MAJOR HAEMORRHAGE PROTOCOL (MHP)

Authors: J Graham, Haematology Consultant and R Sivers, Transfusion Laboratory Lead on behalf of UHNM Hospital Transfusion Committee (HTC)

Contents

Glossary

ATD	Adult Therapeutic Dose (refers to platelets)
BloodTrack	Electronic Blood Tracking System (used to ensure traceability of transfused blood components)
Blood component	Packed red cells, platelets, fresh frozen plasma (FFP) and cryoprecipitate
BMS	Biomedical scientist
CareFlow	Electronic ordercom system for requesting blood tests (excludes transfusion requests, which require paper request)
Cross-match (XM)	Allocation of ABO/Rh (± other red cell antigen) compatible blood for transfusion. See electronic and serological cross-match for details
DAT	Direct agglutination test (also historically referred to as DCT – direct Combs test) identifies if red blood cells have been coated in vivo with immunoglobulin, complement, or both
Electronic cross-match (also referred to as 'electronic issue')	Computer aided selection of red cells, where patient meets specific criteria. Exclusion criteria include: 1) No historical/ confirmed blood group. 2) Positive antibody screen on current sample or historical red cell antibodies. 3) Any manual intervention of sample testing or result entry. 4) Positive DAT. 5) Patient has received a bone marrow or solid organ transplant
ED	Emergency department
FFP	Fresh frozen plasma (Plasma)
Group & Screen (G&S)	Automated analyser assessment of ABO and RhD blood group; plus red cell antibody screen. This process can also be done manually if small sample/analyser failure.
Group specific blood	The provision of red cells based on the patients ABO and RhD blood group prior to completion of a full serological cross-match / antibody screen
Historic Sample Policy (aka '2-sample rule')	In the routine setting, cross-matched components will only be issued after patient's blood group has been confirmed. This is to avoid ABO incompatible transfusion. The lab will inform you if a 2nd G&S specimen is required prior to component issue. Information also provided as a comment on iPortal under G&S result
HTC	Hospital Transfusion Committee
HTT	Hospital Transfusion Team
Issue of frozen products	Frozen products require thawing prior to use. This is routinely performed by the laboratory. FFP and cryoprecipitate will be selected using the ABO group, thawed and issued on the computer system ready for collection. This takes approximately 20 minutes. Nb. Pre-thawed plasma is available for MHP activation.
Issue of platelets	Platelets will be selected using ABO and RhD blood group adhering to any 'special requirements', then issued on the computer system ready for collection. Routinely ordered from

	NHSBT in Birmingham on request (so may take more than 2 hours to arrive - even in emergency setting, however, every effort is made to ensure platelets are available on site for MHP activation).
Issue of blood/pooled plasma products	All blood products will be selected according to type, dose required and expiry date. These will be issued on the computer system ready for collection
IU	International units or 'units'
MHP (adults/paediatrics)	Major Haemorrhage Protocol (adults/paediatrics)
MOH	Major Obstetric Haemorrhage
Neonate	<28 days of postnatal age (although serologically <4 months of age)
Patient	Adults, young people and children
Plt	Platelets
RBC	Red blood cells
RhD pos/neg	RhD positive/negative i.e. red cells express the RhD antigen, or do not express the RhD antigen. RhD status matched for red cell and platelet transfusions. RhD positive patients can safely receive either.
RSUH	Royal Stoke University hospital
Serological cross-match	Performed to match donor red cells to patient plasma using column IAT method (indirect antiglobulin test). This will be used wherever electronic cross-match is not available. E.g. patient excluded, emergency cross-match, computer failure
SOP	Standard Operating Procedure**.** Ensures uniformed delivery of specific tasks/procedures by providing structured instructions and rationale
TXA	Tranexamic acid; an anti-fibrinolytic medication, that exhibits anti-haemorrhagic activity by inhibiting the fibrinolytic properties of plasmin. Administered intravenously or orally.
Transfusion Associated Circulatory Overload (TACO)	Fluid overload (acute pulmonary oedema) caused by transfusion of a blood component
XM	Cross match – refers to serological and electronic cross-match above

MAJOR HAEMORRHAGE PROTOCOL (MHP)

ROLE OF MHP

- Ensures rapid delivery of appropriate blood components during major haemorrhage
- Improves communication between clinical area and transfusion laboratory staff
- Provides tailored products for clinical situation (see MHP adult, paediatrics, obstetrics, cardiac TEG algorithm)

ROYAL STOKE MHP ACTIVATION bleep 175 (dial 78-175- extension number)

- If active/suspected major bleeding associated with haemodynamic instability e.g. in adults a systolic BP<90mmHg +/- pulse rate >110bpm OR on-going severe bleeding e.g. ≥150mL/min
- Allocate MHP team roles (appendix A)
- MHP activation crib sheet available for communication lead (appendix B)
- For inpatients ideally check time to group-specific blood before using group O RhD negative 'flyers' (Information on timing available from transfusion laboratory staff + see section below)
- Transfusion laboratory will arrange dedicated porter (RSUH only)

COUNTY HOSPITAL

- Activate MHP on bleep 4751 from 6.30am – midnight (dial 88 – 4751 - extension no.)
- Out of hours contact RSUH on bleep 175 (dial 78 -175 - extension no.)
- Send appropriately trained staff to transfusion laboratory to collect components
- Coordinate early urgent transfer to RSUH

GENERAL PRINCIPLES

1. Stop the Bleeding

- Use physical methods to control haemorrhage wherever possible e.g. pelvic binder, tourniquet, fracture reduction, physical pressure
- Apply dressings: Gamgee® pad with pressure, topical haemostatic agents (Celox™ gauze)
- Alert and mobilise surgical, anaesthetic, gastroenterology and/or interventional radiology teams immediately as dictated by clinical situation and team leader
- Following trauma ensure intravenous tranexamic acid has been given within 3 hrs of injury (NB. no evidence of benefit in GI bleeding)

- Correct potential/established coagulopathy (see section 3 anticoagulant and antiplatelet management)
- Transfer patient to operating theatre/radiology intervention suite and undertake **'early appropriate care'** e.g. surgery, endoscopy, interventional radiology

2. Resuscitate Patient and Perform Relevant Investigations

- Administer high flow **oxygen** and secure **large IV access**
- On activation/arrival obtain blood for **urgent laboratory tests** (PT, APTT, fibrinogen (blue); cross-match (single pink bottle); FBC (purple); ± U&E, LFT, bone profile (gold)– request 'major haemorrhage protocol MHP activation' bloods on CareFlow) and **near patient testing** (arterial/venous blood gas (ABG/VBG), thromboelastography (TEG, ROTEM) where appropriate e.g. cardiac/obstetric haemorrhage)
- Ensure a pink top EDTA transfusion sample for cross-match (XM) is taken before administration of group O red cells - as latter may interfere with ABO grouping
- **Use positive patient ID at all stages** where possible; "What is your name? What is your date of birth?" cross-checked against wrist band (attached to patient). NB. check tube expiry date is valid prior to sampling
- **Label all MHP samples <u>at the bedside</u>, taking patient details from the wristband attached to the patient**.
- If patient identity unknown label sample as per ED policy :
    - Forename -site/creation month/creation year e.g.RSJuly19
    - Surname – random phonetic e.g. ZuluBravo
    - Title – unknown
    - Date of birth – approximate age to nearest 10 years e.g. 01.01.1940
    - Unique Identifier - Pre-generated emergency number
- Send a **single XM sample** (and other samples) to laboratory via a porter (alternatively use pneumatic tube system if delay in personnel)
- In adults keep systolic blood pressure (SBP) ≥90 mmHg (higher if co-existent serious brain injury suspected – see trauma section below)
- In uncontrolled bleeding consider permissive hypotension (SBP 80-90 mmHg) for 1st hour post injury unless traumatic brain injury
- **Limit crystalloid usage to 500ml** – replace blood volume using blood components
- Consider the role of vasopressors, as may contribute to acute coagulopathy
- Keep patient warm **(≥36°C)** using Bair Hugger® and by **warming all fluids** - rapid infusion of red cells/FFP causes hypothermia which impairs coagulation

