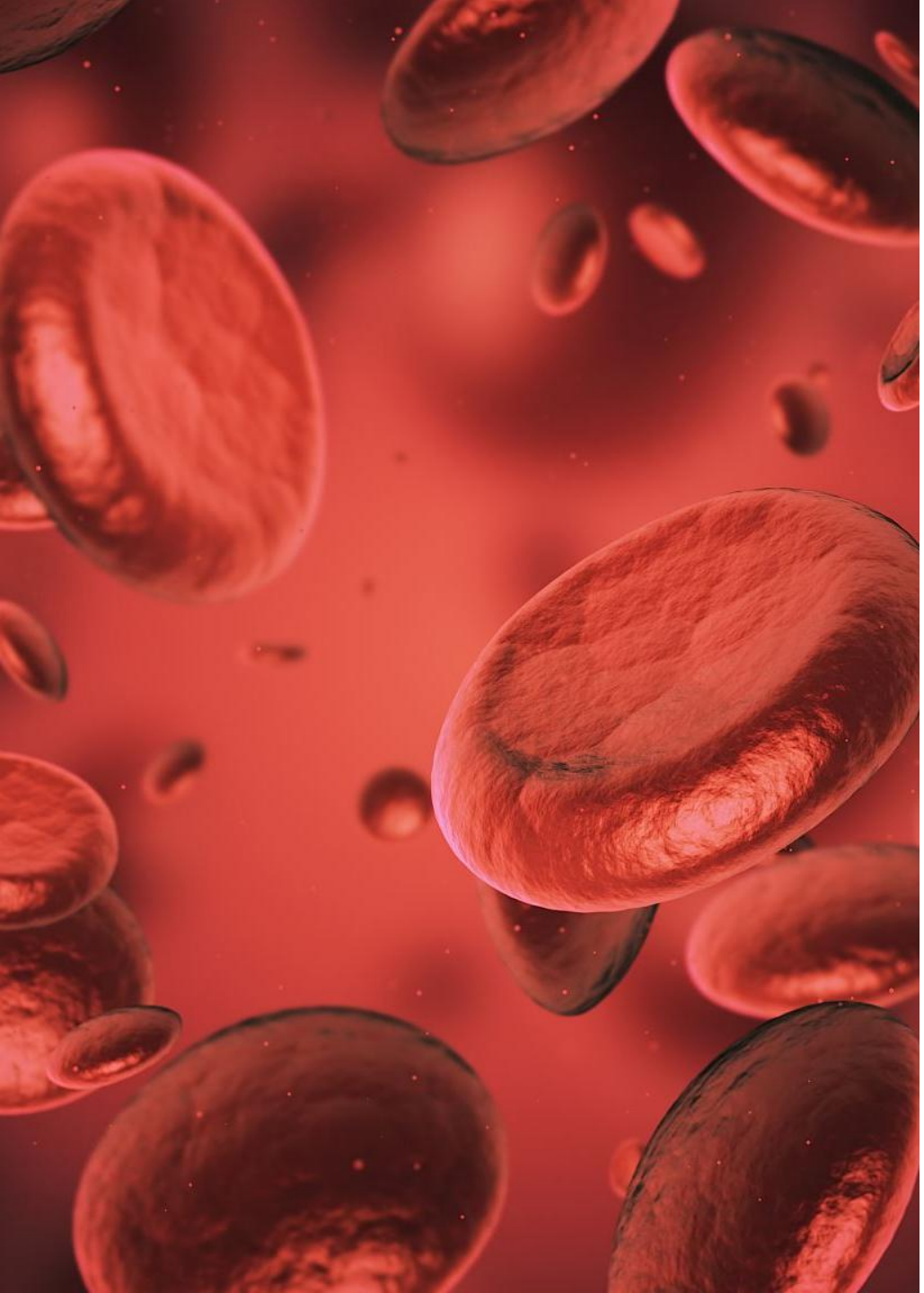


ALL BLEEDING STOPS EVENTUALLY

A PRACTICAL GUIDE TO MASSIVE HEMORRHAGE PROTOCOL

Heather Sawula CCFP EM

Grand Rounds SMMH

May 8 2025

LEARNING OBJECTIVES:

By the end of this session, participants will be able to:

- Describe the steps and activation criteria of the Massive Hemorrhage Protocol (MHP).
- Apply MHP principles in a variety of clinical scenarios.
- Recognize logistical challenges and their impact on hemorrhage management.
- Identify common transfusion pitfalls and strategies to prevent them.

DISCLOSURES

- None

TL;DR - MD ROLE

- MHP (almost) live
- Activate for life-threatening bleeding requiring immediate access to blood products or anticipated requirements. “1, 2, 3 A B C”
- Source control/definitive management of bleeding
- Ensure TXA 2g total dose given
- Labs – blood group and screen, at least hourly labs
- Transfuse as per lab results when available
  - Hb >70-90g/L, plt >50x10^9/L, or >100x10^9/L if head/spinal trauma, INR<1.8, Fibrinogen >1.5g/L, Ionized calcium >1.15 mmol/L
- Maintain temp >36C
- Terminate code to avoid unnecessary transfusion and blood product wastage

WHAT IS A MASSIVE HEMORRHAGE?

- No widely accepted universal definition
  - 10 units in 24hrs, 6RBC in 4 hours, etc
  - Amount and rate of bleeding as well as likelihood of being able to rapidly achieve hemostasis
- Rare, complex, and high stress medical scenario with high mortality rate
- Massive hemorrhage may occur in the context of
  - Trauma
  - Post-partum
  - Cardiovascular events (eg. Ruptured AAA, vessel injury)
  - Acute upper GI bleeding

WHAT IS A MASSIVE HEMORRHAGE PROTOCOL?

