University Hospitals of Derby and Burton NHS Foundation Trust

TRUST POLICY FOR BLOOD TRANSFUSION MAJOR HAEMORRHAGE (QHB)

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	1	Dec 2015	Transfusion Practitioner QHB	Original Policy
	2	Sept 2021	Transfusion Practitioner QHB	Review and amendments
	3	August 2024	Transfusion Practitioner QHB	Review and amendments
	3.1	Sep 2024	K Kacinova BB manager	MH activation dial 2222
Intended Recipients: All staff with responsibility for any step of the blood transfusion process at Queens Hospital Burton.				
Training and Dissemination: Launched through Intranet. Theory training is required by all staff involved all steps of the transfusion process. Competency assessment is required by staff involved with venepuncture for blood bank samples, collection of blood and blood products and administration of blood for transfusion. Theory training is incorporated in Trust Induction and requires update at a frequency according to the job role. The QHB HTT and the Transfusion Practitioner is responsible for training provision. Dissemination of this Policy is via launch through the Intranet.				
To be read in conjunction with: Transfusion of Blood and Blood Components - Trust Policy and Procedure (QHB). Emergency Management of Red Blood Cell and Platelet Shortages - Trust Policy and Procedure Incident Reporting, Management and Learning - Trust Policy and Procedure. Consent Including the Mental Capacity Act (Lawful Authority for Providing Examination, Care or Treatment Policy (UHDB). Patient ID Policy - UHDB Trust Policy and Procedure (UHDB). Developing Our People Policy – Overarching Policy for UHDB. Warfarin Clinical Guideline (QHB). Blood Transfusion Guidelines (Paediatrics and Neonates) - Paediatric Clinical Guideline - Burton Sites Only.				
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Contact for Review	Julie Buchan. Transfusion Practitioner QHB
Executive Lead Signature	Executive Chief Medical Officer

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ABBREVIATIONS

ABG	Arterial blood gas
aPTT	Activated partial thromboplastin time
aPTTr	Activated partial thromboplastin time ratio
BSH	British Society for Haematology
BMS	Biomedical Scientist
Ca++	Calcium
DIC	Disseminated intravascular coagulation
DoB	Date of Birth
FBC	Full blood count
FFP	Fresh frozen plasma
EPR	Electronic Patient Records
HTC	Hospital Transfusion Committee
HTT	Hospital Transfusion Team
INR	International normalized ratio
MHRA	Medicine and Health products Regulatory Authority
NHSBT	National Health Service Blood & Transplant
PT	Prothrombin time
PCC	Prothrombinase Complex Concentrate (PCC)
QHB	Queens Hospital, Burton
SABRE	Serious Adverse Blood Reaction and Events
SHOT	Serous Hazards of Transfusion
TACO	Transfusion Associated Circulatory Overload
TDG	Trust Delivery Group
U&E	Urea and electrolytes

1. Introduction

This Policy outlines the clinical management of patients who develop major haemorrhage at QHB. This includes communication, the management of coagulation problems because of massive blood loss, and the provision and transportation of blood components to ensure patient safety and ensure compliance with all CQC and NPSA requirements, the Blood Safety Quality Regulations (2005) and BSH (2015).

2. Purpose and Outcomes

The purpose of this Policy is to ensure that patients at QHB receive safe blood transfusions during a major haemorrhage. It is a generic Policy related to organisational aspects of managing a patient with massive haemorrhage. Where there is specific guidance for particular situations, these are specified.

Success in resuscitating a patient with massive haemorrhage, halting the bleeding, and seeing him or her through to a stable non-bleeding state, depends critically on calm and well-organised management. The outcome of the Policy is to provide staff with the knowledge / information required;

- Criteria to identify a major haemorrhage
- Leadership and clearly understood roles for everyone involved
- A rapid system for bringing to the scene all those personnel whose skills will be required
- Blood components and major haemorrhage
- Obtaining blood for transfusion
- Administration of rapid transfusion

Clearly there will be patient and speciality-specific guidance for stopping the bleeding, but these are not dealt with in this Policy.

3. Key Responsibilities / Duties

All staff working in areas where major haemorrhage or significant bleeding events could occur must ensure they are aware of this Policy and its contents.

- The Trust Board has a corporate responsibility for approving the Policy
- The Executive Medical Director is the Lead Director for this Policy and is responsible for ensuring appropriate arrangements are in place to manage any resource implications
- The TDG has responsibility for ratification of this Policy and ensuring the most current version is available
- The Patient Safety Group is responsible for ensuring consultation of this Policy.
- The HTC (UHDB) is responsible for monitoring that the Policy documents are kept up to date and implemented as required. It is responsible for reviewing this Policy as part of the consultation process and identifying and managing associated risks
- The HTT (QHB) ensures the transfusion Policies and procedures in place meet national and clinical requirements, ensuring compliance with national transfusion standards and reporting near misses and Serious Hazards of Transfusion to SHOT and SABRE when appropriate
- All staff involved in any step of transfusion need to be aware of the transfusion Policies and procedures and how they impact on their work. They are responsible for maintaining and updating their knowledge and practice, and ensuring that adverse incidents and reactions are reported.

