This is Rebecca Parker; I was scheduled to meet with you at 2:00 today if that is still okay with you.

00:00
Speaker 2
Sure. I can talk.

00:00

Speaker 1
Okay, absolutely. This should take about 15 minutes, maybe a little bit longer. But if you need to go at any time, just let me know. Okay?

00:00
Speaker 2
Okay, sounds good.

00:00
Speaker 1
Okay, All right. So just to reiterate with you, I am a DNP student at Southern Adventist University and this interview is part of my doctoral research towards that degree and this phone call is going to be recorded. So, I just wanted to make sure you didn't have any questions before we got started.

00:00
Speaker 2
No, that's fine.

00:00
Speaker 1
Okay, perfect. Thank you. All right. So, my first question is, how is massive blood transfusion defined in your facility.

00:00
Speaker 2
So, we use the most common definition from the literature, which is a patient that receives ten units or more within a twenty-four-hour period.

00:01
Speaker 1
Okay, perfect. That's what I was looking for. So, do you guys utilize a protocol in your facility?

00:01
Speaker 2
We do.

00:01
Speaker 1
Okay, great. And you mentioned the most widely accepted guidelines, the most common guidelines, what are those? You know?

00:01
Speaker 2
What I meant was the most common definition that's in the system.

00:01
Speaker 1
I gotcha. Okay. What criteria do you use to determine the need for massive transfusion, like clinically with the patient?

00:01
Speaker 2
So, it's really a clinical judgment that's made at the at the bedside.

00:02
Speaker 1
Okay, perfect. Would you mind to describe for me the protocol that you use?

00:02
Speaker 2
Sure, so we have for several years used the same approach, which is we'll issue two rounds of products on request and then we'll keep going after that if additional rounds are asked for. Our hospitals are a level 1 trauma service, but we don't have huge numbers of traumas, but this also, this protocol will also be activated from other OR's. If something goes wrong from the floors if there's a bad GI bleed, that sort of thing. So, what we issue for a male patient, 6 O positive units of blood, 6 units of thawed plasma type A, and then one apheresis platelet unit. So, basically, we're using a one to one-to-one ratio and then our second round is the same thing and so, if you order an MTP, basically, you're getting twelve units of red cells, twelve units of plasma and two apheresis platelets. Oh, and I should mention, So, for men, we're issuing O positive red cells, for women, we're issuing O negative, and we're doing that without regard to the woman's age.

00:03
Speaker 1
Okay, okay, very good. Okay, and actually, I guess I had kind of skipped ahead of myself earlier, but my next question is, what evidence or guidelines were used in the development of the protocol that your hospital uses?

00:03
Speaker 2
So, in general, the literature on massive transfusion, protocols is pretty thin. The vast majority of the papers are uncontrolled case studies, and as I'm sure you're aware, there's really only one large randomized controlled trial to this day, the PROPPR study. So, we had already set up our protocol prior to the publication of the PROPPR study, which showed no statistically significant difference between a ratio of 1 to 1 to 1, versus 1 to 1 to 2. Our clinicians were happy with 1 to 1 to 1, so we stuck with that. And that's really it, yeah.

00:04
Speaker 1
Okay, great. That answers my question perfect. Okay, and how long have you been using this protocol? The 1:1:1 that you guys are using.

00:04
Speaker 2
Oh, I think for more than fifteen years

00:05
Speaker 1
Okay, great. Okay, and I was just wondering if you could tell me about the consistency of use of the protocol itself.

00:05
Speaker 2
I'm not sure I understand what you mean.

00:05
Speaker 1
So, I guess what I'm asking with that question is, how consistently is the protocol used? I know you said it was like clinician discretion as to whether or not the patient would need it, but if a patient is requiring a massive transfusion, is this protocol pretty strictly followed consistently?

00:05
Speaker 2
Well, I think that the steps in the blood bank are quite consistent. So, the protocol goes like I've explained. I would say that on the ordering end, it really varies. So, there are some cases where it's entirely appropriate to order this either for trauma or for other, you know, for other sorts of massively bleeding patients, but there are definitely times when it gets ordered inappropriately. So, we've even had clinicians who, and this is, I think is a fairly common problem that we're starting to try to work on, but we'll sometimes have clinicians for example, who believe that they can get blood faster if they order an MTP. And so sometimes they'll want, literally one unit of red cells quickly and order an MTP. We've gotten crazy orders like that, yeah.

00:06
Speaker 1
Okay. Could you tell me about a recent case where massive blood transfusion was required? I know that you guys are a large facility and that you have lots of lots of patients coming in, but I just wondered if you could tell me about a case where it was required.

00:06
Speaker 2
Oh, yeah, I mean this, I would say our protocol gets ordered multiple times a week. We recently had one where, let me check something really quick. Yeah, so we had, we had a case recently where someone had a splenic artery laceration in the operating room. And they ended up needing something like 20 units of red cells and then getting the, you know, about 18 units of plasma and some platelets as well. That was one where I think it was completely appropriate and, you know, potentially lifesaving, as I said, sometimes it's really. So, we're trying to, we're trying to sort it out, but it's challenging.

00:08
Speaker 1
Right, I understand. Okay, very good. Which labs are routinely monitored during the massive blood transfusion and how often?

00:08
Speaker 2
So, there are none that are built into our protocol. We recommend at the beginning of the protocol that clinicians order a type and screen if there's not one available on that patient so that we can switch to type specific blood instead of having to issue O units. Otherwise, you know, the expectation is that the clinicians will check a CBC approximately every half hour as well as a PTT and fibrinogen. But I think that that's really variable. Um, yeah, it depends on the acuity of the case, and it's not sort of formally defined. Okay, and we don't use any thromboelastography at this point.

