Transfusion Camp

March 24, 2023

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UNIVERSITY OF TORONTO

Massive Hemorrhage Protocol (MHP) Translation to the Real World

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Disclosures

- Advisory board participation: Pfizer
- Clinical trials: Ablynx/Sanofi, Bioverativ/Sanofi, Shire/Takeda, Roche

- None are relevant to the content of this talk

- I will not be covering pediatric implications – refer to the ORBCON MHP Tool
  - https://transfusionontario.org/wp-content/uploads/2021/10/MHP_Toolkit_v1_Oct2021.pdf

Learning Objectives

- Discuss how the different elements of MHP could be practically applied to management of bleeding adult patients

cmajOPEN

Research

A regional massive hemorrhage protocol developed through a modified Delphi technique

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Abstract

Background: A massive hemorrhage protocol (MHP) enables rapid delivery of blood components in a patient who is exsanguinating pending definitive hemorrhage control, but there is variability in MHP implementation rates, content and compliance owing to challenges presented by infrequent activation, variable team performance and patient acuity. The goal of this project was to identify the key evidence-based principles and quality indicators required to develop a standardized regional MHP.

Methods: A modified Delphi consensus technique was performed in the spring and summer of 2018. Panellists used survey links to independently review and rate (on a 7-point Likert scale) 43 statements and 8 quality indicators drafted by a steering committee composed of transfusion medicine specialists and technologists, and trauma physicians. External stakeholder input from all hospitals in Ontario was sought.

Results: Three rounds were held with 36 experts from diverse clinical backgrounds. Consensus was reached for 42 statements and 8 quality indicators. Additional modifications from external stakeholders were incorporated to form the foundation for the proposed MHP.

Interpretation: This MHP template will provide the basis for the design of an MHP toolkit, including specific recommendations for pediatric and obstetrical patients, and for hospitals with limited availability of blood components or means to achieve definitive hemorrhage control. We believe that harmonization of MHPs in our region will simplify training, increase uptake of evidence-based interventions, enhance communication, improve patient comfort and safety, and, ultimately, improve patient outcomes.

Ontario MHP

Large/Academic Hospital Setting

Adult Appendix B

NEED A MASSIVE HEMORRHAGE PROTOCOL?

NO
NOT YET

1. ORDER 4 UNCROSSMATCHED RBC
2. REASSESS NEED FOR MHP

YES
NEED IT NOW

1. MASSIVE BLOOD LOSS
2. HYPOTENSION
3. LIKELY NEED PLASMA

Or based on hospital activation criteria

ANTICOAGULATION REVERSAL	
Warfarin	PCC 2000 units IV over 10 min Vitamin K 10mg IV over 10 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 COOLER DELIVERY SEQUENCE	
Cooler 1	4 units ONeg RBC for women < 45 *All others receive OPos*
Cooler 2	4 units RBC 4 plasma
Cooler 3	4 units RBC 2 plasma 4g fibrinogen concentrate
Cooler 4+	4 units RBC 2 plasma

PLATELETS order if <50 or on antiplatelets
FIBRINOGEN CONCENTRATE order 4g IV if <1.5

PATIENT STABLE AND HEMORRHAGE CONTROLLED

1. Call blood bank to turn off MHP
2. Perform bedside termination checklist
3. Inform family member and SDM of needing MHP
4. Return unused MHP components to blood bank

Laboratory transfusion triggers
(once results available or rate of bleeding controlled)

Value	Transfuse
Hgb < 80	RBCs
INR ≥ 1.8	Plasma 4 units
Fibrinogen < 1.5 *Less than 2.0 for postpartum hemorrhage	Fibrinogen concentrate 4g
Platelets < 50	Platelets 1 adult dose
Ionized calcium < 1.15	$CaCl_2$ 1g

If available, ROTEM triggers

Value	Transfuse
EXTEM CT > 80	Plasma 4 units
EXTEM A10 < 35	Platelets 1 adult dose
FIBTEM A10 < 8-10	Fibrinogen concentrate 4g

CALL XXXX:
INITIATE CODE TRANSFUSION

1. Control rapidly bleeding site (tourniquet)
2. IV/IO access
3. Tranexamic acid total dose of 2g IV / IO
4. 4U RBCs with rapid infuser
5. Limit use of crystalloids
6. Calcium chloride 1g IV
7. Keep patient temperature above 36°C
8. Obtain MHP blood work
9. Reverse anticoagulation
10. Call for definitive bleeding control (OR, angio, endoscopy)

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 IV for every 4 RBC or ionized calcium < 1.15
6. Monitor for complications (hyperkalemia, volume overload)
7. Is resuscitation adequate? (hemodynamics, lactate, VBG)
8. Switch to group specific blood products, when able

https://transfusionontario.org/en/provincial-massive-hemorrhage-toolkit/

Let's review:

MHP = T^7

	The Seven T's
1	Triggering and Treatment of Bleeding
2	Team (incl. Training and Communication)
3	Tranexamic acid
4	Temperature
5	Testing
6	Transfusion
7	Termination and Tracking Performance

Triggering

- MHP (Massive Hemorrhage Protocol) is a code
  - In Ontario hospitals,
    - Should be announced overhead as CODE TRANSFUSION
      - Announcing overhead instantaneously alerts all of the relevant parties and may bring additional resources
    - Should be called the same – MHP – to avoid confusion
  - Activated by a single call to Locating/Switchboard with dissemination to all team members

Triggering

- Triggering criteria
  - May differ from hospital to hospital – KNOW YOURS
  - May be different for different patient populations

Patient group	Validated activation criteria	Description
Adult	Shock Index	HR/SBP > 0.9 has 1.6x risk of massive hemorrhage
	ABC Score for trauma	1 point for: penetrating injury, BP≤90mmHg, HR≥120bpm, positive FAST Score ≥2 has higher risk of massive hemorrhage
	Resuscitation intensity	≥4 units of fluid within first 30 minutes 1 unit = 1 unit RBC or 1 unit plasma or 1L crystalloid or 500ml colloid

Triggering Criteria

Life-threatening bleeding requiring mobilization of blood bank, laboratory and clinical resources

Anticipated need for at least 4 RBC immediately AND component therapy (platelets (PLT), plasma, and /or fibrinogen concentrate)

A non-obstetrical patient with systolic BP<90 mmHg and/or requiring vasopressors

A peri-partum woman with marked ongoing blood loss

Should MHP be activated?