- Protocol, systematic clinical workflow, integrated care pathway to care for a massively bleeding patient
- ORBCON (Ontario Regional Blood Coordinating Network)
  - 2017 survey 150 Ontario Hospitals – 65% had MHP
  - 2023 survey 158 Hospitals – 77% had MHP
  - 86% updated or implements MHP in last 5 years
  - Ontario MHP 2.0 – recent changes reflected in our protocol
- MHP vs MTP
- Going live shortly at MAHC !

WHAT ARE THE PROVEN BENEFITS OF MHP?

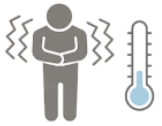
- Reduction in mortality, organ failure, post injury complications
  - Independently of what exactly is in the protocol
- Decreased length of hospital and critical care stay
- Faster delivery of blood components to patient
- Not associated with increase in blood component wastage
- Less blood component utilization (and less cost)
- Decreased variability in treatment

KEY ELEMENTS OF A MHP : 7 T'S

1. **T**rigger plan 

2. **T**eam 
3. **T**ranexamic acid 

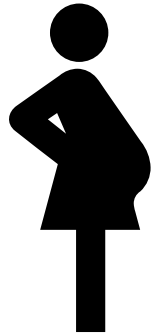
4. **T**est hourly 

5. **T**ransfuse to target 
6. **T**emperature management 
7. **T**erminate the code 

CLINICAL CASES

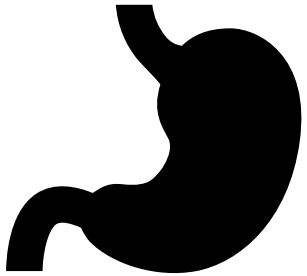
Trauma

- ATV rollover
- HR 115
- BP 93/62
- 92%
- GCS 14
- Unstable pelvis



32yo F G2P1

- PPH
- Precipitous delivery, pale, ++ PVB
- HR 123
- BP 85/50



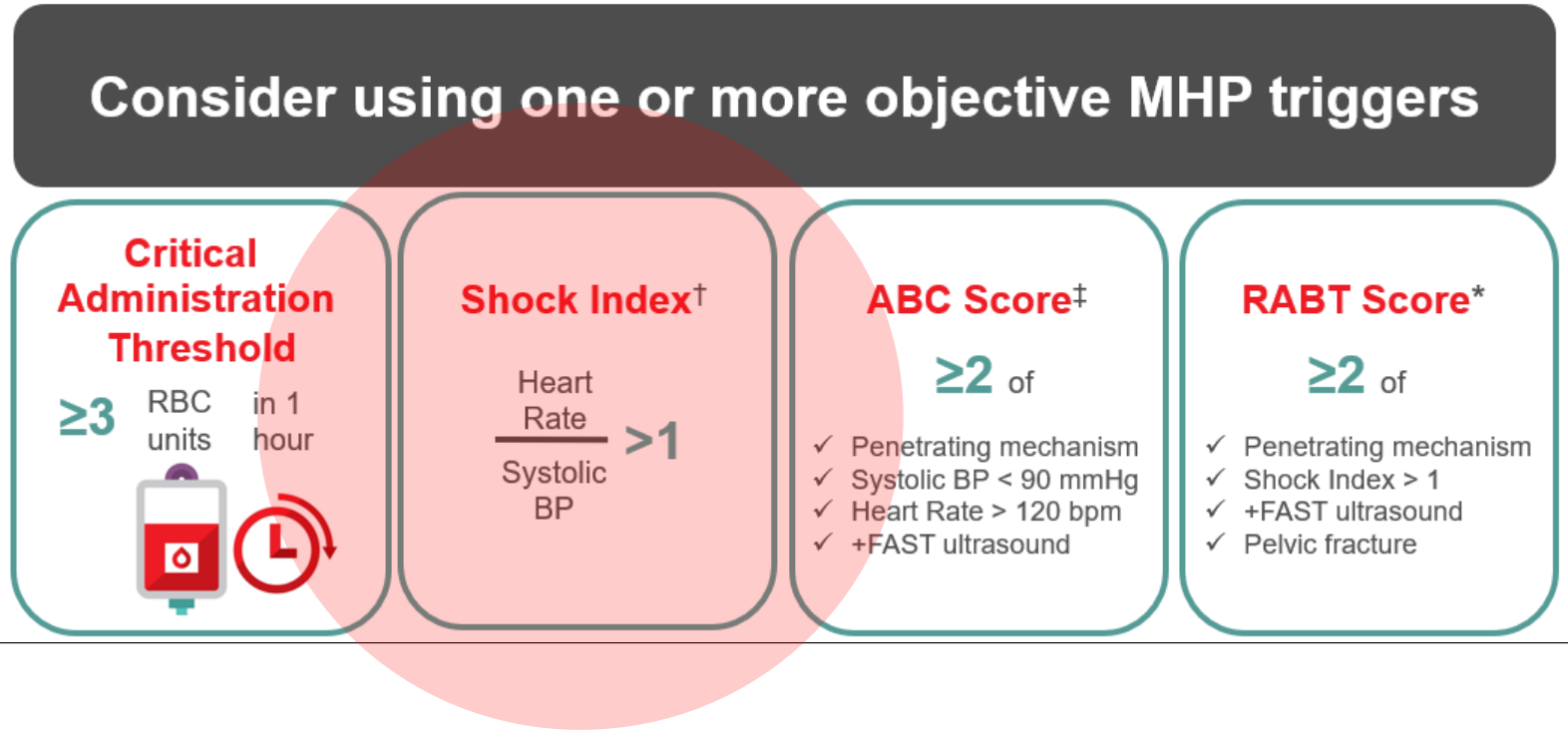
68 yo M

- GI bleed
- PMHx: Hep C Cirrhosis, Afib (rivaroxaban), COPD
- HR 132
- BP 82/61
- 91%
- hematemesis