00:09
Speaker 1
Okay very good. I wanted to know if you had any concerns about calcium derangements during massive transfusions. And if you guys are, if you're monitoring calcium, which you kind of answered that as well. I know there's nothing in the protocol, but concerns that you may have regarding calcium derangements.

00:09
Speaker 2
Yeah, it's not really in the protocol. I think overall, the anesthesiologist does a good job of checking ionized calcium. We have not, just in in general, that's not been a major problem for us. I think that those kinds of issues, either hypocalcemia or hyperkalemia, related to rapid plasma transfusion are probably more likely to be a problem in like a pediatric setting.

00:10
Speaker 1
Okay.

00:10
Speaker 2
But for our hospital we have, we have a NICU with babies and we have adults. We don't have any children.

00:10
Speaker 1
Okay. Okay. All right. Very good. Just a couple more questions here. I wanted to know if you could describe for me the outcomes among trauma patients, receiving MBT at your facility?

00:10
Speaker 2
Oh, I don't really have, I don't really have good data on that.

00:10
Speaker 1
That's perfectly fine. No problem. No problem.

00:10
Speaker 2
We did contribute to a study of patients that were receiving so-called “ultra-massive transfusion” by [redacted]. Did you ever read that one?

00:10
Speaker 1
I've not read that one. No, but I will look it up. Absolutely.

00:10
Speaker 2
Yeah, let me find you the reference really quick.

00:11
Speaker 1
Ok, that’d be great.

00:11
Speaker 2
It would be a good one. It would be a good one for you to look at. Cause basically, it looks at outcomes among patients that get what was defined in this study as ultra-massive transfusion. So at least 20 units of blood in 48 hours, I think was how that was defined. Okay, and what was found was, was basically, there were there were patients, who got hundreds of units of blood, and there were no, there were sort of no defined limits on, that is there's no amount of blood you can get and still not survive. Although it's, you're obviously in a bad group if you need a hundred units of blood, that sort of thing. And the reason for getting massively transfused relates to survival. So, for example, the trauma patients, overall had a 30-day survival. That was like less than 40% versus organ transplant patients, who were also transfused like this and had more like a 90% survival. So, it mattered a lot whether it was a planned surgery versus a gunshot wound, that kind of thing. It's a good paper. It was published in transfusion in 2016, volume 56, page 58. First author is Walter Sunny Dzik.

00:12
Speaker 1
Okay. All right. I appreciate that information. I'll definitely look that up. Sounds great. Okay. This is my last question here, how do you feel about the MTP that you guys have in place? And do you have any recommendations for improvement in the management of a massive transfusion.

00:13
Speaker 2

I mean, I think overall it works well for our hospital, I think it's, the data for these things are really poor, but it's a tough area to study. I think that ours though is consistent with, um, the sort of current standard of practice. Clinicians seem happy with it. And when it goes well, it goes really well. One of the things that can be a problem is, if someone starts bleeding horribly in the operating room and then people panic and ten different people will call the blood bank. And at night, there might be three people in the blood bank and the same people that have to get the products ready have to answer the phone. And so, one thing that's really helpful is when there's a sort of one-to-one connection between either the floor or the operating room and the blood bank so people aren't, they're trying to help, like everybody wants to pitch in, but it's better if one person calls. The other thing is that it's, as I sort of alluded to, we have a lot of trouble with this MTP kind of getting over ordered. And I think that, um, there was another publication from the University of Virginia where they tried to like they tried to publish a study on how they fixed their MTP program because they were having all kinds of problems. And one of the things that they did was a lot of education and audit feedback. It was a big effort to try to get this thing to be ordered less. Cause people get really into it. They think there's something magical about it. And, um, and so it tends to be over ordered. That's another paper that you should really read. Did you see that one?

00:14
Speaker 1
No, I didn't actually, but I have written that down as well. So, all right.

00:14
Speaker 2
Well, let me, in fact I have them both. I don't know if you, do you want to send me an email, so I have your email address and then I'll just send this PDF too?

00:15
Speaker 1
Absolutely. I'll do that. Yeah, I'll do that right now.

00:15
Speaker 2
Yeah, cause this one, they did a nice job. It was on a transfusion section called “How do we” and it was sort of like, how do we get our MTP process under control? I thought it was a good paper.

00:15
Speaker 1
Okay. Awesome. Yeah. Definitely. That would be very helpful. Thank you for the suggestions with both of those articles. That actually concludes my survey. And so, I just really want to tell you again how much I appreciate your time. I know that you have a lot of responsibilities and a lot of things going on, so I appreciate that you took the time to talk to me today and help me out with this project.

00:15
Speaker 2

Oh no, Sure. When is your, when does this wrap-up? How long is this going to take.

00:15
Speaker 1
So, it's, it's kind of it's going a little bit slower than I had anticipated. But I'm slotted to be finished with it, If my plans go the way they should, by the first week of May, is when I hope to be wrapped up completely. So, we'll see. We'll see. Hopefully I'll be able to meet that deadline and so talking to you has helped get me a little bit further.

00:16
Speaker 2
Okay. Well good. Good luck with everything. And yeah, just do you have my email address? You probably do.

00:16
Speaker 1
I do. Yes, sir. I have it pulled up right here. I was going to email you now. Okay, perfect. All right. Thank you. [redacted]. All right. I appreciate you. Have a nice day. Okay.

00:16
Speaker 2
No problem. You too. Thanks.

00:16
Speaker 1
Thanks. Bye.