- Ensure **normocalcaemic** - titrate IV calcium gluconate 10% against ionised calcium result on ABG/VBG
- Titrate resuscitation against base excess/lactate - often a better real-time marker of the situation
- **Imaging:** Immediate chest X-ray, pelvic X-ray, CT scan (or potentially FAST scan, USS or OGD) likely necessary to influence critical decision making - often appropriate to perform CT scan while patient still shocked as diagnosis of injury greatly improves ease of therapy
- If not responding after initial resuscitation, reconsider cause of shock (e.g. tamponade) or source of bleeding (e.g. retroperitoneal)
- **Repeat laboratory testing** every 30-60 minutes until haemostasis controlled and review results
- **Repeat near patient testing** every 10-15 minutes according to clinical situation and consciously review Ca^{2+} (to maintain normcalcaemia), Hb (to avoid over-transfusion), K^{+} (to treat hyperkalaemia) and lactate (to guide resuscitation)

3. Transfuse Blood Components

- Allocate **single communication lead** to liaise with transfusion laboratory during MHP activation
- Alert transfusion laboratory of MHP activation on bleep 175 (dial 78-175-extension number) (NB. use same number during MHP or at stand-down)
- Transfusion laboratory will contact Sodexo and a **dedicated MHP porter** will be allocated until stand-down received from laboratory (RSUH hospital only). At County appropriately trained staff to collect blood direct from blood bank.
- Where no satellite fridge is available, MHP packs divided and provided in validated cool box to prevent component wastage (see section 8)
- In the trauma setting at RSUH, group specific red cells will be issued on receipt of a single XM sample - absence of a confirmed ABO blood group will not delay group specific blood component issue in this particular emergency setting. For other MHP situations a confirmatory G&S may be requested by the transfusion laboratory prior to issue of ABO matched blood (see policy C03 ‘Historic transfusion policy’)
- Use plasma (FFP) from the outset in major haemorrhage (not obstetrics) ensuring a plasma to red cell (RBC) ratio (FFP:RBC) **of at least 1:2** (minimum 1 unit plasma for each 2 units of RBC)
- In exsanguinating trauma/vascular cases **use FFP:RBC ratio of 1:1**
- Administer RBC and FFP simultaneously (or alternate administration)
- Administration rate will vary according to clinical indication/bleeding severity
- Administer all units adhering to *Transfusion SOP: Administration of Blood Components*

- Use a **blood warmer** as soon as possible after MHP activation to avoid hypothermia – which exacerbates coagulopathy. NB. Blood warmers situated in ED and Theatres.
- Group O RhD negative RBC are a finite resource and their use should be minimised wherever possible (see section on *emergency 'flyers'*)
- **Switch to group specific RBC** (i.e. ABO and RhD matched) **as soon as possible** - available within 15 minutes of sample receipt in laboratory (where blood group confirmed – excluding trauma) or sooner if valid G&S available
- MHP packs aim to provide appropriate components to prevent coagulopathy developing
- Pre-thawed plasma (shelf-life 120 hours) is provided initially in unexpected major haemorrhage
- Subsequent plasma takes 20 minutes to thaw
- Platelet transfusion required after transfusion of approximately 1 circulating volume - hence routinely provided in pack 3 (after transfusing 8 units RBC and 8 units FFP)
- Order platelets earlier if platelet count $<100x10^9$/L in multiple trauma, or $<75x10^9$/L in other situations, to maintain platelet count $> 50x10^9$/L
- Order platelets earlier if patient receiving Clopidogrel or dual antiplatelet agents (after discussion with haematology - see section 3). NB Platelets may need to be ordered from NHSBT in Birmingham - blue light guaranteed delivery within 1hr 45 minutes
- Consider additional components according to clinical situation/results (see table 3: Aims of MHP resuscitation) and **inform laboratory early.** NB. Thaw time for FFP/cryoprecipitate approximately 20 mins
- Consider **blood cell salvage** early - contact on-call anaesthetist/surgeon - to minimise allogeneic (donor) transfusion. NB. 250ml equivalent to 1 unit RBC

Table 1: Standard blood components provided by laboratory following adult MHP activation

MHP	Blood components	Comments
Pack 1	4u[1,2] RBC	Group O RhD neg (female aged 50 years or younger[3]) Group O RhD pos (male and female aged 51 years and over[3]) Group specific (where blood group confirmed by second sample - excludes trauma). NB. Only send single pink XM sample[6]
	4[1]u FFP except obstetrics	Pre-thawed FFP (likely Group A) Refer to MOH – request fibrinogen concentrate ± FFP as per thromboelastography (ROTEM) results/flow chart and clinical picture
Pack 2	4u[1,2] RBC	Group specific (ABO/Rh-matched) or as above where blood group still unknown/unconfirmed[6]
	4[1]u FFP[4]	FFP – thaw time approx 20 mins
Pack 3	4u RBC	Group specific (ABO/Rh-matched) or as above where blood group still unknown/unconfirmed
	4u FFP[4]	FFP (Group specific or group A as appropriate) Actioned after MHP pack 2 issue, although potential delay approx. 20mins to enable thawing
	1 ATD Platelets[5]	Group specific (ABO/Rh-matched) or likely Group A RhD neg where blood group still unknown/unconfirmed N.B. Platelets may need to be ordered from NHSBT in Birmingham. Guaranteed blue light delivery 1hr 45min
	2 pools Cryo[4]	Thaw time 20 minutes

[1] Where MHP is activated on ward (or clinical area where satellite blood fridge unavailable), 2 units of RBC and FFP provided in validated cool box (see section 8)

[2] If cell salvage in use, clinical team may choose to request fewer RBC units (250ml salvaged blood equivalent to 1u RBC)

[3] Clinical team to advise laboratory of estimated age in unknown females

[4] Increase quantity/escalate priority where established coagulopathy present or as guided by thromboelastography

[5] Request earlier where plt count <100 x 10^9/L in multiple trauma, <75 x 10^9/L in other situations; as per thromboelastography (obstetrics/cardiothoracics); or as clinically indicated (see section 3)

[6] Confirmation of ABO blood group via a second independent sample may be required prior to release of ABO-matched blood (excludes trauma patients) – transfusion laboratory will advise

Emergency Group O RhD Negative Red Cells ('Flyers')