TRIGGERING CRITERIA

For a patient experiencing a life-threatening hemorrhage (with either of the following):

- Anticipated transfusion requirement of greater than or equal to 4 units of blood product (PRBC, FP, PLTs) in 60 minutes.
- Shock index >= to 1.0 (HR/SBP) or significant bleeding leading to persistent hypotension



SPEED BUMP

- 2 step approach for activation preferred when possible
- Call for 2 units up front, “stat pack”
- When administering 3rd, activate MHP
- “1, 2, 3 think ABC”
  - Activate
  - Balance
  - Calcium/Concentrates

TRIGGERING PROCESS

Call and announce “Code Transfusion”

ext 3333 (SMMH)

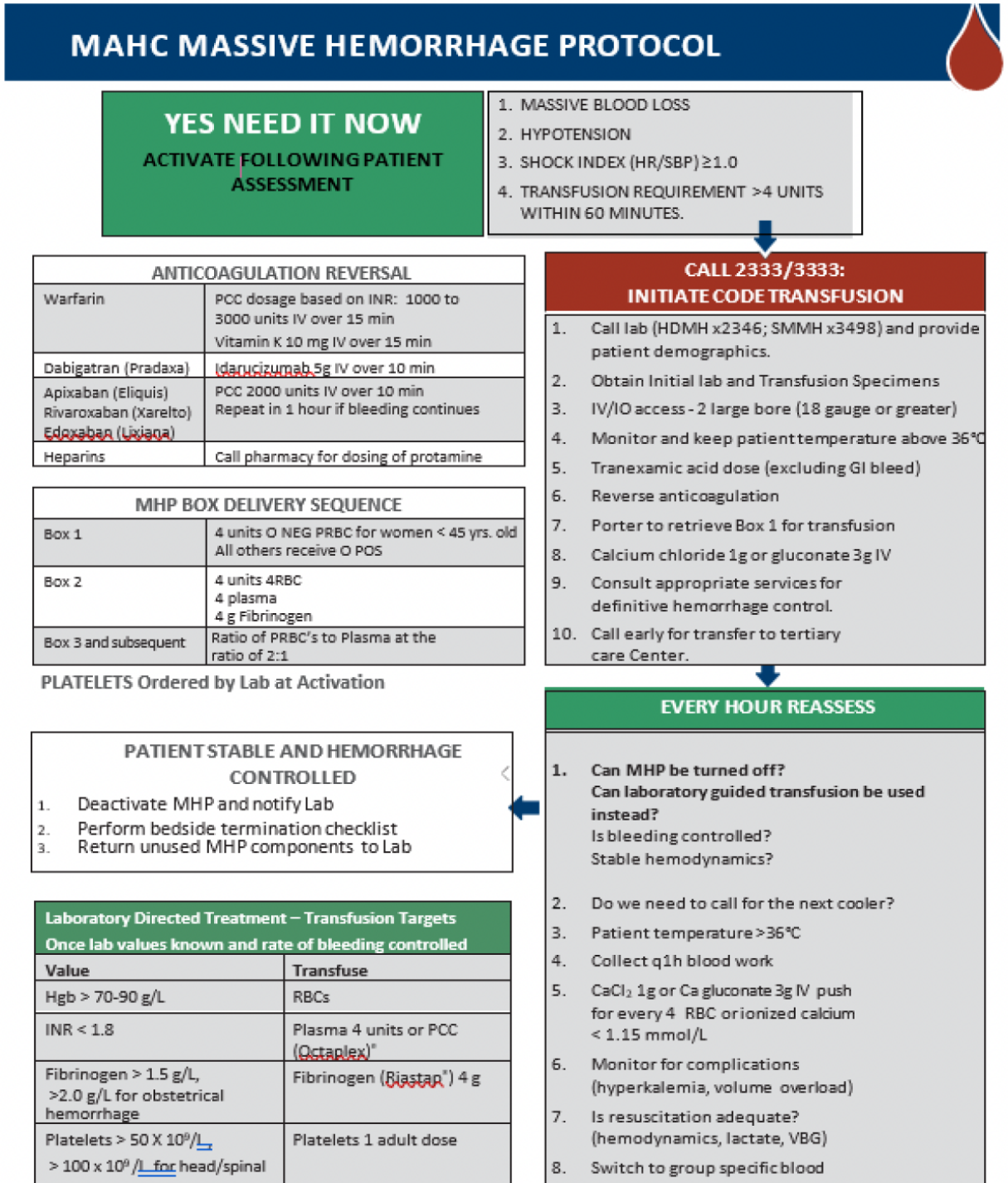
ext 2333 (HDMH)

Overhead announcement

Notify patient/ SDM ASAP

Discuss risks vs benefits

eg, TACO, hyperkalemia, alloimmunization etc



MAHC MASSIVE HEMORRHAGE PROTOCOL

YES NEED IT NOW
ACTIVATE FOLLOWING PATIENT ASSESSMENT

1. MASSIVE BLOOD LOSS
2. HYPOTENSION
3. SHOCK INDEX (HR/SBP) ≥1.0
4. TRANSFUSION REQUIREMENT >4 UNITS WITHIN 60 MINUTES.

ANTICOAGULATION REVERSAL

Warfarin	PCC dosage based on INR: 1000 to 3000 units IV over 15 min Vitamin K 10 mg IV over 15 min
Dabigatran (Pradaxa)	Idarucizumab 5g IV over 10 min
Apixaban (Eliquis) Rivaroxaban (Xarelto) Edoxaban (Lixiana)	PCC 2000 units IV over 10 min Repeat in 1 hour if bleeding continues
Heparins	Call pharmacy for dosing of protamine

MHP BOX DELIVERY SEQUENCE

Box 1	4 units O NEG PRBC for women < 45 yrs. old All others receive O POS
Box 2	4 units 4RBC 4 plasma 4 g Fibrinogen
Box 3 and subsequent	Ratio of PRBC's to Plasma at the ratio of 2:1

PLATELETS Ordered by Lab at Activation

CALL 2333/3333: INITIATE CODE TRANSFUSION

1. Call lab (HDMH x2346; SMMH x3498) and provide patient demographics.
2. Obtain Initial lab and Transfusion Specimens
3. IV/IO access - 2 large bore (18 gauge or greater)
4. Monitor and keep patient temperature above 36°C
5. Tranexamic acid dose (excluding GI bleed)
6. Reverse anticoagulation
7. Porter to retrieve Box 1 for transfusion
8. Calcium chloride 1g or gluconate 3g IV
9. Consult appropriate services for definitive hemorrhage control.
10. Call early for transfer to tertiary care Center.