Interview 6:

3/11/22 @ 12:00 ETS with Texas facility (telephonic interview)

00:00
Speaker 1
Okay, can you guys hear me?

00:00
Speaker 2
Yes. Okay,

00:00
Speaker 1
Okay very good. Okay. So, I am actually doing a qualitative study on massive blood transfusions. So, I have about 13 questions related to massive blood transfusions, massive blood transfusion protocol, and just a little bit about that. So, do you guys have any questions before I get started?

00:00
Speaker 2
I do not, no.

00:00
Speaker 1
Okay. All right. So, my first question is, how is massive blood transfusion defined at your facility?

00:00
Speaker 2
[redacted] do you want to take it? You want me to go ahead? It's whenever the physician orders massive transfusion. So, whenever there's an order for MTP, we consider it an MTP. Now, their clinical triggers might be different. Okay? Right. And according to what we have in our education material is if there's acute blood loss of 30 to 50% of the total blood volume, 1300-1800 ccs, or greater than 150 cc per minute.

00:01
Speaker 1
Okay, Okay, very good.

00:01
Speaker 2
We also have our accrete population. Right? So, we'll have MTP ready to go, ordered, and coolers present. But if the patient doesn't require it, then they might not get it. So, and I don't know how often that happens.

00:01
Speaker 3
More than you realize we have one going today.

00:01
Speaker 2
Oh, no, it's a good thing that you know, you don't have to use it. Yes.

00:01
Speaker 3
Oh no. I mean, I think they've got it down pretty well. Yeah.

00:01
Speaker 1
Okay, very good. So that leads well into my next question, which is do you guys have a protocol for administration of these products? Would you mind describing that protocol for me?

00:02
Speaker 3

As far as what is issued from the blood bank? We issue out five red cells, 5 plasma, and one apheresis platelet. And that goes out in every round. The plasma can be liquid plasma or thawed plasma. The red cells are leukocyte reduced and they're O negative or O positive depending on the patient. As far as a male patient will get O positive. Females of child-bearing age, we try to stay with O negative until we can establish a blood type. Once we establish a blood type, then we go with type specific blood.

00:02
Speaker 1
Okay very good. Okay, and what evidence or guidelines were used to develop this protocol?

00:03
Speaker 3
Oh my, I think that that was very well-researched and vetted by our medical director and it's been in place since before I was in charge of the blood bank. So, I really can't tell you specifically which they used, but I know that they referenced, you know studies and best practices.

00:03
Speaker 1
Right, right. Okay, perfect. That's perfectly fine. That actually leads well into my next question and if you don't know some of these that's perfectly fine, but how long has your current protocol been in place.

00:03
Speaker 3
I'm not certain, it was definitely I want to say like maybe 2014 or 2015 but I could be wrong.

00:03
Speaker 2
That's what I was going to say, it predates me for sure. I want to say as we were becoming a level two trauma center that was one of the initiatives. So, I want to say fourteen, fifteen maybe as late as sixteen but you know, within the last, I don't know, eight to ten years for sure.

00:04
Speaker 1
Okay, perfect. And then, could you tell me about the consistency of use of the protocol?

00:04
Speaker 2
What do you mean exactly, consistency of use?

00:04
Speaker 1
So, if, you know, if a patient is needing a massive blood transfusion, is the protocol used each time, or is there. I guess adherence is kind of what I'm asking about. Adherence to, like following the protocol. Is that done pretty consistently?

00:04
Speaker 3
I would have to defer to [redacted] because we don't see the patients in the blood bank.

00:04
Speaker 2
Yeah. Yeah, I think it's I think it is, you know, for the most part, you know, there's the occasional one-off. Our most difficult challenge I think, is the documentation and trying to follow that.

00:05
Speaker 1
Right. Okay, that makes sense. Okay. Could you tell me about a recent case where massive blood transfusion was required?

00:05
Speaker 3
I think they activated last night, but I don't know if it was on the floor in the ED. I haven't looked at that one yet.

00:05
Speaker 2
Yeah, me either. So, I'm like how recent? I mean, we have a fair number of penetrating trauma patients here where we review them, and we do review our MTP's but it's usually like at the end of the quarter we'll run a report or you know, something like that. So, I don't review them nearly as often as I should in part because you know, we're really busy and there's staffing and you can't review everything. So, one of our Benchmark reports that we get through Tquip, and I don't know if you know what Tquip is.

00:06
Speaker 1
I do. Yes.

00:06
Speaker 2
So, one of our action plans was looking at our penetrating trauma and shock cohorts. And what we decided to do was look at all patients that arrived in shock and review to make sure that we were following the various protocols, you know, was reboa used if it was indicated? Was MTP used if it was indicated? What was the length of time, you know, ED glove time to the OR, those sorts of things. Were there any thoracotomies, all those kinds of things that you would look at. So, we look at that kind of superficially in that way. When we look at MTP specifically, we are looking for a lot of different things. One of those would be sticking to ratios, you know, one to one to one. I'm looking at waste and utilization of that precious resource, and we look at, you know, appropriateness of cases, and, and those sorts of things. So, we review a lot of those on an ongoing basis, you know, issues that we might have might be the blood is out of the refrigerator, and then when it's returned to the blood bank then they're over temp, so they have to be wasted. I

think the biggest issue we have again is the documentation especially with MTP because it's all crazy.

00:07
Speaker 1
Right, right. Okay, understandable.

00:07
Speaker 3
So, a recent case might be you know, we just reviewed an M&M case the other day from you know, a gunshot wound to the neck where MTP was utilized on the case and it was handled very quickly, blood got to the patient very quickly. It was all warmed. We had good one to one to one ratios and the patient, you know, was a survivor. So, it all worked perfectly the last time I reviewed a case.