- Emergency 'flyers' refers to group O RhD negative blood not allocated to a patient. Emergency flyers are located in satellite blood fridges across UHNM (table 2) to ensure emergency blood is available at all times where the clinical situation does not allow for the 10 minutes required to receive MHP pack 1 with patient-allocated units
- Use of emergency 'flyers' may inadvertently delay/hinder MHP activation as an alarm activates in the lab and units must be replaced asap (only 2 members of staff on site at night)
- Where G&S sample unavailable, preferentially use group O RhD positive RBC for males and women aged 51 years and over until group specific RBC available (included in pack 1)
- For inpatients, check availability of group-specific blood with lab staff (available almost immediately if valid G&S in lab) before using the emergency 'flyers'
- **The patient's unique ID (NHS/hospital/ED number) must be entered in the fridge kiosk when removing 'flyers' to provide traceability**
- In addition, the A5 pink form included with the Group O RhD negative unit must be fully completed and sent back to the transfusion laboratory as soon as possible
- Inform the transfusion laboratory on the relevant site immediately (RSUH bleep, '78-175-EXT' or County bleep 88- 4751)) when emergency 'flyers' have been used so that these can be replaced and appropriate blood components allocated
- **For neonates**, a large volume unit is located in maternity delivery suite in a **GREEN BAG.** Use this over adult flyers as special blood requirements must be met for this age

Table 2: Location of Group O RhD negative red blood cells (emergency 'flyers')

Royal Stoke – A&E resus	2 units
Royal Stoke – Theatres 1-5	2 units
Royal Stoke – Theatre hub	2 units
Royal Stoke - Maternity delivery suite	2 units **1 neonatal unit (in green bag)**
County- Main issue fridge, Pathology department, 1st floor	6 units

*N.B Group O RhD negative red blood cells are **not** kept in the Interventional Radiology fridge, main issue fridge at Royal Stoke, County Chemotherapy unit fridge, nor County Theatre fridge.*

MHP TARGET THRESHOLDS

- Massive transfusion is **guided by clinical situation** as laboratory parameters may be unavailable and/or unrepresentative of the current clinical situation, however, regular blood tests during active transfusion are required to:
    - Avoid over-transfusion
    - Correct hypocalcaemia/hyperkalaemia
    - Guide resuscitation

- For this reason, **repeat laboratory testing** every 30-60 minutes and **near patient testing** every 10-15 minutes until haemostasis controlled and ensure results reviewed
- **Near-patient testing of coagulation** (viscoelastrometric tests) provides point of care, rapid assessment of coagulation and includes both thomboelastography (TEG®) and thromboelastometry (ROTEM®). Both have been recommended for use in cardiac surgery
- ROTEM® (situated in delivery suite, theatre 1 anaesthetic room) should be routinely used to guide targeted component use if major bleeding in Obstetrics
- TEG® (situated in hub theatres outside perfusion team room) should be routinely used to guide targeted component use if major bleeding in cardiac surgery
- Near-patient testing of coagulation is not routinely used at UHNM outside of these clinical situations (as there is currently insufficient evidence to support routine use)
- Once haemostasis secured uphold **restrictive transfusion thresholds** Cochrane review 2016 and replenish iron stores

Table 3: Aims of MHP resuscitation

	Target	**Comments**
Hb	70-90g/L (once haemostasis secured)	80-100g/L where known cardiovascular disease/frail elderly
Plts	>50x10^9/L in major bleeding >100x10^9/L in multiple trauma	Order platelets once <75x10^9/L (<100x10^9/L in major trauma) or where clopidogrel/dual antiplatelet use (see section 3)
PT/APTT	Ratio <1.5	Order additional 4 units of FFP where clotting deranged at MHP onset (on laboratory testing)
Fibrinogen	>1.5g/L (>2.0g/L Obstetrics)	Use cryo when hypofibrinogenaemia unresponsive to FFP (fibrinogen

		concentrate used in obstetrics according to ROTEM flowchart)
Ionised Ca^{2+}	>1.1mmol/L	Use 10% calcium gluconate
Lactate	<2mmol/L	
pH	>7.35	
Normothermic	≥36°C	Use blood warmer for all fluids Use Bair Hugger® asap

MHP STAND-DOWN

- Fit patient's vital signs will normalise with small fluid increments whilst they are still vastly hypovolaemic and hypoperfused
- Once resuscitation complete (or situation becomes futile) contact transfusion laboratory on bleep 175 to **'stand-down MHP'** (dial 78-175-extension no) to ensure blood components are not wasted and other lab activities can resume
- Cancel unnecessary requests in progress
- Return surplus blood components to issue fridge via porter and **ensure traceability completed;** both in medical records and by end-fating units on BloodTrack
- Once haemostasis secured:
    - uphold restrictive transfusion thresholds
    - ensure appropriate VTE prophylaxis
    - replenish iron stores

CONTACT DETAILS

- UHNM transfusion laboratory can be contacted on the numbers below (see table 4)
- Clinical haematologist available 24/7 (details are available on intranet under rota watch)
    - In hours (Monday to Friday 9-5) telephone 71597 or bleep 15458
    - Out of hours contact on mobile via switchboard
- Hospital transfusion team (transfusion practitioners) telephone 71534 (in hours)

Table 4: Contact details for UNHM transfusion laboratories

Location	9am – 5pm	Out of hours
RSUH MHP	Bleep 175 *Dial '78-175-extension no'*	
RSUH - non MHP	74946	Bleep 390
County MHP	Bleep 4751 from 6.30am – midnight *Dial '88 – 4751 - extension no'* Otherwise as per RSUH	
County Hospital - non MHP	4758	Bleep 4751 (<6.30am / > Midnight)

SPECIFIC SITUATIONS

1. TRAUMA

- In uncontrolled bleeding consider permissive hypotension (SBP 80-90 mmHg) for 1st hour post injury unless traumatic brain injury
- Where co-existent serious brain injury suspected and aged 50-69 years aim SBP ≥100mmHg (or >110mmHg if serious brain injury suspected and adolescent/>70 years)
- When > 1 hour post injury aim for BP >120mmHg as part of Novel Hybrid Resuscitation
- In unknown patients, allocate unique patient ID, generate ID documentation/stickers and **attach patient wristband asap**
- Confirm patient ID wherever possible through positive patient ID
- Where transfusion administered in transit, register patient with EMRTS unique identifiers
- Any unused components transferred with the patient should go straight to the transfusion laboratory via MHP dedicated porter - ensure transport box remains **unopened** so cold chain can be confirmed
- If units are required immediately a clinical decision may be made to use blood components that have arrived with the patient
- Where transfusion has occurred prior to UHNM admission, further administration of blood components must take into account the units already transfused re FFP:RBC ratios
- Prime rapid infusers with saline
- Ensure tranexamic acid (1g bolus over 10 mins) has been given within 3 hrs of injury. Following this infuse tranexamic acid 1g in 50mL 0.9% sodium chloride IV via syringe driver

over 8 hours, or until haemorrhage controlled. Note this is 'off label' use of tranexamic acid as per NICE guidance[NICE 2016]. Use with caution in renal impairment according to SPC.