- 37 year old female, 2 hours post-vaginal delivery, found by nurse on the floor. Vitals: 90/40, HR 120, oxygen saturation 97% RA, 37.0C. Patient is awake and complains of feeling dizzy. Her gown is soaked with blood.

- A. Yes
- B. No

Should MHP be activated?

- 68 year old male with known liver cirrhosis is seen in ED. He complains of vomiting blood, “about a cup or two”, about 30 minutes ago. He feels nauseated. Vitals: 157/95, HR 100, oxygen saturation 96% RA, afebrile.

- A. Yes
- B. No

Should MHP be activated?

- 19 year old male is brought to ED by ambulance. He has 2 obvious gun shot wounds to his Rt. lower chest and upper abdomen. He is actively bleeding. He is confused and combative. Vitals: 95/60, HR 130, oxygen saturation 92% RA, Temp 36C.

- A. Yes
- B. No

Treatment of Bleeding

- Damage control resuscitation
  - Immediate hemorrhage control
    - Pressure, damage control surgery, angiography, etc.
  - Restoration of blood volume and physiologic/hematologic stability
    - IV fluids
      - Early transfusion
      - Avoid too much crystalloid
    - Correct hypothermia
    - Correct acidosis
    - Correct calcium

https://www.stopthebleed.org/

Expert Support for MHP

- 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

Team

BIG Hospital

- Physician Lead
- Nursing Lead
- Charting Nurse
- RT
- Anesthesia
- Rapid Response/Code Team
- Porter
- MLT – Transfusion Medicine
- MLT – Core lab (Hematology, Coagulation, Biochem)
- OB: back up anesthesia, second call OB, neonatologist, NICU RN
- Chaplain

SMALL Hospital

- Physician Lead
- Nursing Lead
- Charting Nurse
- Code Team
- Anesthesia if available
- Porter
- MLT – Transfusion Medicine and Core Lab
- OB: Obstetrician on call

Team

Challenges

- Team members with different levels of experience
- Team members that may not have worked together previously
- Team members that are geographically separated
- Professional silos and hierarchies

Solutions

- Training, competency maintenance and assessment
- Debriefing after each MHP
- Wearing signs with MHP role designation
- Effective communication
- Regular time-outs
- Smart records and checklists

Team: Make it Easy to Do it Right

Use smart records, checklists, posters with job aids, apps

Adult Appendix C

ADULT PATIENTS, DEFINITIVE CARE AT HOSPITAL

To be repeated on each page

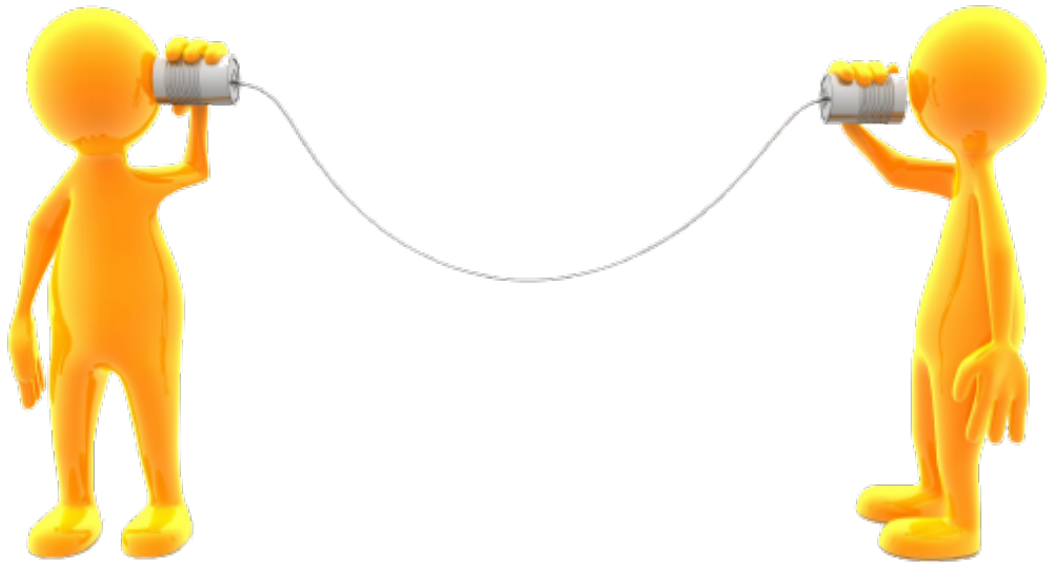
MASSIVE HEMORRHAGE PROTOCOL (MHP) CHECKLIST