00:07
Speaker 1
Awesome. Okay, very good. Okay. And during MTP which labs are you monitoring? And how often are they being monitored?

00:08
Speaker 3
Ok, well, we ask them to collect initially the initial round, you know, obviously our blood bank specimen, we collect a PT, PTT, D Dimer, TEG, fibrinogen, and CBC on the first round. After that, in between additional rounds, we add an ionized calcium to that which is done on the istat.

00:08
Speaker 1
Very good. Okay, that actually leads well into my next question, which is to tell me about the approach to calcium management during the MBT.

00:08
Speaker 3
The calcium management that would be a defer.

00:08
Speaker 2
Okay. Yeah, I mean if they have hypocalcemia, we treat with calcium chloride.

00:09
Speaker 1
Very good. Okay. So, what concerns do you guys have about calcium derangements during this process?

00:09
Speaker 2

I don't really have any, we haven't had any issues with it. My trauma surgeons, and there's a PA, they're really very, very good. They do monitor these things and, you know, when there's a critical value, the lab calls the nurse and nurse calls the doc, they get it fixed. We're not having any issues with it. So, I'm not at all concerned about it.

00:09
Speaker 1
Right Okay, very good. Okay, and then I know that you you've given me a few, or you gave me a scenario recently where the outcome was really good. I just wanted you guys to describe the outcomes among trauma patients receiving these MBT's at your facility. Which it's okay if you don't have exact data, I just wanted to know in general. You know, what you're seeing as far as outcomes go.

00:10
Speaker 2
It's hard to match the outcome with the MTP. You know, I mean I can pull a report of patients who received MTP's and look at their outcomes, but really in my experience, it's hard to connect those, right? You could say that patients who get blood products have a tendency to survive. You know, I mean, yeah, you could say that but there's so many other factors that go into it like, survivability with their injury severity you know, what was their down time? You know, we can order MTP and give a unit and the patient died because really, they didn't even need to call MTP. You're looking at resource utilization. So, I think there's a lot more that needs to be to be looked at when you're looking at trying to connect MTP with survivorship.

00:10
Speaker 1
Perfect. Okay. Thank you. Very good. This is my last question for you guys. In the survey here is how do you feel about the protocol you have, and if you have any recommendations for improving that.

00:11
Speaker 2
[redacted] and I talk about this a lot. And we actually just recently talked about, I think a couple of things, one is designating a runner. That's always very difficult at every trauma center I've worked at it's always been a challenge; you know, nursing doesn't have staff to run, blood bank doesn't have staff to run. You know, phlebotomy doesn't have staff to run. How do you get the blood from blood bank to delivery when this patient can maybe be moving around the hospital? This is always a challenge everywhere. If anybody can solve it, that's great. When I worked in [redacted], we put blood in the tube system and the tube system was kind of our transport for most emergent release pieces. I had each unit where the patient was assigned provide a runner. In my hospital in [redacted], a phlebotomist was the runner. I mean, one, let's say this patient was in the ED, the ED sent a runner for the first cooler, and the phlebotomy picked up a cooler from the floor. If the patient came from L&D, same thing. L&D was the runner then phlebotomy would run. In this hospital? We have not established that process. The process we have here is each unit provides their own runner. So that's probably the thing that I think is pretty difficult. I would not change ours because, you know, there's advantages and disadvantages to both. And right now, I

think we're pretty comfortable with what we have. The other piece that, you know, we're always looking at trying to change and make better again is the documentation. That's just always so hard in these situations. Other than that, I think our ratios are good. We've started using whole blood in our hospital, but only for a very limited subset. It's male trauma patients in the ED that get that only so, you know maybe in the future we'll go to whole blood in the MTP, but I don't think you know anybody other than maybe the military is equipped to do that right now, but I don't know about you [redacted], Do you have any other things we talked about maybe.

00:14
Speaker 3
Maybe one other thing would be the use of cryo. Making sure that they start evaluating around cooler three or four if they need cryo, and ordering cryo because we leave cryo on as an ad hoc. Meaning they just order it when they require it when they need it. We try to remind them between coolers three and four for it. But that's probably one area that could be improved if needed because we don't want to. Initially, I believe when the protocol was rolled out, cryo went with every round and we had a lot of waste. And so that was modified at that point to pull it from every round because it was just too much waste.

00:14
Speaker 1
Okay, very good. All right. Well, that actually concludes all of my questions. I really appreciate all the information you've given to me. And I appreciate the time you've taken. And if you guys have any questions for me, I would be happy to answer them. But if not, we're actually finished with the interview.

00:14
Speaker 2
Okay. Thank you. Would you send us like, I don't know, a copy of your paper when you're done, or if you have anything, that would be great to have a copy of that too. Just so we can, you know, read all about your research.

00:14
Speaker 1
Absolutely. I will most definitely send everybody that I've interviewed, I will send them a copy of my findings and I will loop you guys into what I find for sure.

00:14
Speaker 2
Thank you. Take care, bye-bye.

00:15
Speaker 3
You guys have a good day.

Interview 7:

3/25/22 @ 12:00 EST with Colorado facility (telephonic interview)

00:00
Speaker 2
Blood bank, this is [redacted].

00:00
Speaker 1
Hello [redacted], this is Rebecca, Parker. How are you doing today?

00:00
Speaker 2
I'm fine. How are you?