- Only use group O RhD negative **'flyers'** where unable to wait 5-10 mins for pack 1 arrival
- Ensure XM sample taken before transfusion of group O RBC - may interfere with grouping
- Request XM on blood samples only (not following intraosseous access)
- Enter patient unique ID into blood kiosk to release 'flyers' – to ensure traceability
- **Send single XM sample <u>asap</u>** to enable group specific red cells to be issued (use POD or porter to transport to lab post MHP pack 1 delivery)
- Group specific blood available <15 mins of sample receipt- **Switch to group specific RBC as soon as available**
- 4 units pre-thawed FFP allocated to patient on MHP activation
- Porter will report to trauma team lead on arrival to ED with blood components. Advise if/which units to remain with patient (if imminent transfusion planned) or Porter to scan into kiosk
- **Ensure maintain 1:1 ratio FFP:RBC if trauma 'code red' – as evidence suggests this may reduce death from exsanguination but no impact on overall survival**
- In 'unknown patients', once the patient name/details established, send urgent repeat G&S sample although keep original unknown patient ID until patient stabilised ≥24 hours
- Use MHP prescription and checklist to improve practice and safety (where available)

See UHNM Adult Major Haemorrhage Flowchart - including Trauma (p20)

2. OBSTETRICS

- Refer to full ASQUAM PPH guidelines (2020) including ROTEM protocol/algorithm
- Major post-partum haemorrhage (PPH) is defined as blood loss >1000ml
- Activate MOH where measured blood loss (MBL) ≥1000ml associated with on-going bleeding OR clinical shock
- Trigger 'MOH alert' where MBL 1000ml with no active bleeding – to flag arrival of urgent samples and enable lab staff to prepare for MOH activation where necessary
- Alert full MDT including consultant obstetrician and consultant anaesthetist to attend if MBL ≥1000ml associated with on-going bleeding OR clinical shock
- Alert full MDT (midwife in charge plus first-line obstetric and anaesthetic staff) where minor PPH (blood loss 500–1000 ml) without clinical shock
- Tranexamic acid, administered as soon as possible after bleeding onset, reduces death due to bleeding in women with post-partum haemorrhage with no adverse effects
- Low fibrinogen levels are associated with an increased risk of progression to severe PPH and should be maintained >2.0g/L

- Early plasma usage, extrapolated from massive haemorrhage in trauma, may inadvertently lead to haemodilution of clotting factors (FFP fibrinogen concentration approx. 2.4g/L vs physiological fibrinogen concentration of 6-8g/L at term)
- Once haemostasis secured
    - Uphold restrictive transfusion thresholds
    - Ensure appropriate VTE prophylaxis
    - Replenish iron stores
- Healthcare professionals using ROTEM® should have appropriate training and experience with this device

See UHNM ASQUAM guidelines 'Postpartum Haemorrhage (PPH)' - 2020

3. ANTICOAGULANTS & ANTI PLATELET AGENTS

- Patients receiving anticoagulant and/or anti-platelet medication should have the following treatment in addition to routine MHP activation/treatment/transfusion
- **Warfarin** (or alternative vitamin K antagonist) administer vitamin K (phytomenadione) 5mg IV and 25 units/kg Prothrombin Complex Concentrate (PCC) as Octaplex® up to max 3000 units before INR result available (post INR sampling) – PCC available directly from transfusion laboratory (flowchart/administration information hyperlinked on policy C03) or at County hospital 00:00-06:30 kept in emergency drugs cupboard)
- Where metallic prosthetic heart valves in situ, fully discuss (where possible) the risks/benefits of anticoagulation reversal and document, however, do not delay anticoagulation reversal in life-threatening bleeding. Discuss future management with cardiothoracics.
- **Dabigatran** administer Idarucizumab (Praxbind®). Kept in emergency department, resus, Royal Stoke.
- Patients on **apixaban/rivaroxaban** with life-threatening GI bleeding - consider andexanet alfa (Ondexxya®). Andexanet alfa kept in transfusion laboratory. Refer to medical guidelines for specific access policy. Requires discussion with gastroenterology/upper GI surgeon.
- Patients on **apixaban**/r**ivaroxaban/edoxaban** - administer tranexamic acid 1g IV over 10 minutes and PCC (Octaplex® 50 units/kg – max dose 3000 units) – PCC available directly from transfusion laboratory
- Ensure anticoagulant medication stopped
- **Aspirin** (single agent) – no specific/additional action required
- **Clopidogrel** (single agent or dual with aspirin) – consider 2 ATD platelets – discuss with on-call clinical haematologist

See UHNM medical guidelines 'Management of bleeding in patients receiving direct oral anticoagulants (DOAC)'

4. CARDIAC SURGERY

- Cardiac surgery is associated with a high chance of blood component transfusion
- Viscoelastometric point-of-care testing is recommended to help detect, manage and monitor haemostasis during and after cardiac surgery (NICE 2014)
- TEG® should be used to guide blood product transfusion in the presence of significant bleeding. Do not act on TEG® results in the absence of bleeding
- Healthcare professionals using TEG® during cardiac surgery should have appropriate training and experience with this device

5. ACUTE GI HAEMORRHAGE

- Randomised controlled trial data does not show tranexamic acid improves survival, reduces re-bleeding rates or reduces transfusion in adult patients with 'significant' GI bleeding – no evidence to support routine use(HALT-IT trial, Lancet 2020)
- Early use of platelets/increased use of plasma may be indicated in CLD patients with pre-existing abnormal results/established coagulopathy - **inform transfusion laboratory early -** request additional 4u FFP +/- cryo as per laboratory parameters and ensure vitamin K replete
- Restrictive target threshold of Hb 70-90 g/L is indicated once haemodynamically stable, especially in chronic liver disease (CLD) patients with Child-Pugh A and B Villanueva
- Be cautious not to over transfuse, especially in lower GI bleeds - unless haemodynamically unstable, reassess Hb after every unit transfused
- Ensure iron stores are replenished in addition to any red cell transfusion

See UHNM medical guidelines 'Upper gastrointestinal haemorrhage'

6. PAEDIATRICS

- Paediatric MHP is a rare event at UHNM as paediatric trauma is preferentially transferred to Birmingham
- Provide (estimated) weight at time of MHP activation
- Keep SBP ≥70 mmHg + [2 × age] without exceeding adult values

- Appropriate component volumes according to weight will be provided by the laboratory and special blood requirements adhered to wherever possible/relevant
- In trauma administer tranexamic acid 15mg/kg (max 1g) bolus over 10 minutes (within 3 hours of injury) followed by 2mg/kg/hr (max 125mg/h) by IV infusion for 8 hours using syringe driver, or until haemorrhage is controlled
- Use pre-thawed FFP in emergency bleeding
- **Clinically assess after every 10ml/kg aliquot (max. 250ml) of RBC/FFP**
- Use adult MHP where body weight >50 kg
- Maintain ionised calcium >1.1mmol/L using 0.3ml/kg 10% calcium gluconate IV over 10 minutes
- Consider tranexamic acid outside of trauma setting (dosage as above)
- **Inform the transfusion laboratory in advance** where high risk of neonatal haemorrhage
- Emergency neonatal compatible unit available in maternity fridge (in green bag) – to access unit enter maternal surname and time of birth

