Washington State Department of Health Office of Community Health Systems
Emergency Medical Services and Trauma Section

Trauma Clinical Guideline:
Massive Transfusion For Trauma

The Trauma Medical Directors and Program Managers Workgroup is an open forum for designated trauma services in Washington State to share ideas and concerns about providing trauma care. The workgroup meets regularly to encourage communication among services, and to share best practices and information to improve quality of care. On occasion, at the request of the Emergency Medical Services and Trauma Care Steering Committee, the group discusses the value of specific clinical management guidelines for trauma care.

The Washington State Department of Health distributes this guideline on behalf of the Emergency Medical Services and Trauma Care Steering Committee to assist trauma care services with developing their trauma patient care guidelines. Toward this goal the workgroup has categorized the type of guideline, the sponsoring organization, how it was developed, and whether it has been tested or validated. The intent of this information is to assist physicians in evaluating the content of this guideline and its potential benefits for their practice or any particular patient.

The Department of Health does not mandate the use of this guideline. The department recognizes the varying resources of different services, and that approaches that work for one trauma service may not be suitable for others. The decision to use this guideline depends on the independent medical judgment of the physician. We recommend that trauma services and physicians who choose to use this guideline consult with the department regularly for any updates to its content. The department appreciates receiving any information regarding practitioners' experience with this guideline. Please direct comments to 360-236-2874.

This is a trauma assessment and management guideline. It was adapted from professional literature. The workgroup reviewed the guideline, sought input from trauma care physicians throughout Washington State, and used that input to make changes. Both the Emergency Medical Services and Trauma Care Steering Committee and the Department of Health Office of Community Health Systems endorsed the guideline. This guideline has not been tested or validated.

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The problem

Injuries sustained from trauma related events remain the third leading cause of death for all patients. It is estimated that 20 to 40 percent of deaths occurring in hospitalized trauma patients are related to coagulopathy, and could possibly be prevented with improved hemorrhage control and the rapid administration of blood components.

Damage control resuscitation

In the past decade much research has been conducted and published regarding the administration of blood products. Much of this research began from medical providers in the armed services who were motivated to improve mortality on the battlefield. The result of their research formulated a concept called damage control resuscitation where an emphasis is placed on controlling bleeding, limiting crystalloid administration, and administering blood in a ratio of components.

Massive transfusion and ratios

The blood components of red blood cells (RBC), plasma (FFP), and platelets are found to have the most benefit to the patient and to reduce mortality when administered together in ratios of 1:1:1. The trauma team should strive to transfuse RBC and plasma in a ratio of 1:1 (RBC to plasma). Meaning, for every one unit of RBC the patient should also receive one unit of FFP. One unit of pooled apheresis platelet should be given for every six units of RBC. An example of the 1:1:1 ratio would include six units of RBC, six units of FFP, and one unit of pooled platelets.

Some trauma services may not have platelets available in the blood bank. In those situations, the focus of the MTP should be to maintain the 1:1 ratio of RBC and FFP.

Cryoprecipitate (cryo) may be available at some trauma services. Cryo includes clotting factors (VIII, XIII, fibrinogen, vWF, and fibronectin). When available, cryo should be given as part of the massive transfusion when laboratory values indicate fibrinogen levels < 100 mg/dL.

Trauma services should strive to achieve the 1:1:1 ratio especially where multiple transfusions or rounds are given. In a review of medical records where patients have received a massive transfusion using the ratio methodology, it was common to see a decline in component ratio over time.

It is vital that the trauma program work with blood banking personnel to develop the massive transfusion protocol, determine ratios, and quantities available. The trauma team and blood bank should strive to ensure a seamless massive transfusion occurs with a goal of providing a 1:1:1 ratio immediately upon patient need.

Tranexamic acid

Tranexamic acid (TXA) has recently become an acceptable adjunct in massive transfusion based on its antifibrinolytic properties and ability to stabilize clots once formed. TXA should be given to patients receiving a massive transfusion if it can be administered within three hours of the injury. TXA should be withheld if it is past three hours from the time of injury or the injury time is unknown. Administration and dosage should be based on pharmacological and manufacturer recommendations.

Pediatric patients can receive TXA following the administrative guidelines above. The pediatric specific dosage and administrative recommendations from the manufacturer should be followed.

Indications for massive transfusion

Blood components are valuable resources. The decision to administer them and initiate a massive transfusion can be challenging. There have been several qualifiers or criteria used to determine the need for massive transfusion.