EVERY HOUR REASSESS

1. **Can MHP be turned off?**
   Can laboratory guided transfusion be used instead?
   Is bleeding controlled?
   Stable hemodynamics?
2. Do we need to call for the next cooler?
3. Patient temperature >36°C
4. Collect q1h blood work
5. $CaCl_2$ 1g or Ca gluconate 3g IV push for every 4 RBC or ionized calcium < 1.15 mmol/L
6. Monitor for complications (hyperkalemia, volume overload)
7. Is resuscitation adequate? (hemodynamics, lactate, VBG)
8. Switch to group specific blood

PATIENT STABLE AND HEMORRHAGE CONTROLLED

1. Deactivate MHP and notify Lab
2. Perform bedside termination checklist
3. Return unused MHP components to Lab

Laboratory Directed Treatment – Transfusion Targets
Once lab values known and rate of bleeding controlled

Value	Transfuse
Hgb > 70-90 g/L	RBCs
INR < 1.8	Plasma 4 units or PCC (Octaplex)*
Fibrinogen > 1.5 g/L, >2.0 g/L for obstetrical hemorrhage	Fibrinogen (Riastap*) 4 g
Platelets > 50 X 10^9/L > 100 x 10^9 /L for head/spinal	Platelets 1 adult dose

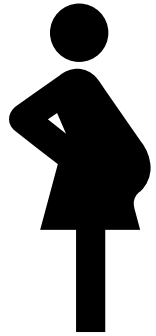
MHP KIT

- Available in ED, OR, and OBS
- Contains
  - Order set, nursing checklist/notes, debrief tool
  - Blood collection kit, transfusion tubing, Ranger kit
  - Bair hugger blanket, continuous temp monitor cord
  - Med cheat sheets
  - Meds
    - TXA 2g
    - calcium gluconate/carbonate
    - Vit K
    - Idarucizamab (Praxbind) in ER

CLINICAL CASES

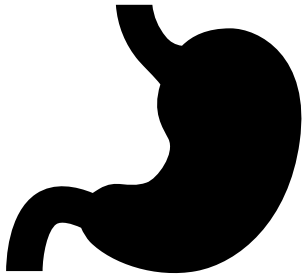
Trauma

- call for 2uRBC with EMS patch
- TXA ready
- ATLS
  - eFAST, pelvic binder
- Criticall
- 123 ABC



32yo F G2P1

- 4 T's
  - Tone
  - Tissue
  - Trauma
  - Thrombin
- PPH kit
  - Oxytocin
  - TXA
  - misoprostol
  - Hemabate
  - Ergot
- Call for 2u RBC



68 yo M

- ABC, IV, O2
- PCC (Octaplex) 2000IU
- Octreotide
- Ceftriaxone
- PPI
- 2 units vs MHP?
- OR?

KEY ELEMENTS OF A MHP : 7 T'S

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4. **T**est hourly 

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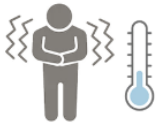
6. **T**emperature management 
7. **T**erminate the code 

TEAM

- MHP MD lead
- MHP Nursing lead
- ED/ICU Nurse responder
- Med/surg nurse
- MHP nurse
- RT
- Lab
- Surgery/Criticall – MRP to call