See UHNM Paediatric Major Haemorrhage Flowchart

7. PATIENTS WITH ANTIBODIES

- MHP activation may be required in patients with known or unknown red cell antibodies
- Emergency 'flyers' may be inappropriate in some situations e.g. where anti-c ('anti little c') known/suspected (as predisposes to delayed haemolytic transfusion reaction)
- **No patient should die (or have life-saving surgery delayed) due to 'lack' of blood**
- Discuss complex cases urgently with transfusion laboratory and clinical haematologist
- **Where antibody is unknown/unspecified** and immediate transfusion is necessary, group specific blood (ABO, RhD-matched) should be transfused as clinically indicated and the patient monitored closely for signs/symptoms of haemolysis (BP, PR, RR, O_2 and urine monitoring for haemoglobinuria) until investigations completed and more specific blood is available. In addition consider extended Rh-matched, K-matched where time allows
- Additional urgent samples may be required
- Samples may have to be sent to the reference laboratory in Birmingham for cross-matching and 'most suitable units' sent from there – this can significantly delay availability
- **Where antibody is known and antigen negative blood is unavailable**, discuss use of IV Methylprednisolone and IV immunoglobulin with on-call clinical haematologist
- Fully compatible cross-matched blood may be unavailable or cause significant delays

- The transfusion laboratory will advise on the availability of suitable blood and the time scales involved. Please ensure that you communicate clearly the urgency of the request so that they can provide the most appropriate units in a timely manner.
- If you do not fully 'understand' what the laboratory is explaining, bleep clinical haematology. The most perfect blood is useless if the patient is dead

8. WARD MHP ACTIVATION & COOL BOXES

- Where MHP activation occurs in a clinical area with no local satellite blood fridge (e.g. ward 230, renal) or when a satellite fridge is out of service, then blood components will be provided in cool boxes to minimise blood component wastage.
- The following amendments are made:
    - Each MHP pack will be split in two
    - 2 units of red cell and 2 FFP will be packaged into a validated cool box and sent directly to the clinical area.
    - **DO NOT OPEN the box unless transfusing!!**
    - Form BTF095 (appendix D) will accompany the units in the plastic wallet (on the top of the cool box).
    - On arrival, remove form BTF095 (appendix D) from the plastic wallet and complete the receiving clinical area section. Ensure this form is retained with the units in the event they need to be returned to the laboratory.
    - Transfusion must be completed within 4 hours of opening the cool box (up to a maximum of 6 hours after packing, where box remains closed for the first 2 hours)
    - Please return unwanted/unused units to the laboratory immediately
    - **If the patient is moving to an area with a satellite fridge,** DO NOT attempt to put these units in the fridge, notify the laboratory and return the units and cool box. The laboratory will issue further units direct to the satellite fridge as required.
    - If the units are transfused, end fate in the usual manner on BloodTrack Enquiry and tick the relevant box on the BTF095 form
    - Please ensure the cool box and completed BTF095 are returned to the laboratory asap.

MHP FLOW CHARTS

- The MHP has been condensed into 1 page flowcharts to facilitate clinical implementation
- Use flowcharts in conjunction with the full MHP
- Relevant flowcharts should be printed, laminated and kept on the resuscitation trolley
- Electronic version located on **intranet** – A-Z > clinicians > clinical guidance > blood and blood products > Major haemorrhage protocol (MHP)

UHNM Adult Major Haemorrhage Flowchart - including Trauma (not Obstetrics)

UHNM Paediatric Major Haemorrhage Flowchart – including Trauma

ASQUAM Guideline for Postpartum Haemorrhage – ROTEM protocol

REFERENCES

Beverley J. Hunt,Shubha Allard,David Keeling,Derek Norfolk,Simon J. Stanworth,Kate Pendry,on behalf of the British Committee for Standards in Haematology. A practical guideline for the haematological management of major haemorrhage. *Brit Soc Haem* 2015;170(6):788-803.

Carson JL, Stanworth SJ, Roubinian N, Fergusson DA, Triulzi D, Doree C, Hebert PC. Transfusion thresholds and other strategies for guiding allogeneic red blood cell transfusion. *Cochrane Database of Systematic Reviews* 2016, Issue 10. Art. No.: CD002042. DOI: 10.1002/14651858.CD002042.pub4.

CRASH 2 collaborators. Effects of Tranexamic acid on death, vascular occlusive a vents, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): a randomised, placebo- controlled trial. *Lancet* 2010; 376(9734): 23-32

Lise J. Estcourt,Janet Birchall,Shubha Allard,Stephen J. Bassey,Peter Hersey,Jonathan Paul Kerr,Andrew D. Mumford,Simon J. Stanworth,Hazel Tinegateon behalf the British Committee for Standards in Haematology. Guidelines for the use of platelet transfusions. *Brit Soc Haem* 2017; 176(3):365-394

NICE (2014) Detecting, managing and monitoring haemostasis: viscoelastometric point-of-care testing (ROTEM, TEG and Sonoclot systems). Diagnostics guidance [DG13]

NICE (2021) Andexanet alfa for reversing anticoagulation from apixaban or rivaroxaban Technology appraisal guidance [TA697]

NICE guideline [NG39] Major trauma: assessment and initial management. Published: 17 February 2016

Roberts I, Shakur-Still H, Afolabi A, et al. Effects of a high-dose 24-h infusion of tranexamic acid on death and thromboembolic events in patients with acute gastrointestinal bleeding (HALT-IT): an international randomised, double-blind, placebo-controlled trial *Lancet*. 2020; 395(10241):1927-1936. DOI: 10.1016/S0140-6736(20)30848-5 NCT01713101

Spahn et al. The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition *Critical Care* (2019) 23:98

Tranexamic acid summary of product characteristics (SPC). Electronic medicines compendium (EMC) available at https://www.medicines.org.uk

Villanueva et al. Transfusion Strategies for Acute Upper Gastrointestinal Bleeding. *N Engl J Med* 2013; 368:11-21 DOI: 10.1056/NEJMoa1211801

WOMAN trial collaborators. Effect of early Tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with postpartum haemorrhage (WOMAN): an international, randomised, double-blind, placebo controlled trial. *Lancet* 2017; 389 (10084); 2105-2116

Flowchart: UHNM Major Haemorrhage Protocol (MHP) – Adult including Trauma (not Obstetrics)

Significant blood loss e.g. 150mL/min OR blood loss with haemodynamic instability e.g. SBP <90 mmHg, HR>110 bpm

Location Group O RhD neg RBC 'flyers':
A&E resus
Hub theatres
Theatres 1-5
Maternity delivery suite
County main issues fridge
Time to group specific red cells: **<15min***
**Time from sample receipt - sooner if G&S available in lab*

Baseline Tests

Lab: XM (single pink); FBC; PT, APTT, Fibrinogen; U&E, LFT, Ca – Select 'MHP' on Medway
Point of care: ABG/VBG (±TEG® (blue – if Cardiac surgery)

Resuscitate

- ABC + Oxygen 15L
- Fluid warmer (saline prime)
- Use Bair-Hugger™
- Continuous cardiac monitoring
- Consider direct transfer to theatres/IR/endoscopy

Notify transfusion laboratory

RSUH bleep 78-175-ext № # (County bleep 88- 4751ext № # 06:30-Midnight)
'Activate MHP adult/MHP adult trauma'
State 'MHP adult (+/- trauma), location, full patient details, team contact numbers, request pack 1'

Transfuse

- **Allocate team roles** and inform consultant +/- anaesthetist
- **MHP Pack 1 available in 10 mins**; only use 'flyers' (group O RhD negative RBC) if transfusion required immediately (see locations in box above right). Enter patient unique ID to access units
- **Use cell salvage** if available and not contraindicated (250 mL = 1 unit red cells)
- **Administer MHP Pack 1** (Contains O neg/O pos/group specific depending on sample availability in transfusion lab and patient demographics). Alternate RBC:FFP administration if single IV access. Use blood warmer. Move to group specific/cross-matched RBC as soon as available
- **Monitor bloods** every 30-60 mins (as per baseline tests) + VBG every 10-15 mins. (±TEG® post transfusion if on-going bleeding in Cardiac surgery)

Bleeding controlled?