TIME	ACTION	INITIALS
ACTIVATION & PACK 1 (date _ _/ _ _ _/ _ _ time _ _/_ _)		
	MHP Lead RN: _____	
	Call to hospital locating (ext. - - - -) to activate **CODE TRANSFUSION**	
	Provide patient number, name, sex, age, location, and information regarding patient use of antiplatelet or anticoagulants to blood bank at ext. - - - - Antiplatelets ☐ Yes; Anticoagulant ☐ Yes, drug name:_____	
	☐ Ensure identification band is affixed to patient	
	☐ Obtain group and screen sample	
	☐ Obtain baseline blood work	
	Tranexamic acid: Administer 2 gram iv bolus in 100 mL over 20 minutes. *Hold if: more than 3 hours from injury/onset of hemorrhage or given pre-hospital or pre-activation or patient has a gastrointestinal hemorrhage*	
	Hypothermia prevention: ☐ Measure and document patient temperature ☐ Obtain blood warmer for all infusions ☐ If patient temperature less than 36°C start active warming	
	Definitive hemorrhage control: Notify if required: ☐ Operating Room ☐ Interventional Radiology ☐ Gastroenterology	
	Obtain 1st MHP pack (if not obtained before activation): Pack arrival time (_ _/_ _) ☐☐☐☐ 4 units Red Cells (RBCs) *Use Rh-negative blood only for females under 45 years* *Avoid additional boluses or infusions of crystalloid except on physician order*	
	☐ **Platelets:** If platelet count below 50 x10^9/L or patient on an antiplatelet drug, transfuse 1 pool of platelets	
	☐ **Fibrinogen:** if fibrinogen less than 1.5 g/L, 4 grams of fibrinogen concentrate over 5 min by iv push	
	☐ **Calcium:** 1g Calcium Chloride or 3g Calcium Gluconate iv push after pack 1	
	Anticoagulant reversal: ☐ If Warfarin: PCC 2000 IU iv over 10 minutes AND ☐ Vitamin K 10 mg iv ☐ If Xa inhibitors (e.g., apixaban, rivaroxaban): PCC 2000 IU iv over 10 minutes ☐ If Dabigatran: Idarucizumab 5 grams iv over 10 minutes ☐ If Heparins: consult Pharmacy for protamine dosing	
PACK 2 (time _ _/ _ _)		
	☐ Obtain hour one blood work	
	☐ Review last set of blood work to ensure at target: Hemoglobin greater than 80 g/L, INR less than 1.8, fibrinogen greater than 1.5 g/L, platelets greater than 50x10^9/L	
	☐ Measure and document patient temperature ☐ If patient temperature less than 36°C start active warming	
	Obtain 2nd MHP pack (if needed): Transfusions based on laboratory measures where feasible	

Use signs to identify roles

Team Communication

- How? Established, reliable and mobile means to communicate
- Who? MHP clinical team, laboratories, porter, other services
- When? Trigger/terminate, location change, clinical status change, goals of care change, transfer of care



Tranexamic Acid

- Find out if TXA was already given and how much
  - If none given
    - Intentional? (ex. Contra-indication)
    - Unintentional? If within 3 hours of bleeding start, administer 2g IV bolus
  - If only 1g given
    - If within 3 hours of bleeding start and no contra-indication, administer 1g IV bolus

https://www.theglobeandmail.com/life/health-and-fitness/hospitals-shun-cheap-drug-used-to-stop-bleeding/article4178385/

Should TXA be given?

- 68 year old male with known liver cirrhosis is seen in ED. He complains of vomiting blood, “about a cup or two”, about 30 minutes ago. He feels nauseated. Vitals: 157/95, HR 100, oxygen saturation 96% RA, afebrile.

- A. Yes
- B. No

Haemorrhage alleviation with tranexamic acid - Intestinal system

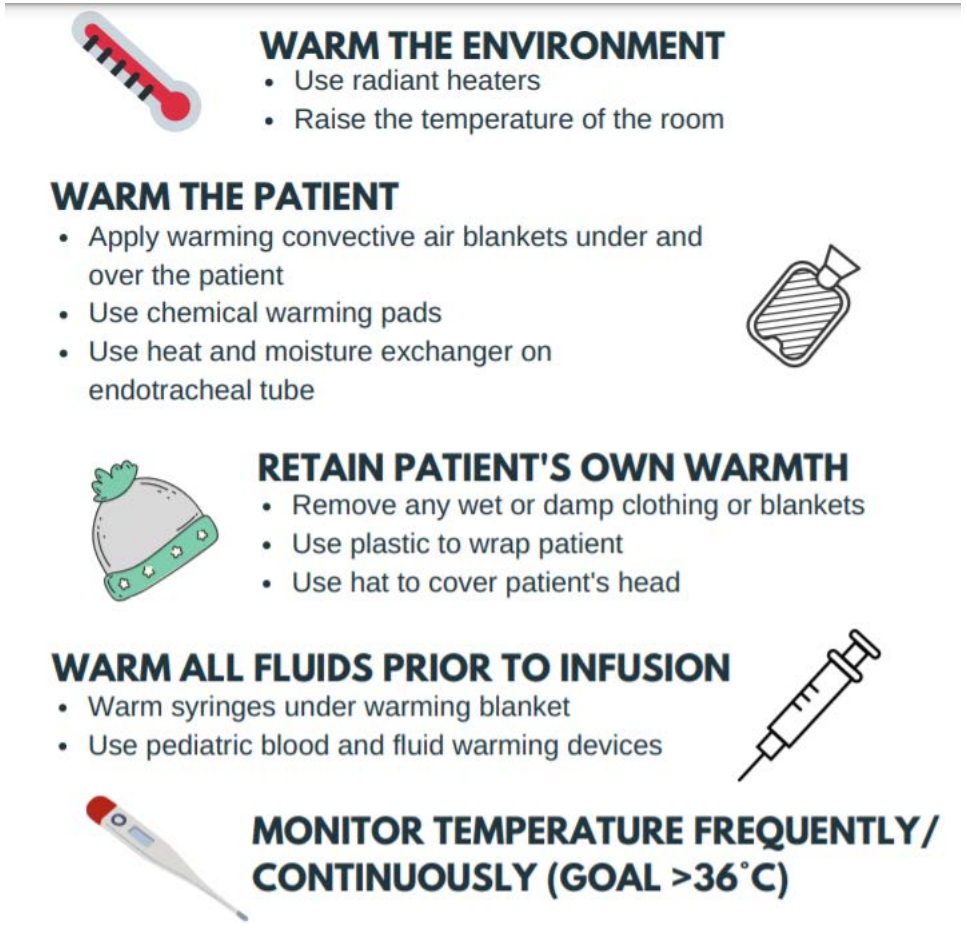
Should 2nd dose of TXA be given?