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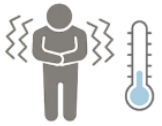
6. **T**emperature management 
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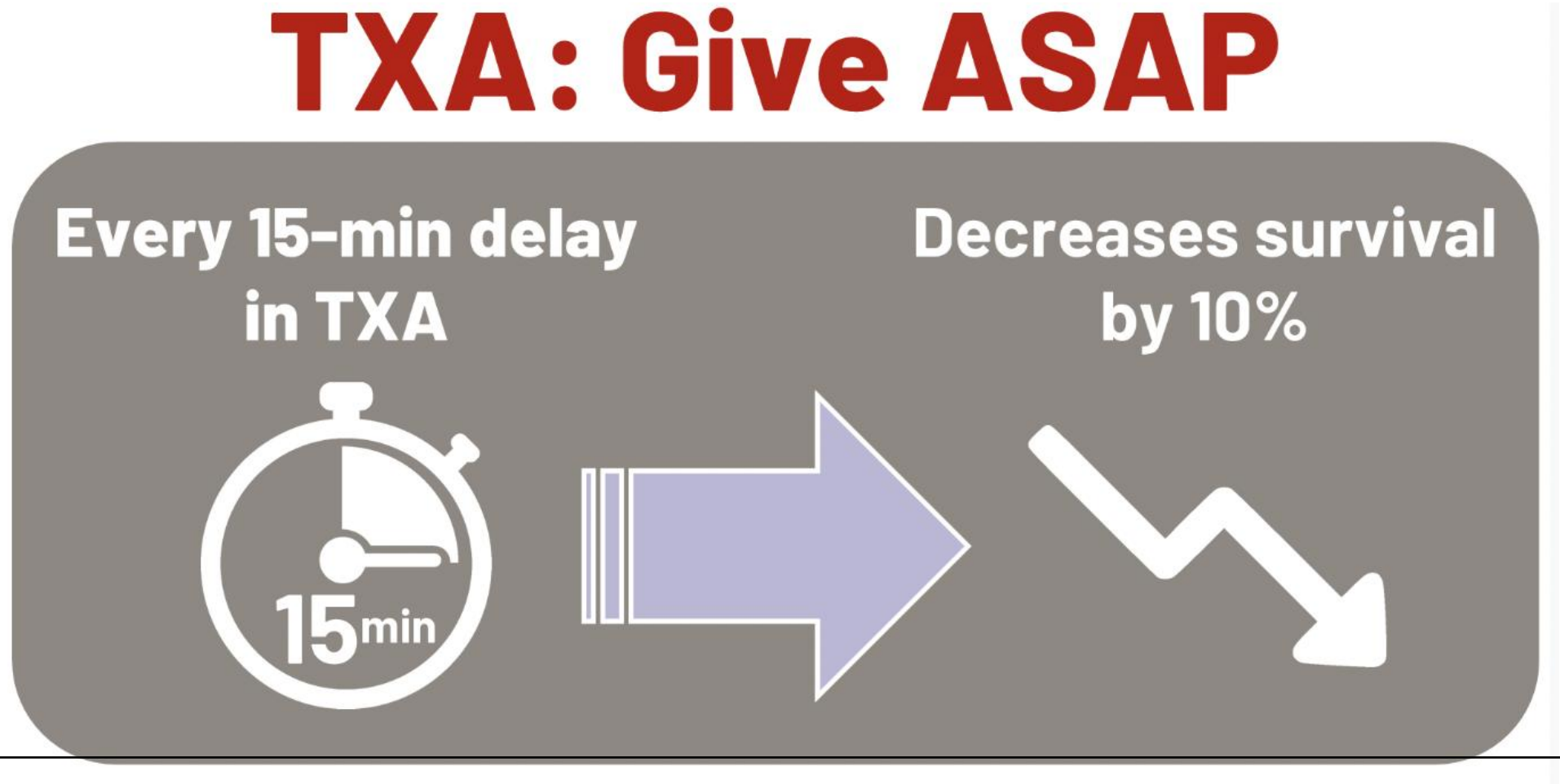
TXA

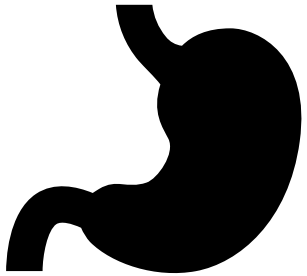

TXA: Give ASAP
Every 15-min delay in TXA
15min
Decreases survival by 10%

TXA

- Anti-fibrinolytic
- Reduces chance of death in trauma and obstetrical bleeds
- Caution in GI bleeds - HALT-IT Trial
  - RCT of TXA vs placebo in pt with major GI hemorrhage: TXA does not reduce mortality and increases risk of VTE

- Dosing options
  - 1g bolus then repeat 1g bolus in 1 hr
  - 1g bolus then 1g infusion over 8 hr
  - **2g bolus up front**

CLINICAL CASES



Trauma	32yo F G2P1	68 yo M
• 2g TXA	• 1-2g TXA	• No TXA

KEY ELEMENTS OF A MHP : 7 T'S

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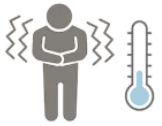
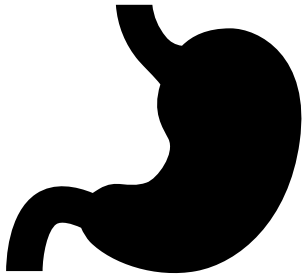
6. **T**emperature management 
7. **T**erminate the code 

TESTING

- Group and Rh, antibody screen, crossmatch
- CBC
- Electrolytes, creatinine
- VBG, lactate, ionized calcium
- INR, PTT, and Fibrinogen
  - Fibrinogen testing only available at HDMH
- Repeat (minimum q1hr) is same minus Group and screen and PTT

CLINICAL CASES



Trauma	32yo F G2P1	68 yo M
• Trauma vs MHP Panel	• MHP Labs	• MHP Labs

KEY ELEMENTS OF A MHP : 7 T'S

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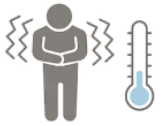
6. **T**emperature management 
7. **T**erminate the code 

TRANSFUSION

- Red Blood Cells (pRBC) should be available within 10 min
  - 25 units/site, 18max are O
- Frozen Plasma (FP) takes 25-30 min to be available
  - 12 units/site
  - If blood group unknown, AB FP can use used until group determined
- No platelets stocked on site. Ordered on activation. May take 1-2.5hrs to arrive.
  - May not have group specific plts available. 1% risk of alloimmunization of Anti-D from plts.
  - Consider rhogam for Women<45 who are Rh- within 72hrs.
- Fibrinogen
  - 8x 1g Fibrinogen RiaStap / site. 4g is an average adult dose.
  - 1 dose fibrinogen = 10 units Cryoprecipitate (not available)
- PCC (Octaplex)
  - 6000IU stocked / site

TRANSFUSION

Ontario Provincial MHP Targets:

Target	***Blood Component required***
Hemoglobin >70-90 g/L	*Red Blood Cells*
INR <1.8	*Frozen Plasma or Prothrombin Complex (PCC)*
Platelets >50 X 10^9/L, consider >100 x 10^9/L for head/spinal trauma	*1 Adult Dose Platelets*
Fibrinogen >1.5 g/L, >2 g/L for obstetrical bleeding	*Fibrinogen concentrate RiaStap (4 gm dose)*
Ionized Calcium >1.15 mol/L	*Calcium gluconate 3 g IV direct push over 5 – 10 mins OR Calcium chloride 1 g IV direct push over 5 – 10 mins (Central preferred)*