YES

'Stand down MHP'
- Notify transfusion laboratory
- Return unused products and document usage
- Uphold restrictive Hb thresholds +/- oral/IVFe
- DVT prophylaxis when haemostasis secured

NO

Administer MHP Pack 2 and evaluate response/monitor. Bleeding controlled?

YES

Administer MHP Pack 3 and evaluate response/monitor. Bleeding controlled?

Provide 'goal directed therapy' and evaluate response

Stop the bleeding

Therapeutic interventions (consider)
- Trauma <3 hrs - tranexamic acid 1g IV stat + 1g IV over 8 hours
- Vitamin K (phytomenadione) 10mg IV if liver disease
- 25 IU/kg PCC (≤3000u) + vit K 5mg if warfarinised
- Haemostatic agents as clinically appropriate if anticoagulated with DOAC
- Topical haemostatic agents
- Terlipressin 2mg IV + IV Abx if suspected variceal bleed
- 10ml 10% calcium gluconate if ionised Ca<1.1mmol/l

Surgical interventions
- Early appropriate care

Radiological interventions
- Embolisation

Endoscopy
- Variceal banding

Manual interventions
- Tourniquet/external pressure

MHP team roles

Team Leader: Coordinate management & transfusion

Communication Lead: Liaise with laboratory/other services

Scribe: Document management & blood product usage

Runner: Deliver samples/ collect blood products
N.B. Dedicated Sodexo porter ordered by the transfusion lab at time of activation – RSUH site only

Specific tasks: As per team leader

Pack 1	Red cells 4 units FFP 4 units
Pack 2	Red cells 4 units FFP 4 units[1]
Pack 3	Red cells 4 units FFP 4 units Platelets 1 ATD[1] Cryo 2 pools[1]

[1]Additional components may be required – See guidelines

Aims of Therapy

- Hb 70-90g/L (once haemostasis secured)
- Plts >50 x10⁹/L (>100 multiple trauma)
- PT/APTT ratio <1.5
- Fibrinogen >1.5g/L
- Ionised Ca^{2+}>1.1mmol/L
- Normokalaemic
- Normothermic ≥36°
- pH>7.35
- Lactate <2mmol/L

Flowchart: UHNM Paediatric Major Haemorrhage Protocol

Actual/suspected blood loss with haemodynamic instability OR blood loss 2-3ml/kg/hr

Baseline Tests
Lab: XM (single pink), FBC, PT, APTT, Fibrinogen, U&E
Point of care: ABG/VBG,

Resuscitate
- ABC + Oxygen 15L
- Fluid warmer (saline prime)
- Use Bair-Hugger™
- Continuous cardiac monitoring
- Consider direct transfer to theatres/IR/endoscopy

Notify transfusion laboratory
RSUH bleep 78-175-ext Nº #
'Activate Paediatric MHP' State 'Paediatric major haemorrhage, location, full patient details & weight, team contact details'

Location of Group O RhD neg RBC 'flyers':
A&E resus
Main issues fridge (pathology)
Hub theatres
Theatres 1-5
Maternity delivery suite*
County main issues fridge
Time to group specific red cells: **<15min** (Time from sample receipt - sooner if G&S available in lab)

* Neonatal unit in GREEN BAG

MHP team roles
Team Leader: Coordinate management/transfusion
Communication Lead: Liaise with laboratory /and other services
Scribe: Document management / blood product usage
Runner: Deliver samples/ collect blood products
N.B. Dedicated Sodexo porter ordered by the transfusion lab at time of activation – RSUH only
Specific tasks: As per team leader

- **Allocate team roles** and inform consultant +/- anaesthetist
- **PMH Pack 1 available in 10 mins**; only use 'flyers' (group O RhD negative RBC) if transfusion required immediately (see locations in box above right). Enter patient unique ID to access units
- **Use cell salvage** if available and not contraindicated
- **Prescribe PMH Pack 1 –** Volume/dose as per table below
- **Administer RBC/FFP** simultaneously via a Y-connector
- **Objectively evaluate after each 10ml/Kg aliquot** (max250ml) 1) Extent of bleeding 2) Response to treatment 3) Evidence of TACO
- **Monitor Bloods** every 30-60 mins (as per baseline tests) + VBG every 10-15 mins if on-going bleeding

Aims of Therapy
Hb 80-100g/L
Plts >75 x10⁹/L
PT/APTT ratio <1.5
Fibrinogen >1.5g/L
Ionised Ca^{2+}>1.1mmol/L
Give 0.3ml/Kg (<10ml) 10% calcium gluconate
Normokalaemic
Normothermic ≥36°
pH>7.35 (On ABG)
Keep SBP ≥70mmHg + [2 x age] or>80mmHg (whichever is lower)

Bleeding controlled?
YES
NO

'Stand down PMH'
- Notify transfusion laboratory
- Return unused products and document usage

YES

Administer PMH Pack 2 and evaluate response/monitor.
Give platelets through separate line (or via Y-Connector possible if component mixing occurs post filter)
Bleeding controlled?