00:00
Speaker 1
Good, I'm good. Thank you. Is now an okay time to have our interview? Thank you so much for agreeing to participate with this. I really appreciate it. Just to reiterate, I'm a doctorate of nurse practitioner student at Southern Adventist University and this is going towards that degree. This phone call will be recorded, and I just wanted to see if you had any questions before we got started.

00:01
Speaker 2
Nope. I'm fine.

00:01
Speaker 1
Okay, good deal. All right. So, my first question is, how is massive blood transfusion defined at your facility?

00:01
Speaker 2
We don't have a formal definition for it. But in general, it's anything where they activate a massive transfusion protocol, which for us means that they put an order into the Epic computer system and they are asking for us to give them a cooler with five red cells, five plasma, and one platelet.

00:02
Speaker 1
Okay, very good. Okay. So, my next question is, do you guys utilize a protocol for these massive blood transfusions?

00:02
Speaker 2
Yes.

00:02
Speaker 1
Okay, very good. And what criteria is used to determine if the patient needs a massive blood transfusion?

00:02
Speaker 2
That's up to the folks who are actually transfusing the patient, but it's generally going to be something where they have evidence of active bleeding with the expectation that they will have ongoing bleeding that cannot be controlled.

00:02
Speaker 1
Okay, very good. Okay. Could you describe for me the protocol that you use?

00:02
Speaker 2
So, each cooler that we send out has five red cells and five plasma and the first cooler also has a platelet, and then every odd-numbered cooler can also get a platelet with it.

00:03
Speaker 1
Okay, very good. And what evidence or guidelines were used to develop the protocol that you use?

00:03
Speaker 2
Well, we have a trauma committee here, and this is something that the trauma committee basically agreed upon. They've got representatives from anesthesia, surgery, the emergency department, and OB.

00:03
Speaker 1
Okay. Very good. All right. How long have you been using your current protocol?

00:03
Speaker 2
Oh, it's been several years. Now. I have to think about it. Probably at least ten years.

00:03
Speaker 1
Okay, very good. Very good. Could you tell me about the consistency of use of the protocol?

00:03
Speaker 2

I would say it's very consistent. People have gotten used to that. Nowadays if anybody has any doubt about how to get a lot of blood quickly, they know to just order the massive transfusion protocol.

00:04
Speaker 1
Very good. Okay. Could you tell me about a recent case where massive blood transfusion was required?

00:04
Speaker 2
We have them every day. Yeah, I mean on average, we activate our massive transfusion protocol, I want to say it's like fifty-three times a month because we keep track of those activations.

00:04
Speaker 1
Oh wow. Okay. Yeah. All right, very good. Which labs are routinely monitored during the massive transfusion, and just wondering why and how often are they routinely monitored?

00:04
Speaker 2
They're expected to get a CBC, and with that a PT and often they'll get a fibrinogen level. More commonly in the operating room, they'll also get a TEG, thromboelastogram. And they'll typically do that about every 30 minutes to 60 minutes depending on how fast the patient is bleeding.

00:05
Speaker 1
Okay, very good. Would you be able to tell me about the approach to calcium management during massive blood transfusion?

00:05
Speaker 2
Yeah, they monitor the ionized calcium level. That’s something that can be obtained with every blood gas. And so, if it's less than one, then they definitely will give additional calcium.

00:05
Speaker 1
Okay, very good. And on that note, could you share concerns that you have about calcium derangements during this process?

00:05
Speaker 2

Well, we know that massive transfusion, because the citrate is the anticoagulant used in all of our blood components, that we are going to get a hypocalcemia with that. And so, we do expect that to be monitored and that they will need calcium supplementation.

00:06
Speaker 1
Okay. Okay, very good. This one may be hard to answer. I know with you being in the blood bank, and so you're covering more than just the trauma patients. But my next question is, if you could describe the outcomes among trauma patients that receive massive blood transfusion.

00:06
Speaker 2
For just the trauma patients who received this? You know, because we do it for like liver transplants and stuff like that too.

00:06
Speaker 1
Right. It's okay if you don't. Yeah, I guess overall would be fine. My question was specifically to trauma, but just to describe the outcomes among the patients, receiving it.

00:06
Speaker 2
My impression just, again, yes, you're right coming from the blood bank, it's not really clear. But I would say that it depends on the nature of the trauma that they've had, but that if it's something where it can be repaired, I'll put it that way. We generally have really good outcomes. I would say probably two-thirds of the people who have a massive transfusion, where they truly get massively transfused, not just where they ask for a cooler, and they end up sending it back because it's not as bad as what they thought it was going to be. But if you're truly massively transfused, where they've, they've taken say, two coolers or more, at least two-thirds of them survive and it's probably more than that, but I'm not exactly sure about what happens in the long run.

00:07
Speaker 1
Sure. Okay. All right, and then actually, we've come to the last question here and that is how do you feel about the massive transfusion protocol that you have? And do you have any recommendations for improving the management of these transfusions?

00:08
Speaker 2
I think the protocol that we have is good. It's something that has, you know, been tweaked a little bit. When I first came here, we had a different, massive transfusion protocol in every area, like the emergency department had one, the OR had one. For OB massive hemorrhages they had one. And so, having one standard protocol throughout the institution is something that has really helped us to get the blood out the door quickly and respond to what the patient needs are. We also have whole blood available in the emergency department for people who initially come in

and need to be quickly transfused while we're getting our first cooler ready. So, I think that's something else that has helped. But I don't think that I would change it at this point. If anything, I would just want them to maybe get their labs a little more often, like order a TEG closer to every 30 minutes rather than closer to every 60 minutes.