TRANSFUSION

- Box 1:
  - 4 pRBC (uncrossed O positive, O neg if woman <45yo)
  - (includes any pRBCs given in step 1)
- Box 2:
  - 4 pRBC (uncrossed group specific)
  - 4 FP (uncrossed group specific)
  - 4 g Fibrinogen
- Box 3 (and beyond)
  - 4 pRBC
  - 2 FP

TRANSFUSION - FIBRINOGEN

- Essential for hemostasis and rapidly depleted in trauma, massive hemorrhage.
- Empiric administration no longer routinely recommended, even in OB
  - (CRYOSTAT-2 and FIDEL)
- Consider empiric administration if significant time delays in testing, evidence of microvascular coagulopathy, profound hemodynamic instability where hypofibrinogenemia is likely.
- Adult dose – 4g

TRANSFUSION - CALCIUM

- Sodium citrate preservative added to blood products, binds to ionized calcium
- Calcium is essential for clotting, myocardial contractility and vascular tone
- Hypocalcemia = impaired clot formation + hypotension + cardiac instability
- 1g Calcium chloride if central access available
- 3g Calcium gluconate if peripheral

TRANSFUSION

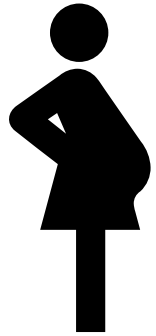
- Complications
  - Mechanical: Air embolism, volume overload (TACO, TRALI)
  - Electrolytes: hyperkalemia, hypocalcemia
  - Metabolic: metabolic acidosis, hypothermia, dilutional coagulopathy
  - Transfusion: anaphylaxis allergic reaction, blood-product infection, hemolytic transfusion reaction
    - Women of child-bearing potential should undergo red cell antibody screening at 6 weeks and/or 6 months after transfusion

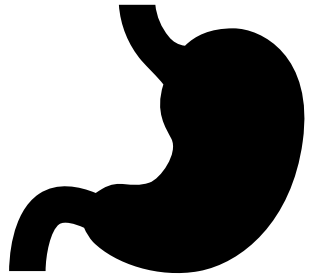
REVERSAL AGENTS

- Antidotes available
- Indicated or order set

Anticoagulant	Examples	Reversal Recommendations
LMWH	Dalteparin, enoxaparin, tinzaparin, danaparoid	Enox <8hr = 1mg protamine/1mg enox Enox 8-12 hrs = 0.5mg prot/1mg enox Enox >12hr = may not require Others = see order set, max 50mg IV protamine as a single dose
Vitamin K antagonists	Warfarin	10g Vit K IV + ??? INR – 2000 units PCC IV INR <3 – 1000 units PCC IV INR 3-5 – 2000 units PCC IV INR >5 – 3000 units PCC IV
UFH		1mg protamine IV / 100 units UFH in past 4 hours 25mg protamine IV will reverse UFH infusion at rate of approx. 1500units/hr
Direct Xa and Thrombin Inhibitors	Bivalirudin, lepirudin, agrotraban Rivaroxaban (xarelto), apixaban (eliquis), edoxaban (lixiana)	TXA 1g bolus and repeat 1 hour PCC (Octaplex) 2000 units IV over 10 min, repeat at 1 hr if still bleeding
Direct Thrombin Inhibitor	Dabigatran	Idarucizamab (Praxbind) 2.5g IV x 2 (total 5g) over 10 min

CLINICAL CASES





Trauma	32yo F G2P1	68 yo M
• MHP • TXA	• MHP • TXA/PPH meds • fibrinogen	• MHP • PCC (Octaplex)

KEY ELEMENTS OF A MHP : 7 T'S

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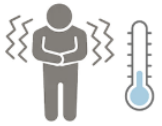
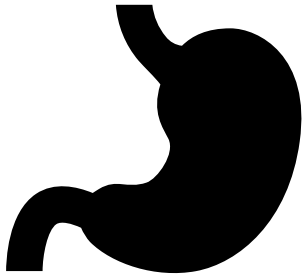
6. **T**emperature management 
7. **T**erminate the code 

TEMPERATURE

- Every 1°C drop in temperature increases blood loss by 22%
- Measure temp within 15min of MHP initiation/arrival to hospital
- Target temp is ≥ 36 ° C
- Blood warmers, fluid warmers, warm blankets, Bair Hugger

CLINICAL CASES



Trauma	32yo F G2P1	68 yo M
• Warm blankets, bair hugger, • Level 1	• Warm blankets, bair hugger, • Level 1	• Warm blankets, bair hugger, • Level 1