- 20 year old female was riding a bicycle and was hit by a car head-on about 5 hours ago. She was taken to the nearest hospital where she was found to have multiple orthopedic injuries and imaging concerning for intra-abdominal bleeding. She was given 1g TXA and 2 units of uncrossmatched Group O Rh negative RBC. She was suspected to have head injury and was then transferred to a trauma centre. On arrival in Trauma Bay, she has decreased LOC, BP 90/40, HR 120.

- A. Yes
- B. No

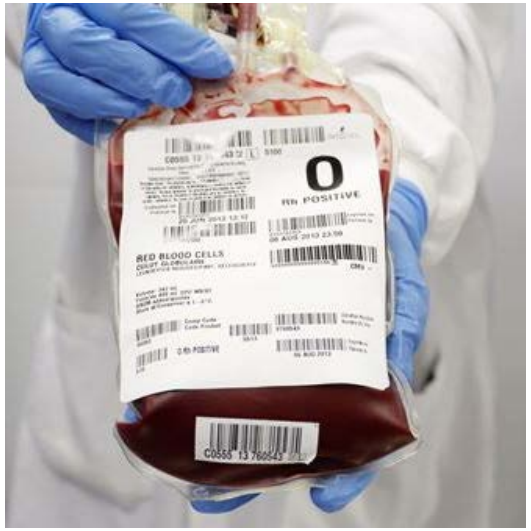
Temperature

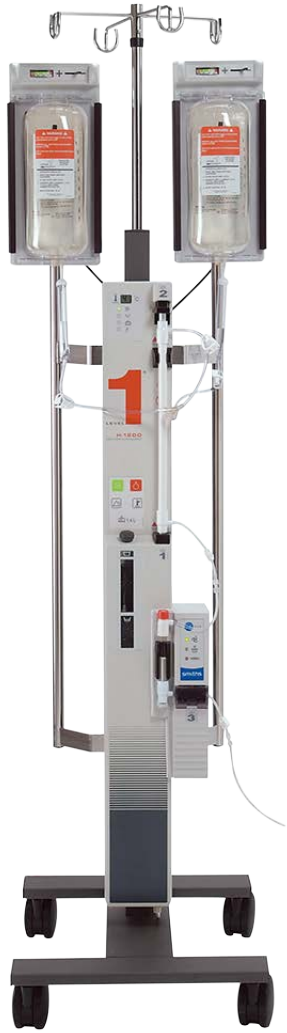
- Check temperature within 15 min of MHP activation and then every 30 min or continuously
- Promote normothermia (aim for temperature 36C) by passive and/or active warming



Temperature

- Use warmer to administer
  - IV crystalloid
  - RBC and Plasma





Testing

- **Tests to assess organ damage and/or adequacy of resuscitation**
  - Blood gases, lactate, troponin, creatinine
- **Tests to assess Hgb and hemostatic function**
  - CBC
  - Standard: INR, aPTT, fibrinogen
  - Specialized: ROTEM/TEG (thromboelastometry)
  - Consider that abnormal test results might be from anticoagulants in older patients
    - aPTT up = dabigatran
    - INR up = warfarin, apixaban, rivaroxaban, edoxaban

Testing

- Perform at activation/termination and at pre-defined intervals (at least hourly during MHP, prior to each pack, etc.)
- Lab calls (and clinical team should be ready to receive!) critical results

Big Hospital	Small Hospital
CBC (Hgb, PLT)	CBC (Hgb, PLT)
INR, fibrinogen ROTEM	INR, fibrinogen if available
Lactate or ABG/VBG	Lactate or ABG/VBG
Ionized calcium	Calcium
Lytes, Creatinine, Trp	Lytes, Creatinine, Trp

Testing

Having order sets/bundles, prepared packs with tubes and requisitions, and regular time-outs/reminders ensure labs are not forgotten

BLOOD DRAW TOOL

MHP Blood Draw and Testing Protocol

Lab tests[1]		Adult	Pediatric	Baseline	#1	#2	#3	#4	#5
INR, aPTT (baseline only), Fibrinogen	Sodium Citrate (Blue)	2.7mL	1.8 mL	x	x	x	x	x	x
ROTEM/TEG	Sodium Citrate (Blue)	2.7 mL	1.8 mL	x	x	x	x	x	x
Na, K, Cl, Mg, Urea	Serum (Red/Gold)	4.5 mL	2.0 mL	x	x	x	x	x	x
Glucose (baseline only)	Serum (Red/Gold)	NA		x	NA	NA	NA	NA	NA
Ionized Calcium[2]	Serum (Gold)	4.5 mL	2.0 mL	x	x	x	x	x	x
Venous Lactate[2]	Lithium Heparin (Green)	4.5 mL	2.0 mL	x	x	x	x	x	x
G&S (baseline only)[3]	EDTA (Pink)	6.0 mL	1.0 mL[4]	x	NA	NA	NA	NA	NA
CBC	EDTA (Lavender)	4.0 mL	1.0 mL	x	x	x	x	x	x
Venous Lactate	Lithium Heparin (Syringe)	-	-	x	x	x	x	x	x
Arterial Lactate	Lithium Heparin (Syringe)	-	-	x	x	x	x	x	x
Blood gas (pH and base excess)	Lithium Heparin (Syringe)	-	-	x	x	x	x	x	x
Ionized Calcium	Lithium Heparin (Syringe)	-	-	x	x	x	x	x	x
Na, K, Cl	Lithium Heparin (Syringe)	-	-	x	x	x	x	x	x

[1]Lab draws appear in appropriate draw order - Sodium Citrate should always be draw n first.