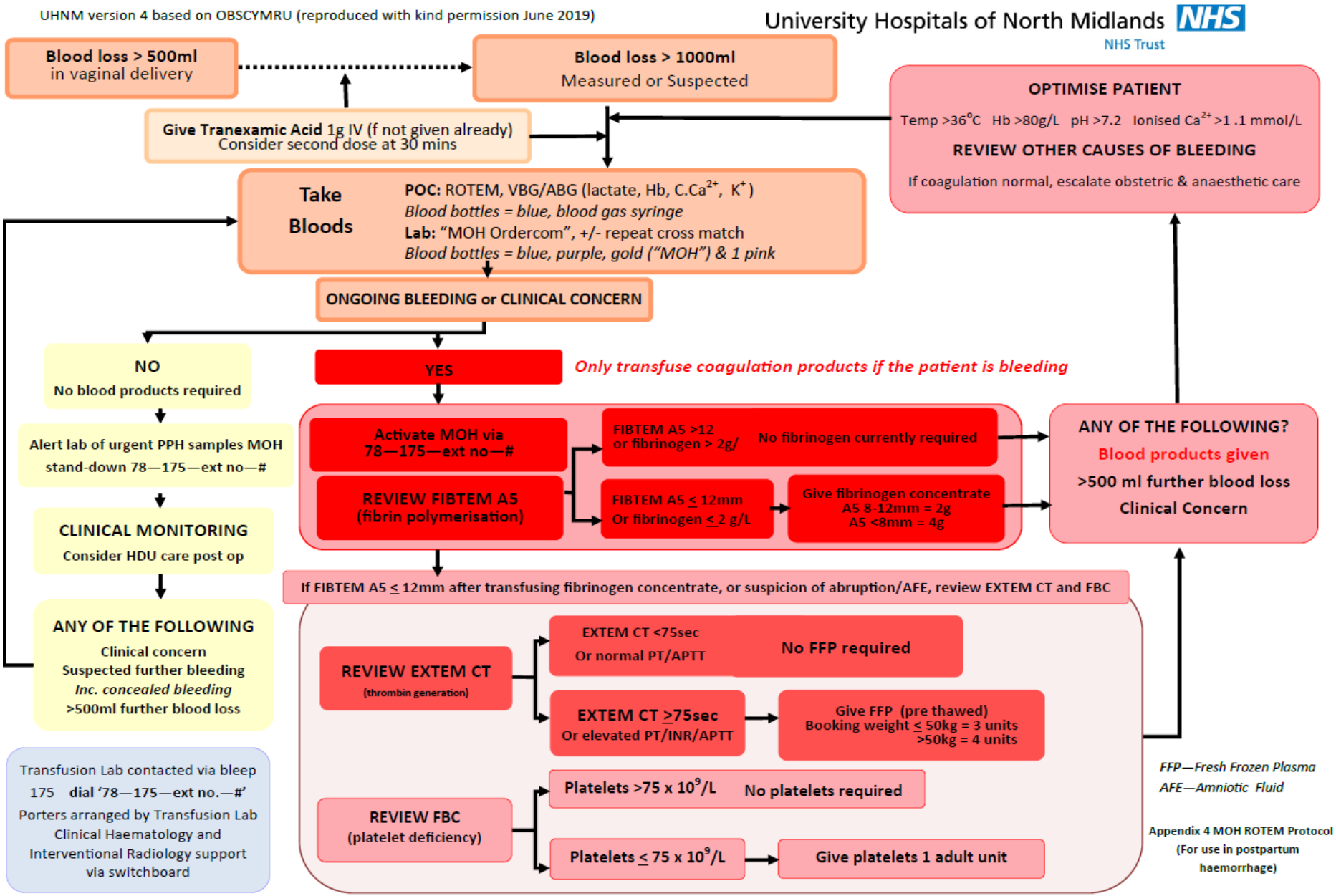
Provide 'goal directed therapy' and evaluate response

Stop the bleeding
Therapeutic interventions (consider) Trauma- Give Tranexamic acid 15mg/kg (<1000mg) IV over 10 mins followed by 2 mg/Kg/hr for ≤8 hours/haemostasis secured
Surgical interventions Damage control surgery
Radiological interventions Arterial embolisation
Manual interventions Tourniquet/external pressure

MHP	RBC	Plasma	Platelets	Cryo	Comments
Pack 1	20ml/Kg	20ml/Kg			Contains O RhD neg/ O RhD pos/ Group specific/ cross-matched depending on sample availability and patient demographics Pre-thawed FFP will be provided in all cases initially
Max	1100ml (4 units)	1000ml (4u FFP)			
Pack 2	20ml/Kg	20ml/Kg	15ml/Kg	10ml/Kg	Move to group specific/ cross-matched RBC as soon as available– delivered by porter Consider platelets +/- cryoprecipitate after 40mg/kg RBC given
Max	1100ml (4 Units)	1000ml (4u FFP)	200ml (1 ATD)	380ml (2 pools)	

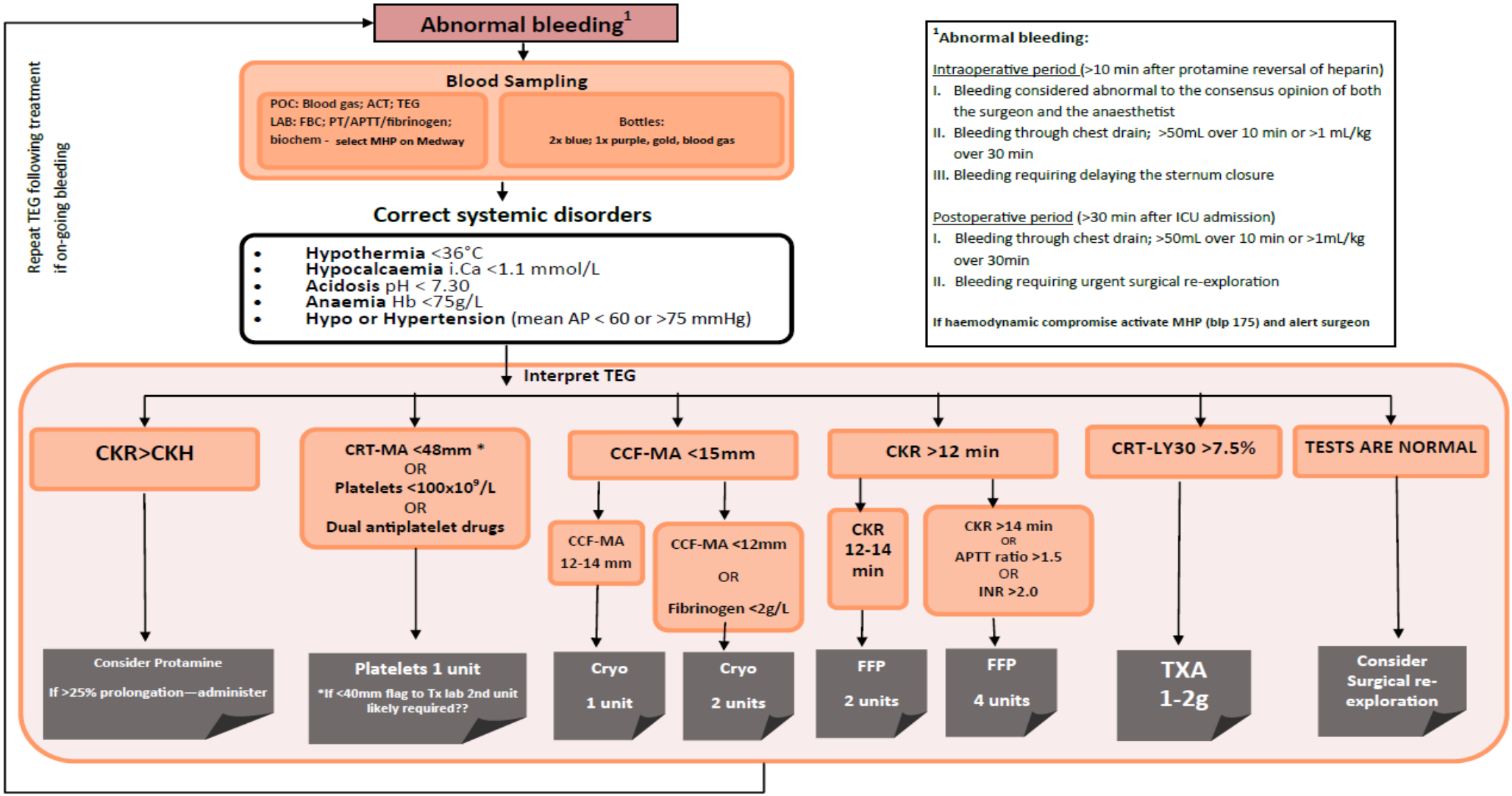
Appropriate volume component according to patient weight will be provided by the transfusion laboratory.
Special blood requirements will be adhered to wherever possible, with most appropriate alternative units supplied where necessary
Where weight unknown– estimate weight by age using UHNM Children's emergency resuscitation chart (manage those >50kg as per adult MHP volumes)