4. Definitions Used

Major haemorrhage: Definitions of major haemorrhage are necessarily arbitrary. Definitions in terms of total blood volume loss (e.g. 50% of blood volume in less than 3 hours or rate of blood loss (150 ml/min) are generally difficult to apply in clinical situations. The BSH defines major haemorrhage as bleeding which leads to a heart rate more than 110 beats / min and / or systolic blood pressure less than 90 mm Hg. This is also arbitrary. It is important to remember that young healthy patients may show limited changes in physiology until a late stage. Anaesthetised or sedated patients may also fail to develop a tachycardia despite significant volume loss. It may not be straight forward to readily determine that major haemorrhage is occurring, for example post-partum and other situations where bleeding may be concealed; but early recognition of significant blood loss, ideally before major increments in pulse rate and fall in blood pressure, will allow prompt action to pre-empt shock. (BSH, 2015).

SHOT: The Serious Hazards of Transfusion (SHOT) scheme is the National haemovigilance scheme of the United Kingdom.

NPSA: The National Patient Safety Agency (NPSA) The National Patient Safety Agency (NPSA) is a special health authority that collects patient safety information and identifies patient safety issues that need a national response.

Flying Squad O Negatives: Unmatched O Rh D Negative (rr), K negative and HbS negative red blood that is stored in the blood banks fridge for use in cases of life-threatening emergency. 2 units are available in the Blood Bank fridge.

Group Compatible: Blood that is of a different ABO or RhD group to the patient but is compatible with the patient's blood group e.g. issue RhD positive blood to a RhD negative male.

Group Specific: Blood that is of the same ABO RhD blood group as the patient.

PT / APTT: Prothrombin time (PT) and Activated Partial Thromboplastin Time (APTT) are the tests performed to monitor plasma coagulation pathway.

Hospital Transfusion Committee: (HTC - UHDB) Monitors blood transfusion issues within QHB. The Committee has representatives from all disciplines that use blood.

Hospital Transfusion Team: (HTT - QHB) Ensures the blood transfusion service at QHB meets all national transfusion standards and requirements. Members include the Haematology medical team, Blood Bank Manager and Senior and the Transfusion Practitioner.

5. Key Contacts

The key personnel with regard to transfusion and their contact details are listed below, they constitute the HTT which meets bi-monthly.

Title	Extension
Consultant Haematologist	4047, (bleep via switchboard)
Haematology Specialist Practice Registrar	4394, Bleep 423
Site Lead Blood Transfusion	4298

Transfusion Practitioner	4126

REFER TO APPEDIX E FOR EMERGENCY CONTACT

The Blood Bank is staffed from 09.00 – 17.30 Monday to Friday. Outside of these hours contact the on-call BMS via internal bleep 367.

6. Major Haemorrhage Priorities for Treatment

The management of a patient with major haemorrhage has three elements:

- Assessment and resuscitation following Advanced Life Support principles
- Local control of bleeding (surgical and endoscopic techniques)
- Haemostatic, including transfusion support.

The aims of patient management are:

- Maintenance of tissue perfusion and oxygenation by restoration of blood volume and haemoglobin
- Arrest of bleeding e.g. by treating any traumatic, surgical or obstetric source
- Correction of coagulopathy by targeted use of blood component therapy
- Our duty of care does not diminish in an emergency and the Trust's Patient Identification and Blood Transfusion Policies must be followed.

7. Allocations of Roles within the Team

The importance of the non-technical aspects of managing a major haemorrhage should not be underestimated. A coordinated response with good communication is essential to reduce the chances of a poor clinical outcome, suboptimal or inappropriate transfusion practice and component wastage. Appropriate expertise for the site of bleeding is vital – surgeons, endoscopists or others with specific expertise may be needed. Consideration should be given to early referral and, if necessary, transfer to other centres to access such expertise. An intensive care bed may be required, and early communication is advisable to ensure availability.

The following roles should be allocated as soon as possible after identifying a major haemorrhage:

- **Team leader** – Usually the most senior person present. In the first instance this may be a consultant from the specialty dealing with the cause of bleeding (Anaesthetist, Emergency Department, Gastro-intestinal (GI), obstetric etc.) If the patient requires surgery, this will often be an anaesthetist. The team leader takes control of the situation, ensures the number and skill mix of those in attendance is appropriate, and allocates the roles to the team members
- **Communication lead** – Reports directly to the team leader. Their sole role is communication with laboratories, Theatres, other required specialists or other departments (this will usually be a junior doctor). They should call Blood Bank (ext.4087 or bleep 367 out of hours) as soon as possible to establish contact with a named BMS. They should describe the scenario, give patient details as available, provide their name and contact details, outline the blood component requirements, establish the availability of blood and the need for sample(s) for Blood Bank tests and cross-matching. (Refer to the table in the Blood Bank User Guide for reference)

- **Consultant Haematologist –** Contact the on-call haematologist if haemostatic tests are abnormal and the type of blood component therapy required is not clear. Authorisation for the ordering of platelets will be required from the Consultant Haematologist when requesting platelets
- **Runner** – Reports to the communication lead. Takes samples directly to the laboratories and collects blood from Blood Bank. This will often be a porter
- **Other Staff** – Other staff will be assigned other important tasks, including monitoring and support of airway and breathing, attaining vascular access, setting up equipment such as rapid transfusion devices, and checking blood components. It is important that this is done in a coordinated fashion.