[2]Can be bundled up (i.e., done together with a blood gas sample, if device/analyzer is available).

[3]Follow facility specific policies regarding ABO confirmation and requirement for second specimen.

[4]500uL for neonates

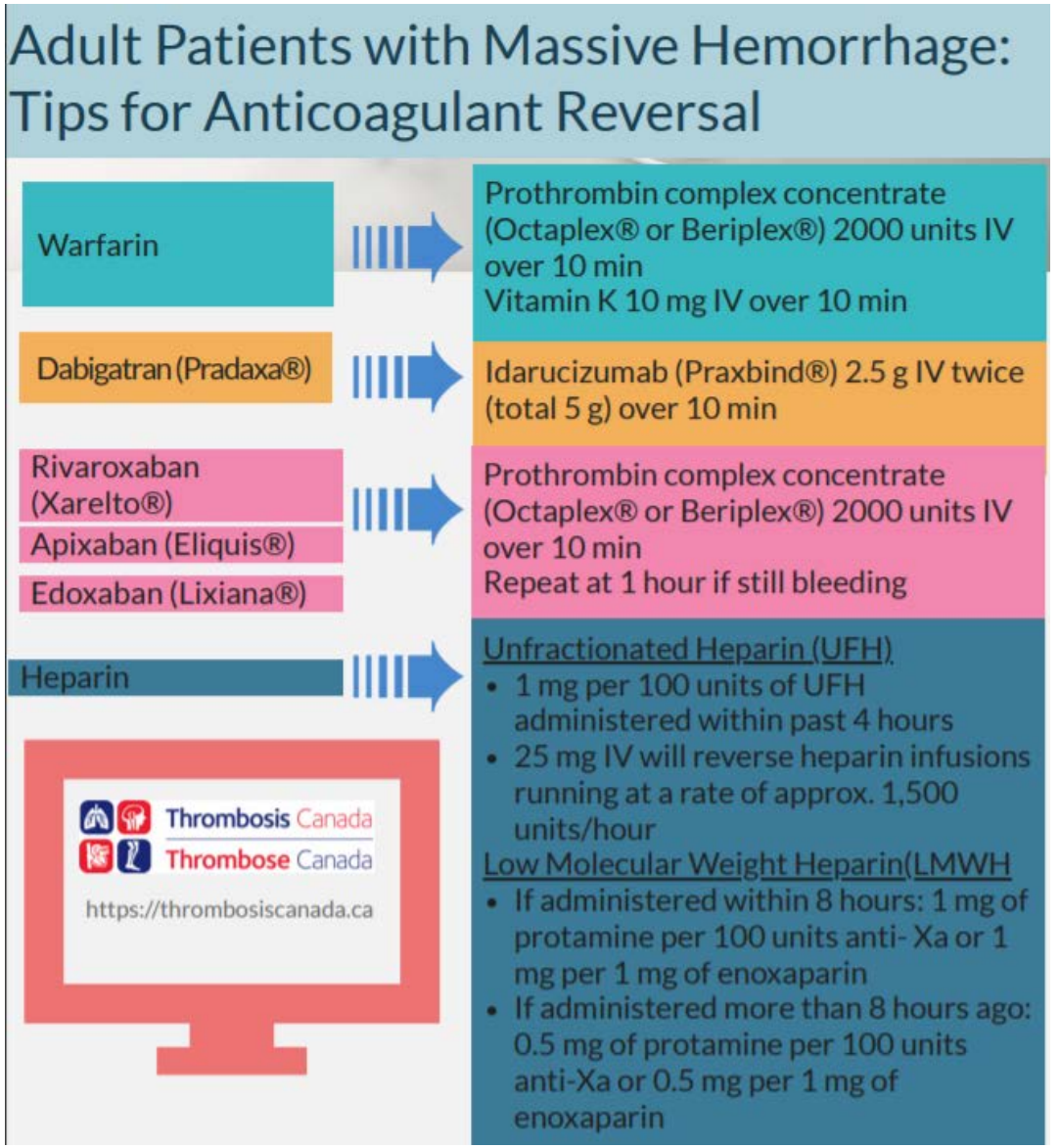
Prioritize samples as per MHP lead and as available at your facility - vacutainer/microtainers may differ depending on facility and patient population.

Pick the best answer

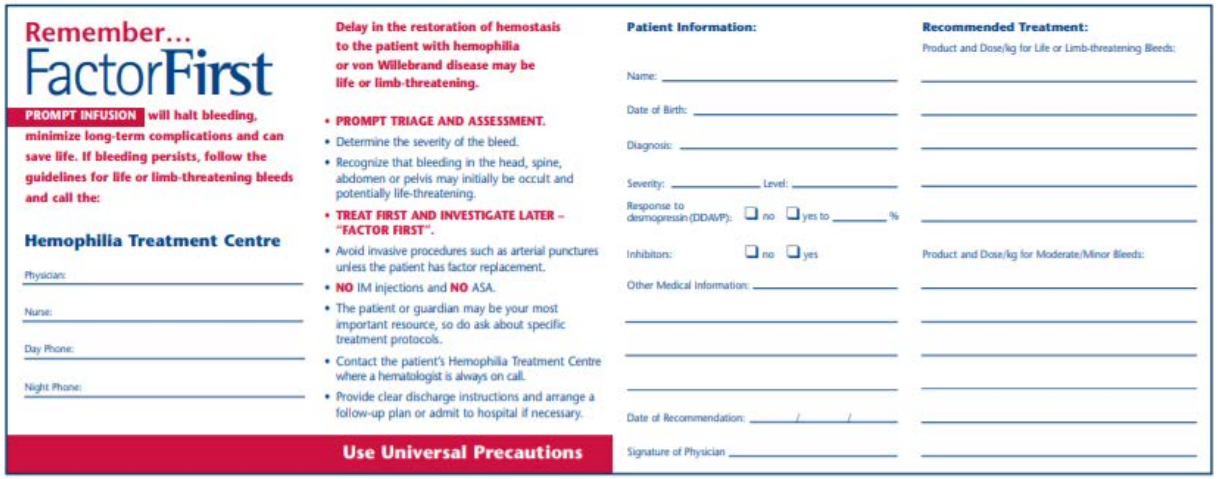
- 78 year old female is brought to ER by ambulance. She was crossing the street and was hit by a sedan turning left at approximately 60km/hr. She is obtunded, has multiple orthopedic injuries and her FAST is positive. “Atrial fibrillation, warfarin” is engraved on medic alert bracelet. Vitals: 120/55, HR 100, oxygen saturation 97% RA.