ASQUAM Guideline for Postpartum Haemorrhage – ROTEM protocol



Cardiac TEG® Guided Bleeding Algorithm

University Hospitals of North Midlands NHS
NHS Trust



[1]Abnormal bleeding:

Intraoperative period (>10 min after protamine reversal of heparin)

I. Bleeding considered abnormal to the consensus opinion of both the surgeon and the anaesthetist
II. Bleeding through chest drain; >50mL over 10 min or >1 mL/kg over 30 min
III. Bleeding requiring delaying the sternum closure

Postoperative period (>30 min after ICU admission)

I. Bleeding through chest drain; >50mL over 10 min or >1mL/kg over 30min
II. Bleeding requiring urgent surgical re-exploration

If haemodynamic compromise activate MHP (blp 175) and alert surgeon

Treatments can be administered simultaneously. Only administer blood products if active bleeding. Access blood bank via MHP pager 'dial 78-175-ext no.-#'

Appendix A

Major Haemorrhage Protocol (MHP) Team Roles

MHP Role	Responsibility	Who?
Team Leader	• Coordinate clinical care • Decide use of group O/group specific blood • Decide use of other components/haemostatic medications • Allocate other MHP roles and specific tasks • Maintain situational awareness and effectively communicate with team	Most senior member of team
Communication Lead	• Liaise between team leader/clinical setting and the transfusion laboratory/other support services e.g. endoscopy • Follow guidance on MHP activation and patient handover e.g. SBAR format • Coordinate response to patient's care e.g. timely provision of blood components/definite care	Sole named individual Relatively senior member of team
Runner*	• Collect blood components from transfusion laboratory • Deliver samples to the laboratory • Ensure competency assessed to carry out role • Adhere to SOP on blood component collection	Specified porter or designated member of staff from the clinical area (ensure has own unique valid barcode if collecting components)
Scribe	• Overall documentation of MHP time line • Record start/stop time of blood components to ensure traceability maintained • Ensure patient ID secured asap (trauma setting)	Medical officer or registered practitioner
Specific tasks /Other	• Complete task as allocated by the team leader e.g. blood sampling, requesting of investigations and communicate action on completion • Use positive patient identification at every step	As appropriate for task

* At RSUH a dedicated porter ordered by transfusion laboratory on receipt of MHP activation. To be 'stood-down' by transfusion laboratory only

* At County hospital send an appropriately trained member of staff to laboratory to collect components

Appendix B

Activating the MHP – Crib sheet for the 'MHP Communication Lead' for initial contact with transfusion laboratory

Statements in red are essential for safe communication and effective MHP activation

	Action	Details
1	Contact transfusion laboratory	MHP Bleep 175 = "dial 78-175- 'ext no' Dial carefully!
2	Activate MHP	*'I would like to activate the Major Haemorrhage Protocol* *- Adult* *- Adult trauma* *- Paediatrics* *- Major Obstetric Haemorrhage* *- Cardiac bleeding algorithm*
3	Provide contact details for MHP Communication Lead	*'Contact details for the MHP are...'* Provide own name, job role and contact details- including extension no. and bleep/mobile
4	State MHP location	*'MHP is situated in ....'* e.g. ward 230, ED resus
5	State patient details	*'Patient details are...'* Full name / Unknown M/F DOB / Estimated DOB/age (relevant if female or paediatric) NHS number / unique patient ID Estimated patient weight in paediatrics
6	Confirm G&S/transfusion sample status	Lab will state G&S status and time to group specific red cells e.g. • Valid G&S sample is in the lab (e.g. inpatient setting) • No G&S sample in lab *Confirm G&S status* • Urgent XM has been taken and sent via POD/ individual • XM is in process of being taken and will be sent urgently asap (NB. porter will take after delivering pack 1or use POD) • Sampling for XM likely to be delayed with reason (e.g. neonatal emergency)
7	Group O RhD negative ('flyer') red cell usage	State whether Group O RhD negative blood has been used and quantity Confirm pink form has been filled in (or ensure it has!)
8	Inform laboratory of transfusion history • Transfusion outside this hospital • If blood components have been transferred with patient	*e.g. 'Patient has been transfused in X hospital – details of components' and/or '2 units group specific Group A RhD positive blood have been transferred with patient'* *Aim to keep transport box shut and send immediately to laboratory*
9	Order blood components as agreed with MHP team leader	*e.g. 'I would like to order MHP pack 1'* MHP pack 1 contains 4 group-appropriate RBC (see 10 below) and 4u pre-thawed FFP unless alternative components requested by clinical team e.g. cell salvage
10	Red cell requirements – Group O /Group-specific	*'We require group O red cells OR* *We require group specific red cells'* State which red blood cells required • Group O (available immediately with RhD negative/positive provided by lab depending on patient demographics) • Group specific (available between immediately and < 15 mins of sample receipt – i.e. time dependent on G&S sample status) *Nb. Switch to group specific red blood cells as soon as possible*
11	Confirmation	Lab will confirm blood components ordered and time to arrival

Appendix C

'MHP Communication Lead' subsequent MHP contact with transfusion laboratory including 'stand-down'

	Action	Details
1	Contact transfusion laboratory	MHP Bleep 175 = "dial 78-175- 'ext no'
2	Confirm MHP	*'This relates to the Major Haemorrhage situation in ..., involving patient...'*
3a	Order blood components as agreed with MHP team leader	*e.g. 'I would like to order MHP pack 2'* MHP pack 2/3 – or specific blood components according to patient situation
3b	Stand-down MHP	*'I would like to stand-down this MHP'* *'Products used are...'* *'We are returning.../satellite location of unused blood components'*

Appendix D: BLOOD AND BLOOD COMPONENT TRANSFER FORM TO CLINICAL AREA WITHIN UHNM

This form must accompany units transferred in a cool box to a clinical area

Blood and blood components must only be transported using a validated container and in strict accordance with a locally agreed method which complies with the Blood Safety & Quality Regulations (2005)

LABORATORY NUMBER | LOCATION

PATIENT NAME | NHS Number/ Hospital number | DOB enter as dd/mm/yy | Gender

TYPE OF UNITS: Red cells ☐ FFP ☐ Enter donation number of all units transferred below

Red cells UNIT 1 | FFP: UNIT 1

Red cells: UNIT 2 | FFP: UNIT 2

Date Packed: **Time packed:** **Signature:**

Moved out of Blood Track using "Cooler" option ☐

All products must be transfused within 6 hours
Please complete the date/time receive by below and ensure the end fate of the products is recorded on blood track/ blue tags

If products are no longer required return the box and contents to the laboratory IMMEDIATELY as a failure to do so will lead to wastage and failure to comply with the Blood safety and Quality regulations

Laboratory contact details: Tel 74946/48 Bleep 390 (5.30pm-9am)

RECEIVING CLINICAL AREA:.....

Date received: **Time received:** **Signature:**

RETURNED TO LABORATORY: YES ☐ **NO** ☐

Date returned: **Time returned:** **Signature:**

FINAL DISPOSITION

	RC: UNIT 1	RC: UNIT 2	FFP: UNIT 1	FFP: UNIT 2
Transfused	☐	☐	☐	☐
Returned	☐	☐	☐	☐

Traceability must be recorded on Blood Track