Conditions associated with the need for massive transfusion may include trauma patients with evidence of significant hemorrhage, massive GI hemorrhage, ruptured aortic aneurysms or similar clinical scenarios. Blood loss great than 1500ml or documented substantial blood loss from prehospital providers; anticipation for the need of greater than six units of PRBC in the next three hours; or the need for at least 10 units of PRBC within the next 24 hours should prompt the decision to activate a massive transfusion.

Researchers have developed a tool to assist in predicting the need of massive transfusion based on patient assessment information. The Assessment of Blood Consumption (ABC) tool uses the patient's pulse rate, systolic blood pressure (SBP), FAST exam, and mechanism of injury to develop a score to determine the need for massive transfusion. A score greater than or equal to two signifies the potential need for massive transfusion.

Category	**Score**
Pulse > 120	
SBP < 90	
Positive FAST	
Penetrating torso trauma	

Assign one point to each category if "yes." Greater than two points consider the need for massive transfusion.

MTP end-points

To help reduce the unnecessary use of blood components, it is important to consider the end points for transfusion. Anatomical control of bleeding should be determined first. If bleeding is not controlled the transfusion should continue. Once bleeding is controlled the following lab values can guide the transfusion.

- Hemoglobin ≥ 10 g/dl (discontinue PRBC transfusion)
- Prothrombin time (PT) < 18 seconds (discontinue FFP)
- Partial thromboplastin time (PTT) < 35 seconds (discontinue FFP)
- Platelet count > 150,000 (discontinue platelets)
- Fibrinogen level > 100 mg/dL (discontinue cryo)

The patient's coagulation studies should be monitored for six to 12 hours following the end of the transfusion.

Pediatric considerations

Pediatric patients are also at risk for hypovolemia during trauma, and will benefit from rapid control of bleeding and blood administration. Generally, the need for a massive transfusion in pediatric patients can be based on blood volume loss of greater than 30 ml/kg. Pediatric patients should receive the same 1:1:1 ratio of blood components as adults discussed above. The volume of these components should be reduced to prevent circulatory overload. Generally, pediatric patients should receive blood components in a volume of 10ml/kg. An example of blood components for pediatrics following the 1:1:1 format would include (1 unit RBC, 1 unit FFP, 45

ml platelet). The Harborview Medical Center Reference Card in appendix A is for reference only and can help guide the administration of blood products for the pediatric patient.

Administration considerations

- Do not delay the transfusion of emergency uncrossed match blood components if unable to obtain a blood specimen for type and crossmatch.
- Multiple large bore venous access devices may be necessary to rapidly administer a massive transfusion.
- RBC and FFP should be administered via a rapid infuser with warming capabilities.
- Pediatric patients < 20kg should not receive blood products via rapid infuser but warming should still take place via in-line warming device. In the event rapid blood administration is required it may be necessary to administer with a syringe.
- Platelets should not be administered via rapid infuser or warming device.
- Frequent and accurate communication with the blood bank is imperative to ensure the availability of blood components.
- Crystalloid solution should be limited during a massive transfusion.

Complications

Patients receiving a blood transfusion are at risk for developing a reaction and/or complications. Patients should be monitored during and after the infusion for:

- Hemolytic reaction
- Hypothermia
- Hypocalcemia
- Hyperkalemia

Education and training

The administration of a massive transfusion is a critical task and in some trauma services it occurs very infrequently. Trauma programs and emergency services tasked with administering massive transfusions should develop annual training events to ensure this process is rehearsed, and staff members involved are capable of performing the critical steps necessary to ensure a safe and appropriate administration of these blood products.

Performance improvement

All massive transfusions should be reviewed as part of the trauma program's quality improvement (QI) process. The inherent risk associated with massive transfusions could result in reactions, complications, administration errors, delays etc. Many of these risks can be mitigated if properly reviewed and discussed in the trauma QI committee.

Reference

American College of Surgeons, Committee on Trauma. Massive transfusion in trauma guideline. 2013. Accessed: July 15, 2016 https://www.facs.org/~/media/files/quality%20programs/trauma/tqip/massive%20transfusion%20in%20trauma%20guildelines.ashx