00:08
Speaker 1
Okay. Okay, great. All right. Well, that's all my questions. So, I really appreciate the time you've given me for this project. And if you don't have any other questions for me, we're actually done. But if you do have any questions, I'll be happy to answer.

00:09
Speaker 2
So, are my questions similar to the answers you've gotten from other people?

00:09
Speaker 1
You know, they are. What I really found is that most places do have like an internal protocol that they've developed themselves, and your questions are very similar to what I have seen. A lot of the places I've interviewed so far have no, like really, there's not a lot of consistency with how and when labs are checked. And so, when I started my project, my interest was in hypocalcemia specifically, and then that became a little too narrow, so I opened it up to just like a larger, you know, focus on the protocol in general. But yeah, I've actually just found a lot of variation with checking Labs. But as far as the actual products and the ratios, it's been pretty similar from institution to institution. So yeah, it was pretty in keeping with the rest of them.

00:10
Speaker 2
Okay. Well, very good. All right.

00:10
Speaker 1
Well, thank you so much. And when I'm finished, I'm going to be emailing everybody, like just a little bit of a synopsis of my results. So, I will email that to you as well. Okay?

00:10
Speaker 2
Alright, sounds great. Thank you.

00:10
Speaker 1
Thank you so much. Okay, bye-bye.

00:10
Speaker 2
Bye.

Appendix E

Table 1:

Definitions and Criteria

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
Definition	More than the first two units of whole blood given	Greater than ten units, in 24 hours	Greater than one total blood volume replacement in twenty-four hours	Four or greater units in an hour, or ten units within 10-12 hours	Ten or greater units within 24 hours	Any order placed by provider for MTP	No formal definition. Electronic order placed by provider for MTP requesting 5 units PRBC, 5 plasma, and 1 platelet
Use Protocol	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Criteria	Based on physician judgement; actively hemorrhaging and requiring more than two initial units of whole blood	No criteria specified in protocol guidelines Patients presenting condition and complaint	Provider discretion for initiation of massive transfusion; Patient bleeding rapidly, amount of blood lost	Protocol for activation based on clinical indicators such as vital signs, including systolic blood pressure, pulse rate, and elevated lactate	Based on bedside clinical judgment by physician	Acute blood loss of thirty to 50% of total blood volume; 1300-1800 CC's blood loss; or greater than 150 cc per minute blood loss	Provider discretion: Evidence of active bleeding with the expectation of bleeding that cannot be controlled

Table 2:

Protocol and Evidence

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
Protocol	Blood Box:	First cooler: 4 units PRBCs and	1:1:1 ratio of packed red blood cells to	1:1:1 ratio of red blood	1:1:1 ratio of red blood cells	Each round: 5 units	First cooler: 5 units red

	6 units PRBCs, 6 units plasma, 1 pooled unit platelets, 1 ASP or 10 units of cryo Routine use of TXA, DCC, rare use of Factor VII	2 units plasma. 1 dose of platelets in each from 2nd cooler on. Cryoperecipitate given with every 4th cooler (i.e., every 6 units of plasma).	plasma to platelets; Blood cooler: 6 units PRBCs, 6 units plasma, 1 unit of platelets	cells to plasma to platelets	to plasma to platelets; O positive RBCs for men, O negative for women of all ages 2 rounds issued initially, each with 6 units RBCs, 6 units thawed plasma type A, and 1 unit apheresis platelet	PRBCs, 5 units plasma, and one apheresis platelet; plasma either liquid or thawed; RBCs leukocyte reduced; O negative for males, O positive for females of childbearing age until blood type established	blood cells, 5 units plasma, I unit of platelets; platelets with every other cooler
Evidence	Not stated; Reviewed literature with blood bank approximately 10 years ago Modified based on ACS and tquip data and guidelines	Technical manual from AABB	Massive transfusion guidelines from Bethesda Maryland Also- Recommendations from the technical manual by the Association for the Advancement of Blood and Biotherapies (AABB)	Not stated; "It's a pretty standard resuscitation protocol"	PROPPR study	Unknown; Stated that it was taken from various studies and best practices	Facility based decision with representatives from trauma committee, anesthesia, surgery, emergency department, and OB
Developed	8-10 years ago	2008 or 2009	February of 2017	20 years or greater	Greater than 15 years	Within the last 8-10 years	At least 10 years
Consistency of usage	N/A	Consistent with identification of patients who need MBT and administering it	Consistently	Consistently used; Greater risk of overuse rather than underuse	Steps in the blood bank are consistently used; Physicians sometimes order	For the most part it is consistently used; Biggest challenge is with	Very consistent

					inappropriately	documentation	

Table 3:

Labs Monitored during MBT

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
CBC		Yes 60 min	Yes	Yes	Yes 30 min	Yes	Yes
H&H	Yes	Yes 60 min	Yes	Yes		Yes	
PT/PTT	Yes	Yes 60 min	Yes		Yes 30 min	Yes	Yes
INR			Yes				
Fibrinogen	Yes	Yes 60 min	Yes		Yes 30 min	Yes	Yes
BUN			Yes				
pH			Yes				
Potassium			Yes				
iCalcium	Yes		Yes	Yes		Yes (between rounds after first)	
D-Dimer						Yes	
TEG	Yes			Yes	No	Yes	Yes 30-60
Platelets	Yes		Yes				
Lactate	Yes						
Type and Screen			Yes		Yes		
No labs required by protocol			Yes		Yes		
CMP			Yes	Yes			
ROTEM				Yes			

Table 4:

Calcium Management

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
Approach to Management	Managed by anesthesiology; Routine administration of calcium; On average, 1 amp calcium per box; Check iCa++ on	Does not know	Follow Ca++ and replace per lab values	Replaced based on iCa++, checked at least Q 6 hours	Not part of protocol, managed by Anesthesiologist	Treat low Ca++ with calcium chloride	Monitor iCa++ with each blood gas, if iCa++ is <1, treat with additional calcium

	istat or empirically give Ca++						
Concerns about derangements	N/A	N/A	Follow iCa++ because products preserved with citrate which can cause hypocalcemia, patients getting lots of products in MBT. Hypocalcemia can cause coagulation factors to work poorly, which may contribute to coagulopathy. Concern with awareness of physicians regarding hypocalcemia.	Concerned when calcium is low, but stabilization of patient is more important	Not been a major problem. Issue such as hypocalcemia or hyperkalemia, related to rapid plasma transfusion are more likely a problem in a pediatric setting	Haven't had any issues with it, when there is a critical lab value, it is addressed. "We're not having any issues with it, so I'm not at all concerned about it".	Expect hypocalcemia during massive transfusion because of citrate in blood components, expect calcium to be monitored and that calcium supplementation will be needed.

Table 5:

MBT Outcomes, Mortality, Morbidity

	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado
Outcomes	"It depends on how extensive the MTP is. I mean for the large majority of our MTPs	"Outcomes are pretty good. Our mortality rate is very low here at the hospital. We're	"Outcomes range from severe morbidity and mortality to, you know, excellent outcomes	"Most of our patients survive. If you're talking about survival at 24 hours,	Unable to answer	"Difficult to match outcomes with MTP"	"I would say probably two-thirds of the people who have a massive transfusion.

	that don't require greater than five boxes. I would say the survival is pretty good, probably upwards of seventy or eighty percent survival. For the patients that, you know, go on to true, massive, massive transfusion and, you know, a hundred units of cells, that kind of thing, it's probably more of ten to twenty percent Survival"	about 4% mortality rate, which is under the Acceptable maximum of 5%"	without morbidity and mortality. And that seems to vary a lot with severity of injury or on the cause of the bleed, and the ability to treat somebody versus not"	it's actually very good" "The problem is, you know, in what condition, right"?			They truly get massively, transfuse, not just where they ask for a cooler, and they end up sending it back because it's not as bad as what they thought it was going to be. But if you're truly massively transfused, where they've, they've taken say, two coolers or more but at least two-thirds of them survive and it's probably more than that, but I'm not exactly sure about what happens in the long-term"

Table 6:

Recommendations for Improved Outcomes

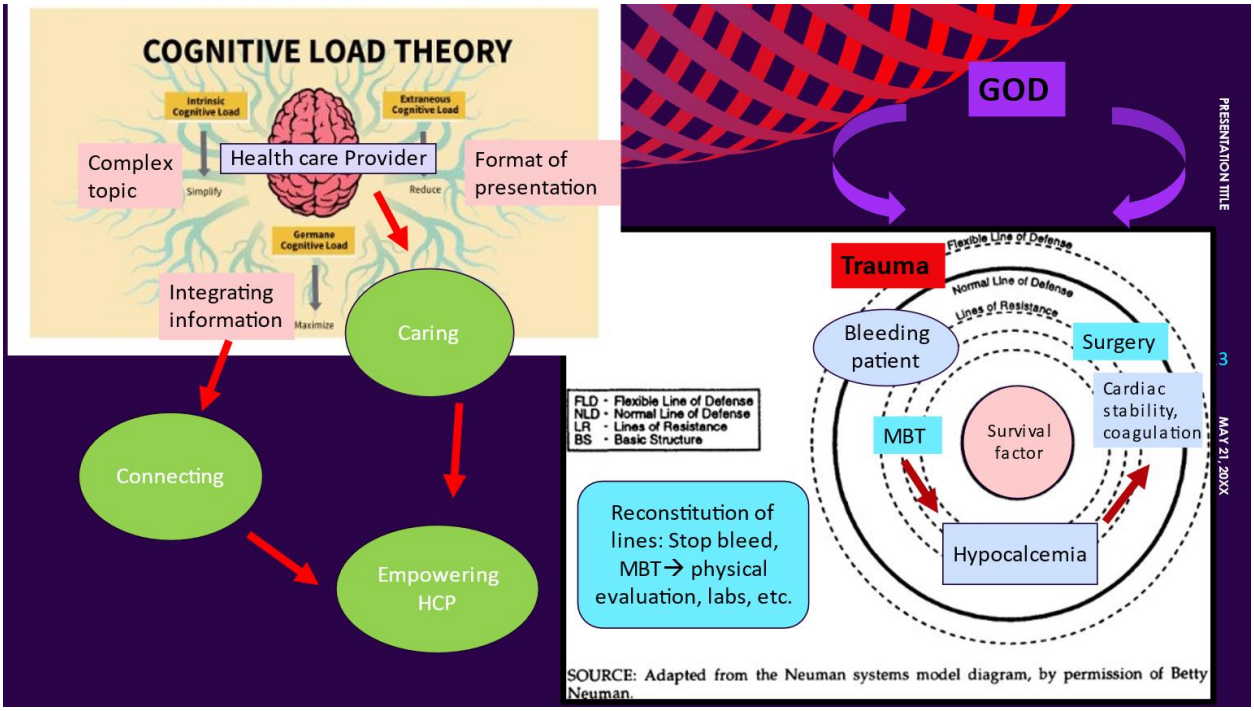
	1 California	2 Mass 1	3 Mass 2	4 Maryland	5 Mass 3	6 Texas	7 Colorado