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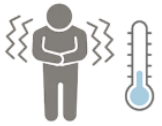
6. **T**emperature management 
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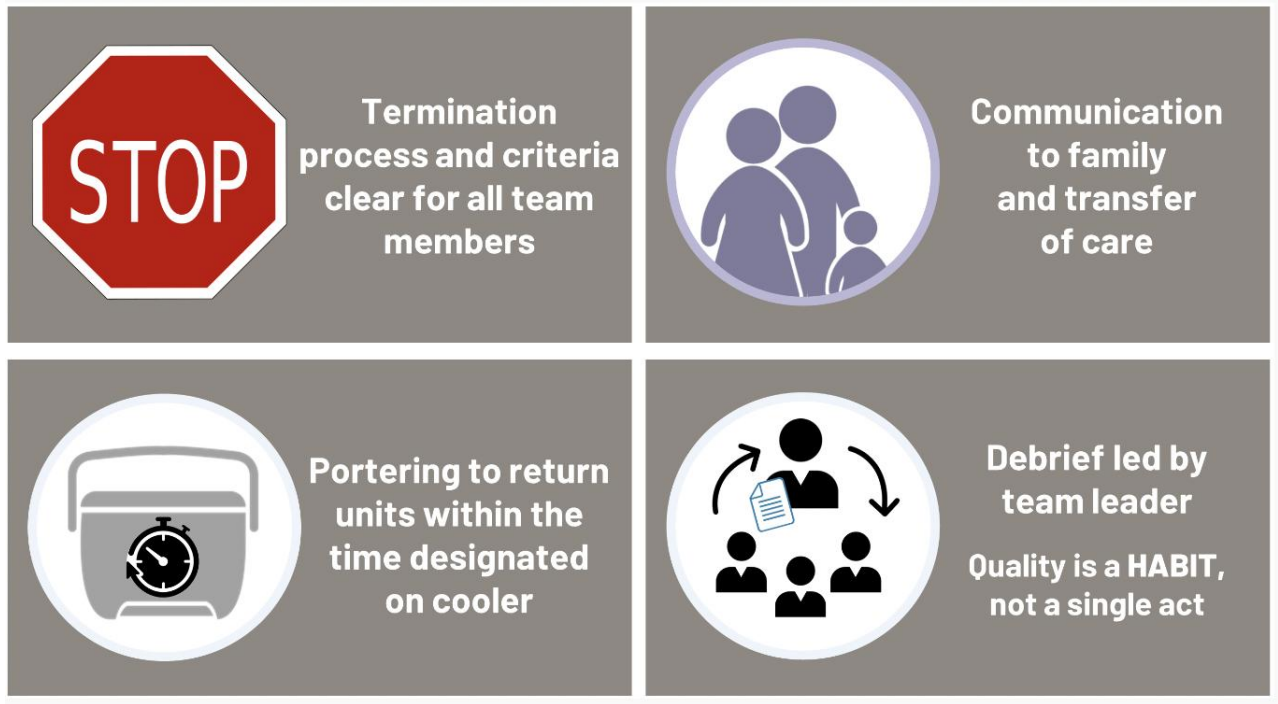
TERMINATION



- Once life threatening hemorrhage treatment completed, notify lab
- Return all unused blood products
- Debrief
- When clinically appropriate, MRP to inform pt/family of MHP transfusions

KEY ELEMENTS OF A MHP : 7 T'S

1 Trigger plan

2 Team

3 Tranexamic acid

Test hourly

8 Targeted treatment of bleeding

5 Transfuse to target

6 Temperature management

7 Terminate the code

DEFINITIVE MANAGEMENT AND DISPOSITION

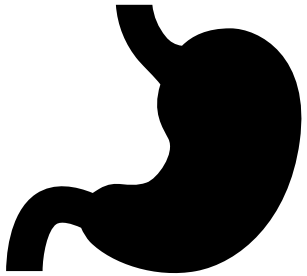
- Tourniquet
- OR / interventional radiology
- Pelvic Binder
- Any patient on whom MHP was activated and who cannot receive definitive management locally, must be considered for transfer ASAP

- CritiCall 1 800 668 4357

CRITICALL - ORNGE

- 2 units of RBC on board
- SWIFT Canada Trial (launched Dec 2024)
  - 2 units whole blood
  - 2u RBC and 2u plasma
- Send patient with cooler

CLINICAL CASES



Trauma	32yo F G2P1	68 yo M
• Transfer to Trauma Centre	• Stabilized in OR, retained placenta	• Variceal banding/ Blakemore

LEARNING OBJECTIVES:

By the end of this session, participants will be able to:

- Describe the steps and activation criteria of the Massive Hemorrhage Protocol (MHP).
  - 7 T's, "123, ABC", TXA, hourly labs, transfuse to target, temp, terminate
- Apply MHP principles in a variety of clinical scenarios.
  - Trauma, OB, OR, GI bleed
- Recognize logistical challenges and their impact on hemorrhage management.
  - Transfer required, local resources available, site specific considerations
- Identify common transfusion pitfalls and strategies to prevent them.
  - 2g TXA total in, keep temp >36C, give calcium