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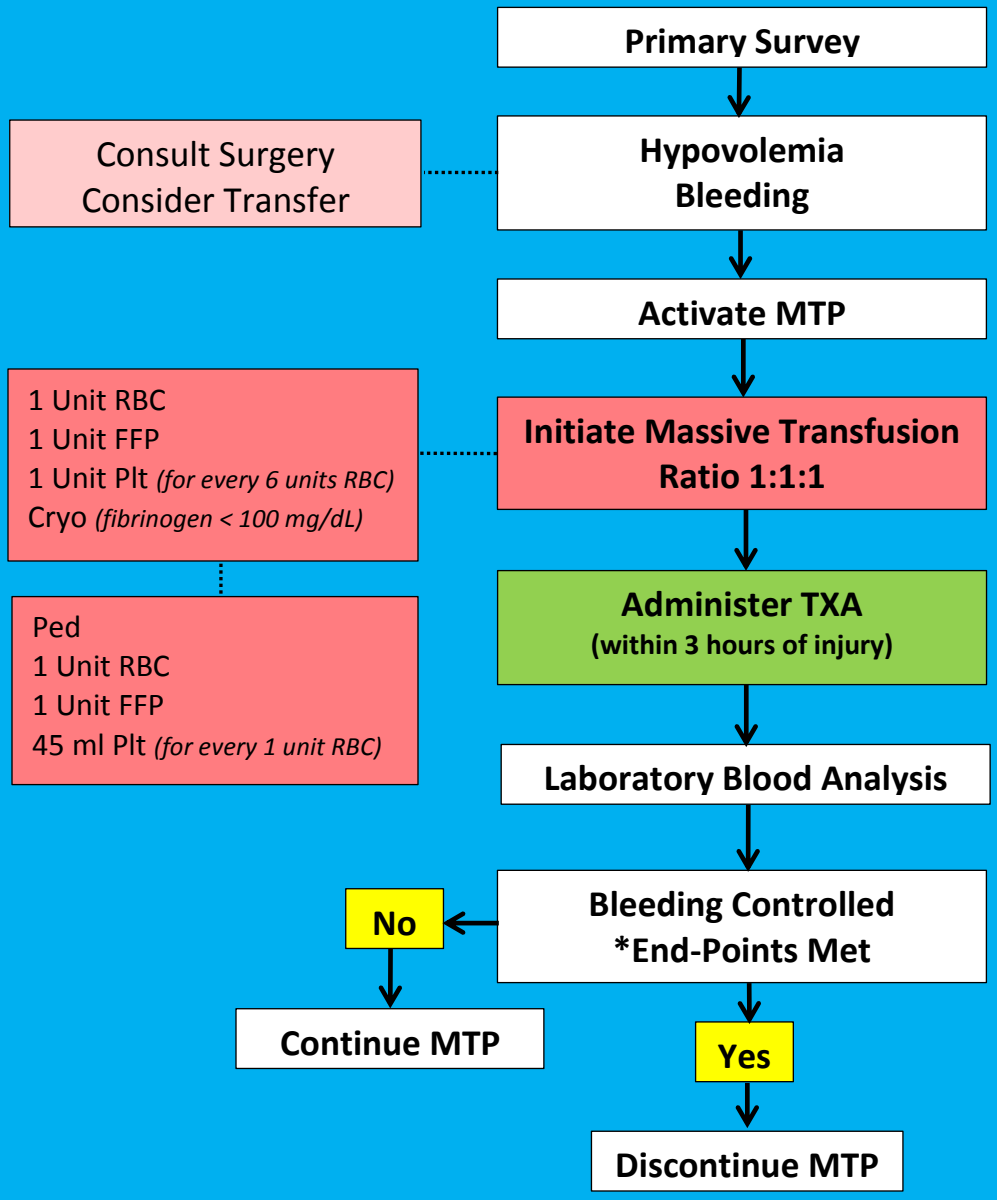
Massive Transfusion For Trauma Patient



Key Points

***End Points**

- Bleeding controlled
- Hemoglobin ≥ 10 g/dl (discontinue PRBC transfusion)
- Prothrombin time (PT) < 18 seconds (discontinue FFP)
- Partial thromboplastin time (PTT) < 35 seconds (discontinue FFP)
- Platelet count > 150,000 (discontinue platelets)
- Fibrinogen level > 100 mg/dL (discontinue cryo)

TXA

- Administered within three hours of the injury.

Complications

- Hemolytic reaction
- Hypothermia
- Hypocalcemia
- Hyperkalemia

ABC Score	
Pulse > 120	
SBP < 90	
Positive FAST	
Penetrating torso trauma	
Assign one point to each category if "yes". Greater than two points consider the need for massive transfusion.	

Appendix A.