How do you feel about the protocol? Recs for improvement?	"We tend to focus mostly from a quality standpoint, not only on lived or died outcomes, but we also look at wastage very carefully. And if anything, our implementation of MTP and how we've refined it over the years, we've reduced our waste wastage"	Development of a massive transfusion policy or guideline specific to trauma	"I think personally that in the literature some of the studies supporting a 1:1:1 transfusion ratio has a few challenges, so I actually prefer a 2:1:1 transfusion ratio. If it were up to me to redesign, I might consider changing the ratio to 2:1:1" "It might be really nice to include within the massive transfusion protocol automatic lab orders"	"In times of shortage, we have to monitor some of the components. We are possibly going to move to whole blood units instead of replacing components, but the blood shortage has not allowed us to do that yet"	"I think overall it works well for our hospital. I think that ours is consistent with current standard of practice. Clinicians seem happy with it. And when it goes well, it goes really well" Recommendations for improvement: -Designated person to communicate with blood bank -Reduce over-ordering/abuse of MBT	-Designated runner to bring blood products to the patient -Improved documentation that's just always So, so hard in these situations "I think our ratios are good. We've started using whole blood in our hospital, but only for a very limited subset, male trauma patients in the ED. Maybe in the future. we'll go to whole blood in the MTP"	"I think the protocol that we have is good. When I first came here, we had a different MTP in every area, like the ED had one, the OR had one, and so, having one standard protocol through out the institution is something that has really helped us to get the blood out the door quickly and respond to what the patient's needs are. We also have whole blood available in the

							ED for people who initially come in and need to be quickly transfused while we're getting a cooler. ready” “I don't think that I would change it at this point. If anything, I would just want them to maybe get their labs little more often, like order a TEG closer to every 30 minutes rather than every 60 minutes”

Appendix F

Figure 1: Theoretical Framework



Appendix G

Southern Adventist University

School of Nursing

DNP Scholarly Project EOP SLO Synthesis

PICO/Research question:

P: Population of Interest: Level 1 Trauma Care Facilities who would utilize MBTs to treat trauma patients in need

I: Intervention: Survey to evaluate the how MBTs are managed

C: Comparison of Interest: Other level I trauma centers throughout the U.S. regarding MBT management

O: Outcome of Interest:

1. To discover how facilities manage massive blood transfusions
2. To discover if a protocol is being utilized for this practice
3. To explore perceptions and experiences related to this practice

1. Cultural Competence:
   Mentor Christian responsiveness and caring to a global culture through sensitivity and competence for patient traditions and values.

   This project demonstrates cultural competence as the skills and knowledge that could be obtained from this research project could be translated into evidence-based practice that is not limited. The need for trauma services and therefore massive blood transfusions is applicable globally and therefore competence in this area will provide all cultures with the access to this type of treatment.

2. Evidence Based Practice:
   Translate quality research findings and outcomes to solve problems for quality personalized outcomes.

Evidence based practice was demonstrated through this project by investigating the current standard of care for administering massive blood transfusions and comparing this to the available literature. After personal interviews with a variety of healthcare providers within the area of trauma services, this project was able to present what is being practiced as well as proposed suggestions for change.

3. Health Promotion:
Propose evidence-based methods that prevent disease and promote human flourishing through the utilization of a wholistic framework to educate and empower healthy lifestyle choices.

While the focus of this project was aimed at a therapeutic intervention which takes place after a traumatic injury, it does provide information regarding a treatment that can be lifesaving, and hopefully will provide the patient with a future, in turn allowing them the opportunity to make healthy lifestyle choices and changes.

4. Patient Centered Care:
Facilitate inter/intra professional healthcare to achieve personalized, compassionate, and coordinated whole person care.

This scholarly project focused on massive blood transfusion (MBT), massive transfusion protocols, and hypocalcemia related to this practice. The goal was to provide insight into these practices and to demonstrate the need for further research. Having a massive transfusion protocol that has been formulated based on evidence-based practice will allow providers to deliver optimal care to patients.

5. Quality and Safety:
Evaluate current evidence and outcomes of practice in health care systems to ensure a just culture that minimizes the risk of harm and promotes safety and quality of care.

Safety concerns that were raised during this project include the lack of standardization among massive transfusion practices. Variation in protocol and administration guidelines varied greatly among facilities. Addressing this need for updated research and standardized guidelines will allow healthcare providers in trauma services to administer safer, more effective massive transfusions to trauma patients.

6. Informatics and Innovation:
Analyze healthcare outcomes using knowledge of nursing, computer, and information sciences to ethically and innovatively manage data, information, and technology.

Technology that was helpful for use in this scholarly project included an electronic phone call, recording, and transcription application. This was an example of innovation as it allowed me to easily connect with and interview participants for this study.

7. Teamwork and Collaboration:
Organize effective inter/intra professional teams to promote quality health outcomes and reduce risk.

This project demonstrated collaboration as participants in this study came from a variety of disciplines. Some of the participants interviewed were in roles such as trauma program director, critical care physician, trauma surgeon, pathologist, transfusion specialist, and blood bank manager. Coordination for a massive blood transfusion requires a collaborative effort from the healthcare team as there are many moving parts that allow it to be executed safely and efficiently.

8. Professionalism:
Advocate for Christ-centered excellence in nursing roles and professional behaviors throughout the inter/intra professional team.

Professionalism was maintained throughout this scholarly project as both the academic and clinical preparation for this project was rigorous. Prior to starting the study, all necessary steps were taken to gain approval from the institutional review board (IRB) at Southern Adventist University. Once the interviews started, every effort was made to maintain professional and respectful conduct with all participants, advisors, and individuals involved.