- A. She needs STAT imaging – send her to CT scan
- B. Activate MHP
- C. Order 2 units of uncrossmatched RBC and 2000U PCC STAT
- D. Order 2000U PCC STAT

Urgent Reversal of Anticoagulants



Patients with Bleeding Disorders



Remember...
FactorFirst

PROMPT INFUSION will halt bleeding, minimize long-term complications and can save life. If bleeding persists, follow the guidelines for life or limb-threatening bleeds and call the:

Hemophilia Treatment Centre

Physician:
Nurse:
Day Phone:
Night Phone:

Delay in the restoration of hemostasis to the patient with hemophilia or von Willebrand disease may be life or limb-threatening.

- **PROMPT TRIAGE AND ASSESSMENT.**
- Determine the severity of the bleed.
- Recognize that bleeding in the head, spine, abdomen or pelvis may initially be occult and potentially life-threatening.
- **TREAT FIRST AND INVESTIGATE LATER – "FACTOR FIRST".**
- Avoid invasive procedures such as arterial punctures unless the patient has factor replacement.
- **NO** IM injections and **NO** ASA.
- The patient or guardian may be your most important resource, so do ask about specific treatment protocols.
- Contact the patient's Hemophilia Treatment Centre where a hematologist is always on call.
- Provide clear discharge instructions and arrange a follow-up plan or admit to hospital if necessary.

Use Universal Precautions

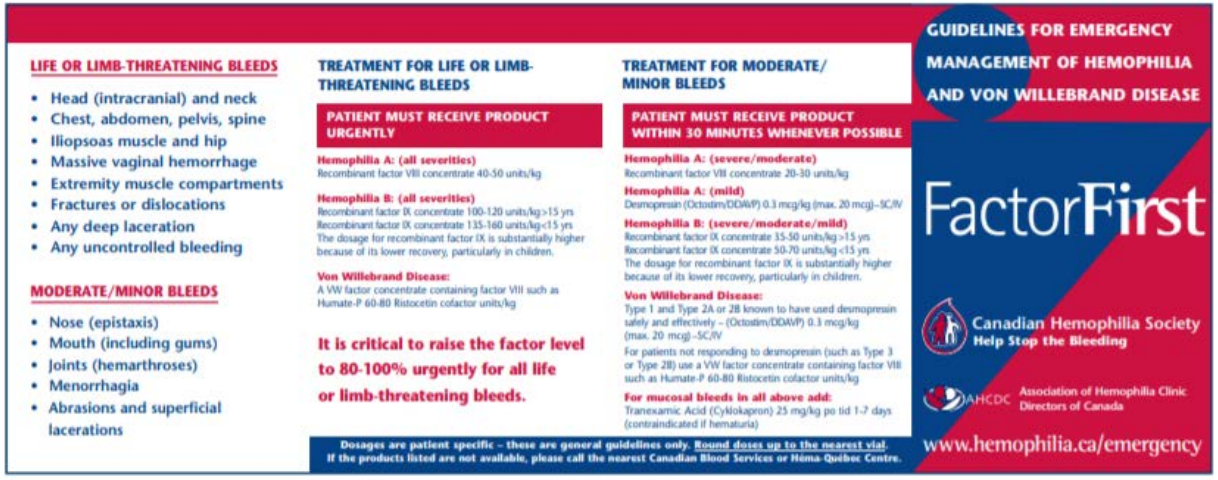
Patient Information:

Name:
Date of Birth:
Diagnosis:
Severity: Level:
Response to desmopressin (DDAVP): ❑ no ❑ yes to ____ %
Inhibitors: ❑ no ❑ yes
Other Medical Information:
Date of Recommendation: / /
Signature of Physician

Recommended Treatment:

Product and Dose/kg for Life or Limb-threatening Bleeds:

Product and Dose/kg for Moderate/Minor Bleeds:



LIFE OR LIMB-THREATENING BLEEDS

- Head (intracranial) and neck
- Chest, abdomen, pelvis, spine
- Iliopsoas muscle and hip
- Massive vaginal hemorrhage
- Extremity muscle compartments
- Fractures or dislocations
- Any deep laceration
- Any uncontrolled bleeding

MODERATE/MINOR BLEEDS

- Nose (epistaxis)
- Mouth (including gums)
- Joints (hemarthroses)
- Menorrhagia
- Abrasions and superficial lacerations

TREATMENT FOR LIFE OR LIMB-THREATENING BLEEDS

PATIENT MUST RECEIVE PRODUCT URGENTLY

Hemophilia A: (all severities)
Recombinant factor VIII concentrate 40-50 units/kg

Hemophilia B: (all severities)
Recombinant factor IX concentrate 100-120 units/kg>15 yrs
Recombinant factor IX concentrate 135-160 units/kg<15 yrs
The dosage for recombinant factor IX is substantially higher because of its lower recovery, particularly in children.