HMC PEDIATRIC TRANSFUSION REFERENCE CARD

Broselow® Color	GRAY	PINK	RED	PURPLE	YELLOW	WHITE	BLUE	ORANGE	GREEN	
Approximate Weight (kg)	4	6	8	10	13	16	20	26	32	
Approximate Age	Newborn	4 m/o	8 m/o	1 y/o	2 y/o	4 y/o	6 y/o	8 y/o	10 y/o	13 - 17 y/o
ROUTINE TRANSFUSIONS	Request for "fresh," irradiated, & leukoreduced blood components.									
Packed Red Blood Cells @ 10 mL/kg (1 Unit PRBC ≈ 350 mL)	40 mL	60 mL	80 mL	100 mL	130 mL	160 mL	200 mL	260 mL	1 Unit	1 Unit
Platelets *in plasma* @ 5 mL/kg (1 Unit Platelets ≈ 300 mL)	20 mL	30 mL	40 mL	50 mL	65 mL	80 mL	100 mL	130 mL	160 mL	1 Unit
Plasma @ 10 mL/kg (1 Unit Plasma ≈ 250 mL)	40 mL	60 mL	80 mL	100 mL	130 mL	160 mL	200 mL	1 Unit	1 Unit	1 Unit
Cryoprecipitate	Call TSL (x43088) for dose, which will be based on patient's weight and measured fibrinogen.									

PEDIATRIC MASSIVE TRANSFUSION PROTOCOL

Initiate when blood volume loss ≥ 40 mL/kg with UNCONTROLLED hemorrhage. Deactivate protocol once hemorrhage controlled AND hemodynamically stable.

TYPE & SCREEN REQUIREMENTS: Obtain ASAP and ideally, prior to the administration of any blood product.	Send at least 1 mL of blood in a ***PINK TOP*** (TSL may request additional samples to complete testing)					Send a full ***PINK TOP*** (7 mL) (TSL may request additional samples to complete testing)				
TSL will deliver: *TSL will deliver *universal type* products until *type-compatible* products are available.	**3 Units of PRBC, 2 Units of Thawed Plasma, and 1 Unit of Platelets** (Broselow® Gray & Pink: TSL will attempt to provide "fresh," irradiated, & leukoreduced.)									6 PRBC 6 Plasma 1 Platelet
Administer PRBC and Plasma–based Products (*Platelets in Plasma* or *Plasma*) 1:1 in weight appropriate volumes to maintain hemostasis and blood pressure. **FOR EVERY 20 ML/KG OF BLOOD VOLUME LOSS, GIVE (Subsequent dosage dependent on lab results and clinical assessment):**										
Packed Red Blood Cells @ 10 mL/kg (1 Unit PRBC ≈ 350 mL)	40 mL	60 mL	80 mL	100 mL	130 mL	160 mL	200 mL	260 mL	1 Unit	Transfuse **1 Plasma to 1 PRBC** (1:1). Transfuse platelets early and as indicated.
Platelets *in plasma* @ 10 mL/kg (1 Unit Platelets ≈ 300 mL)	If ***type-compatible*** **Platelets in Plasma** is *unavailable*, *administer* **Plasma** *first*.									
if type-compatible unavailable, then: **Plasma @ 10 mL/kg** (1 Unit Plasma ≈ 250 mL)	40 mL	60 mL	80 mL	100 mL	130 mL	160 mL	200 mL	1 Unit	1 Unit	
Cryoprecipitate	Call TSL (x43088) for dose, which will be based on patient's weight and measured fibrinogen.									

TRANEXAMIC ACID PEDIATRIC DOSING GUIDELINES

Consider **ONLY** if within 3 hours of initial injury. Administer **BOLUS DOSE (15 mg/kg over 10 minutes)** *first*, then **MAINTENANCE DOSE (2 mg/kg/hr for 8 hours)**.

Use approximate weight for programming in Alaris® Pump → Approximate Weight	4 kg	6 kg	8 kg	10 kg	13 kg	16 kg	20 kg	26 kg	32 kg	
Bolus Dose – *infuse over 10 min*	60 mg	90 mg	120 mg	150 mg	195 mg	240 mg	300 mg	390 mg	480 mg	1000 mg
Maintenance Dose – *infuse over 8 hours*	64 mg	96 mg	128 mg	160 mg	208 mg	256 mg	320 mg	416 mg	512 mg	1000 mg

PEDIATRIC MTP – REQUIRED LABS

- **Type & Screen** ASAP
- **EHP** every 20 minutes
- **ABG** every 20 minutes
- **Potassium** and **Ionized Calcium** every 20 minutes

EXPECTED INCREASE (per dose)

- **Red Blood Cells:** 10 ml/kg will increase hematocrit by 5-7%
- **Apheresis Platelet:** 50,000/μL rise in platelet count
- **Plasma:** 5-10% rise in factor level
- **Cryoprecipitate:** 60-100 mg/dL rise in fibrinogen

PEDIATRIC MTP – HEMOSTASIS GOALS

- Symptomatic anemia subsides
- Platelet count > 100,000/μL while patient is actively hemorrhaging
- INR < 1.5
- Fibrinogen > 175 mg/dL
- Core temperature > 35° C

These are guidelines only. Ordering MD must evaluate the indication and dosage of every blood component prescribed.