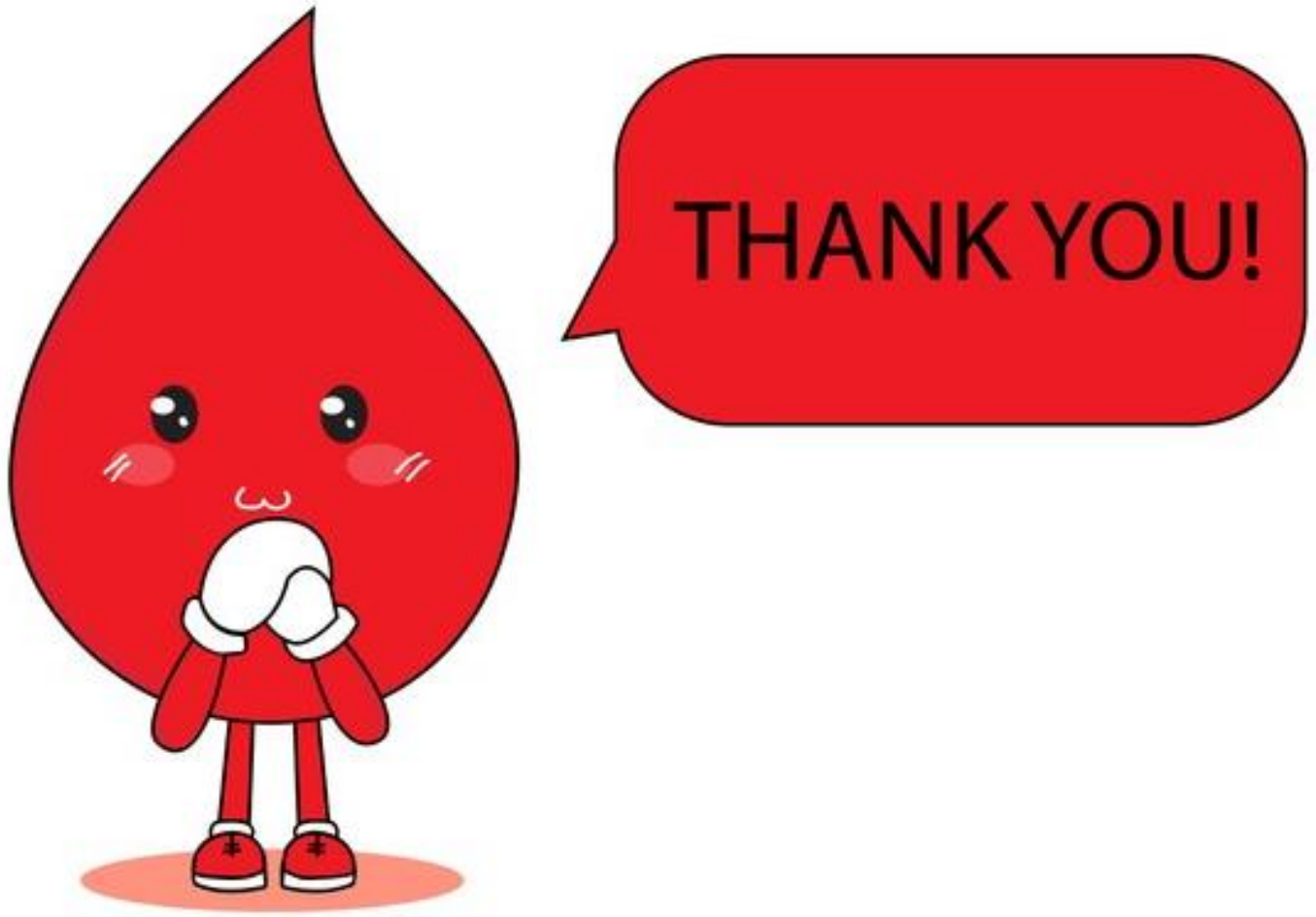
ALL BLEEDING STOPS EVENTUALLY…

Keep calm.

Stay warm.

Call early.

You’ve got this.



MAHC MASSIVE HEMORRHAGE PROTOCOL

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Heparins	Call pharmacy for dosing of protamine

MHP BOX DELIVERY SEQUENCE	
Box 1	4 units O NEG PRBC for women < 45 yrs. old All others receive O POS
Box 2	4 units 4RBC 4 plasma 4 g Fibrinogen
Box 3 and subsequent	Ratio of PRBC's to Plasma at the ratio of 2:1

PLATELETS Ordered by Lab at Activation

CALL 2333/3333: INITIATE CODE TRANSFUSION

1. Call lab (HDMH x2346; SMMH x3498) and provide patient demographics.
2. Obtain Initial lab and Transfusion Specimens
3. IV/IO access - 2 large bore (18 gauge or greater)
4. Monitor and keep patient temperature above 36°C
5. Tranexamic acid dose (excluding GI bleed)
6. Reverse anticoagulation
7. Porter to retrieve Box 1 for transfusion
8. Calcium chloride 1g or gluconate 3g IV
9. Consult appropriate services for definitive hemorrhage control.
10. Call early for transfer to tertiary care Center.

EVERY HOUR REASSESS

1. **Can MHP be turned off?**
   Can laboratory guided transfusion be used instead?
   Is bleeding controlled?
   Stable hemodynamics?
2. Do we need to call for the next cooler?
3. Patient temperature >36°C
4. Collect q1h blood work
5. $CaCl_2$ 1g or Ca gluconate 3g IV push for every 4 RBC or ionized calcium < 1.15 mmol/L
6. Monitor for complications (hyperkalemia, volume overload)
7. Is resuscitation adequate? (hemodynamics, lactate, VBG)
8. Switch to group specific blood products ASAP

PATIENT STABLE AND HEMORRHAGE CONTROLLED

1. Deactivate MHP and notify Lab
2. Perform bedside termination checklist
3. Return unused MHP components to Lab

Laboratory Directed Treatment – Transfusion Targets Once lab values known and rate of bleeding controlled	
Value	**Transfuse**
Hgb > 70-90 g/L	RBCs
INR < 1.8	Plasma 4 units or PCC (Octaplex)*
Fibrinogen > 1.5 g/L, >2.0 g/L for obstetrical hemorrhage	Fibrinogen (Riastap*) 4 g
Platelets > 50 X 10^9/L, > 100 x 10^9/L for head/spinal trauma	Platelets 1 adult dose
Ionized calcium > 1.15 mmol/L or every 4 units PRBC	$CaCl_2$ 1g or Ca Gluconate 3g

MAHC MASSIVE HEMORRHAGE PROTOCOL

YES NEED IT NOW

ACTIVATE FOLLOWING PATIENT ASSESSMENT

1. MASSIVE BLOOD LOSS
2. HYPOTENSION
3. SHOCK INDEX (HR/SBP) ≥1.0
4. TRANSFUSION REQUIREMENT >4 UNITS WITHIN 60 MINUTES.

ANTICOAGULATION REVERSAL	
Warfarin	PCC dosage based on INR: 1000 to 3000 units IV over 15 min Vitamin K 10 mg IV over 15 min
Dabigatran (Pradaxa)	Idarucizumab 5g IV over 10 min
Apixaban (Eliquis) Rivaroxaban (Xarelto) Edoxaban (Lixiana)	PCC 2000 units IV over 10 min Repeat in 1 hour if bleeding continues
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RESOURCES AND REFERENCES

- https://www.treatthebleed.org/index.html
- https://transfusionontario.org/en/
- Ontario Regional Blood Coordinating Network. (2025, March). *Provincial massive hemorrhage protocol (MHP 2.0): Statements and references*. https://transfusionontario.org/wp-content/uploads/2021/10/MHP-2.0_StatementsReferences_Final_March2025.pdf