Von Willebrand Disease:
A VW factor concentrate containing factor VIII such as Humate-P 60-80 Ristocetin cofactor units/kg

It is critical to raise the factor level to 80-100% urgently for all life or limb-threatening bleeds.

TREATMENT FOR MODERATE/ MINOR BLEEDS

PATIENT MUST RECEIVE PRODUCT WITHIN 30 MINUTES WHENEVER POSSIBLE

Hemophilia A: (severe/moderate)
Recombinant factor VIII concentrate 20-30 units/kg

Hemophilia A: (mild)
Desmopressin (Octostim/DDAVP) 0.3 mcg/kg (max. 20 mcg)–SC/IV

Hemophilia B: (severe/moderate/mild)
Recombinant factor IX concentrate 35-50 units/kg >15 yrs
Recombinant factor IX concentrate 50-70 units/kg <15 yrs
The dosage for recombinant factor IX is substantially higher because of its lower recovery, particularly in children.

Von Willebrand Disease:
Type 1 and Type 2A or 2B known to have used desmopressin safely and effectively – (Octostim/DDAVP) 0.3 mcg/kg (max. 20 mcg)–SC/IV
For patients not responding to desmopressin (such as Type 3 or Type 2B) use a VW factor concentrate containing factor VIII such as Humate-P 60-80 Ristocetin cofactor units/kg

For mucosal bleeds in all above add:
Tranexamic Acid (Cyklokapron) 25 mg/kg po tid 1-7 days (contraindicated if hematuria)

Dosages are patient specific – these are general guidelines only. Round doses up to the nearest vial.
If the products listed are not available, please call the nearest Canadian Blood Services or Héma-Québec Centre.

GUIDELINES FOR EMERGENCY MANAGEMENT OF HEMOPHILIA AND VON WILLEBRAND DISEASE

FactorFirst

Canadian Hemophilia Society
Help Stop the Bleeding

AHCDC Association of Hemophilia Clinic Directors of Canada

www.hemophilia.ca/emergency

Transfusion: Large Hospital

TM Shipments (q30min):

- Box 1 : 4 RBC
- Box 2: 4 RBC , 4 plasma
- Box 3: 4 RBC, 2 plasma, 4g FC
- Box 4+: 4 RBC, 2 plasma

- Transfuse platelets based on platelet count
- Give more FC as per fibrinogen level
- Switch to lab-based transfusion as soon as practically possible

For OB hemorrhage, issue 4g FC with Box 1

RBC

- O Rh negative RBC to females <45 years old and O Rh positive RBC to all others
- Switch to group specific RBC when group determined
- Switch to crossmatched RBC when compatibility testing completed

Plasma

- AB plasma
- Switch to group specific or compatible plasma when group is known/plasma thawed

Platelets

- Any group

Fibrinogen Concentrate

Transfusion: Small Hospital

TM Shipments

- **Box 1: 4** RBC
- **Box 2: 4 RBC and where plasma not stocked** 2,000IU PCC, 4g FC
- **Box 3 and subsequent**: transport out

- Transfuse platelets based on platelet count

RBC

- O Rh negative RBC to females <45 years old and O Rh positive RBC to all others
- Number of units may vary

Platelets

- If not stocked, order
- If patient is transferred out before platelets are transfused, communicate this to receiving hospital

Transfusion

If returning to TM, please ensure to return in the same transport container as received!

Component	Transport	Storage at bedside	Blood warmer?
RBC	Cooler (temp controlled)	Cooler	Yes
Plasma If warm/just thawed	Cooler (temp controlled) Plastic bag	Cooler Bedside, ambient temp	Yes Yes
Platelets	Plastic bag	Bedside, ambient temp	No
Cryoprecipitate	Plastic bag	Bedside, ambient temp	No

Fibrinogen Concentrate (FC)	4 g over 10 minutes
Prothrombin Complex Concentrate (PCC)	2000 IU over 10 minutes

Transfusion

- Switch from 2:1 ratio RBC to FP to lab-guided transfusion as soon as practically possible to avoid over-transfusion
- **Ontario Provincial MHP Targets**

Laboratory Test	Transfusion
Hemoglobin<80g/L	RBC
INR>1.8	Plasma 15mL/Kg (3-4 units)
Platelets<50	1 adult dose of PLT
Fibrinogen <2.0g/L (OB hemorrhage) Fibrinogen <1.5g/L (all others)	Fibrinogen concentrate 4g

Termination

- Terminate MHP
  - Termination criteria: hemorrhage is controlled or patient succumbed
  - Termination process – call Transfusion Medicine, release porter, etc.
- Return coolers and any unused blood components to transfusion medicine ASAP
- Complete charting and hand-over care if applicable
- Debrief
  - Why?
    - Debriefing improves psychological well-being and communication after trauma resuscitation
    - Structured audiovisual interdisciplinary debriefing improves patient survival
  - Who?
    - Multi-disciplinary team
  - What?
    - What went well? What could have been done better? What processes need to be fine-tuned or changed?

Termination

- Inform patient and/or their substitute decision maker about MHP
- Be aware of risks of massive transfusion
  - Acute
    - Common: fever, rash, TACO, hyperkalemia
    - Uncommon: TRALI, anaphylaxis
  - Delayed
    - RBC alloimmunization
      - Note: individuals of child-bearing potential should undergo RBC antibody screening at 6 weeks to 6 months after transfusion

Tracking Performance

- According to studies, compliance with MHP is not optimal
  - Canadian study:
    - Bawazeer et al: 1.4-94.5% for various interventions
  - American studies
    - Cotton et al: 27% overall protocol compliance
    - Plackett et al: 27-97% for various interventions
      - Significant variability between surgeons

- **Full compliance is an independent predictor of survival**
- **We must strive to do better for our patients**

Bawazeer et al Injury 2015; Cotton et al J Trauma 2009; Plackett et al J Trauma Acute Care Surg 2017

Tracking Performance

How?

- Audits
- Mortality and morbidity rounds
- Utilization review at a multidisciplinary committee

What metrics should be tracked? (Ontario MHP)

- Proportion of patients receiving TXA within 1 hr of protocol activation
- Proportion of patients in whom RBC transfusion is initiated within 15 min of protocol activation.
- Proportion of patients transferred for definitive care with initiation of call for transfer within 60 min of protocol activation
- Proportion of patients achieving a temperature >35^{o}C at termination of the protocol
- Proportion of patients with Hgb between 60-110 g/L during protocol activation
- Proportion of patients transitioned to group specific RBCs and plasma within 90 min of arrival/onset of hemorrhage
- Proportion of patients with appropriate activation (>6 RBC in first 24 hrs or before this level in patients dying due to hemorrhage within 24 hrs)
- Proportion of patients without any blood component wastage (including plasma that is thawed and not used before expiry)

Tracking Performance - ON

- 11 ON hospitals, >1500 activations, from Jan 2019
- Overall compliance score for adult patients: 72.3%

Secondary Outcomes

Table 2.1.1. Overall performance for each quality metric monthly from January 2019 - Dec 31, 2019 for the all hospitals combined

Characteristic	Total	Overall, N = 542[1]	Jan, N = 48	Feb, N = 39	Mar, N = 35	Apr, N = 56	May, N = 39	Jun, N = 56	Jul, N = 34	Aug, N = 42	Sep, N = 50	Oct, N = 62	Nov, N = 38	Dec, N = 43
No blood/blood products wasted during this MHP activation, n (%)	542	420 (77)	32 (67)	28 (72)	28 (80)	48 (86)	29 (74)	43 (77)	25 (74)	36 (86)	37 (74)	49 (79)	31 (82)	34 (79)
Was the MHP activation appropriate for this patient, n (%)	541	287 (53)	25 (52)	28 (72)	15 (43)	35 (62)	18 (46)	27 (48)	13 (38)	19 (45)	28 (56)	31 (50)	24 (63)	24 (57)
Was the patient transitioned to group specific RBC/Plasma within 90 minutes of MHP activation (non-O patients), n (%)	244	190 (78)	20 (83)	13 (76)	9 (75)	19 (95)	9 (82)	18 (90)	15 (88)	15 (65)	16 (73)	25 (71)	11 (69)	20 (74)
Was the patient's Hb below 110 g/L at 24 hours, n (%)	449	232 (52)	25 (66)	16 (52)	19 (59)	24 (50)	18 (53)	28 (58)	13 (45)	20 (57)	17 (42)	18 (38)	15 (47)	19 (56)
Was the patient's hemoglobin maintained over 60 g/L in the first 24 hours, n (%)	459	420 (92)	36 (90)	30 (97)	30 (94)	44 (90)	33 (97)	46 (94)	27 (93)	34 (97)	34 (83)	45 (88)	30 (91)	31 (89)
Was the patient's temperature >=35 C at termination of protocol (30 minutes prior to/after termination), n (%)	465	333 (72)	25 (64)	23 (74)	22 (67)	33 (66)	28 (78)	34 (68)	22 (76)	27 (73)	30 (75)	40 (80)	26 (74)	23 (66)
Was RBC transfusion initiated within 15 minutes of protocol activation, n (%)	542	470 (87)	43 (90)	32 (82)	30 (86)	50 (89)	33 (85)	51 (91)	28 (82)	35 (83)	43 (86)	55 (89)	32 (84)	38 (88)
Did Patient receive TXA within 1 hour of MHP Activation, n (%)	542	301 (56)	25 (52)	24 (62)	23 (66)	31 (55)	26 (67)	35 (62)	20 (59)	17 (40)	27 (54)	34 (55)	17 (45)	22 (51)

[1] n (%)

Tracking Performance – site to site comparison

Table 4.2. MHP case score by hospital site

Hospital	Overall Mean (95% CI)	Pediatric Mean (95% CI)	Adult Mean (95% CI)	Senior Mean (95% CI)
A	0.8 (0.77, 0.84)	0.83 (0.47, 1.19)	0.8 (0.76, 0.84)	0.82 (0.71, 0.94)
B	0.77 (0.68, 0.87)		0.77 (0.68, 0.87)	
C	0.8 (0.78, 0.82)	0.9 (0.67, 1.12)	0.8 (0.77, 0.82)	0.8 (0.77, 0.82)
D	0.74 (0.63, 0.85)	0.74 (0.63, 0.85)		
E	0.7 (0.69, 0.72)	0.67 (0.54, 0.8)	0.71 (0.69, 0.73)	0.7 (0.66, 0.73)
F	0.78 (0.74, 0.82)	0.78 (0.74, 0.82)		
G	0.67 (0.63, 0.71)		0.68 (0.61, 0.74)	0.67 (0.62, 0.73)
H	0.75 (0.74, 0.77)	0.68 (0.6, 0.76)	0.77 (0.75, 0.79)	0.71 (0.68, 0.75)
I	0.72 (0.63, 0.8)		0.75 (0.64, 0.85)	0.62 (0.45, 0.8)
J	0.66 (0.64, 0.68)		0.68 (0.65, 0.7)	0.63 (0.6, 0.66)
K	0.74 (0.72, 0.75)	0.71 (0.57, 0.85)	0.73 (0.71, 0.75)	0.76 (0.72, 0.8)

Homework:
Review MHP Simulation in Trauma

- https://transfusionontario.org/en/simulation-mhp-1-trauma-case/

- Debriefing
  - What was done well?
  - What could be improved upon?
  - Did I learn anything new?
  - Does this video reflect my real world experience with MHP?

Questions