8. Immediate Actions in a Patient with Major Haemorrhage

- Escalate concerns to the senior medical staff responsible for the patient
- Administer high flow oxygen via a non rebreathe mask (refer to the relevant UHDB oxygen clinical guideline)
- Secure IV access with the largest bore which can be achieved (minimum 14g/16g) and take blood samples (see below)
- Control obvious bleeding points (pressure, elevation, tourniquet, haemostatic dressings)
- Fluid resuscitation – colloid or crystalloid use should be restricted to that necessary to achieve adequate perfusion until blood components are available. Use warmed blood and plasma as soon as possible
- Adult patients in whom antifibrinolytics are not contraindicated should be given tranexamic acid 1g in 10ml IV bolus as soon as possible. This should be followed by 1g in 1000ml IV over 8 hours
- Warm the patient
- Assess / investigate for sites of injury / bleeding. Consider radiology examination and / or gastroscopy etc as indicated
- Call the appropriate specialists who will be needed to deal with the major bleeding / injured site(s). This may include specialist surgeons and endoscopists
- Alert theatres to the likely need for surgery.

Simultaneously:-

- Ensure the patient is identified and wearing a wristband. If patient is 'unknown' follow appropriate procedure as specified in the Patient Identification Policy. This wristband must stay on the patient throughout all the resuscitation and interventional procedures, and at least until the patient is stable and not requiring further blood transfusion.
- Alert Blood Bank BMS that blood components are or maybe required. Discuss with the Blood Bank BMS what blood components are required, and how quickly they are needed. (Refer to appendix A, B and D. **Refer to appendix E for the QHB blood bank emergency contact telephone number)** On the basis of products currently issued, recent and historical blood bank tests, and samples currently held by blood bank, the BMS will be able to advise which blood is available in the required timespan, and the requirement for further blood bank samples.
  Options for packed red cells are as follows: -
  - Blood group O Rh D Negative red cells – 2 units (Flying Squad blood) are available in the Blood Bank fridge for immediate use at all times.
  - Uncross matched ABO Group specific red cells as advised by the Blood Bank BMS (group compatible or group specific)
  - Fully cross matched red cells. For more details see section 17.
- Communicate to Blood Bank at the earliest opportunity if the O Neg Flying Squad blood has been used so that additional blood can be provided for the patient, and the Flying Squad blood can be replaced.

- Before any blood component is administered, take baseline bloods with appropriate / accurate request on EPR / order forms: FBC, U&E's, Ca++, PT / aPTT, Fibrinogen, crossmatch / G&S and if required ABG (including ionised Ca++). Label all as urgent and send them to the laboratory with the Runner who hands them in personally to Specimen Reception in the laboratory, except for the crossmatch / G&S sample which must go directly to Blood Bank or the Haematology BMS if out of hours. At all handovers of samples, they must state the urgency (Refer to Appendix B for *Blood Sampling During a Major Haemorrhage*).
- Inability to draw sufficient blood for all tests must not delay Blood Bank samples reaching Blood Bank.
- In the event of clinical staff having difficulties obtaining a Blood Bank sample (crossmatch / G&S) from an adult, it may be possible to undertake the tests with a minimum of 3ml of blood in the tube. Discuss this with the Blood Bank BMS. Note; adult samples should not be taken in paediatric tubes as it will restrict the tests that can be undertaken with the sample. (Paediatric tubes require less blood as fewer tests are undertaken on the child's blood). Coagulation samples and Chemistry samples can not be undertaken with a smaller blood volume.
- Despite best efforts, if a sample **cannot** be obtained, communicate this to Blood Bank. Whilst Blood Bank will provide blood in the absence of a sample this will be not be cross-matched and the clinician will be asked to take responsibility. Efforts to obtain a sample should continue so that the necessary pre-compatibility testing and crossmatch can be performed.

9. Blood Transfusion: Laboratory Response

The Blood Transfusion BMS will:

- Liaise with the Communication Lead, and provide advice if required
- Advise on timeframes for the availability of blood components and the need for Blood Bank sample(s)
- Provide the requested volume of blood components and / or blood products in the requested timeframe. In general, this will initially be 4 units of red blood cells, 2 to 4 units of FFP and 1 unit of platelets
- Seek advice from Consultant Haematologist if required
- Inform the Consultant Haematologist if there is difficulty in the provision of transfusion requirements or if the patient has special transfusion requirements that cannot be met in an emergency (e.g. phenotyped or irradiated components)
- Inform the Consultant Haematologist and / or Blood Bank Manager if demands of the massive transfusion begin to impact on the ability to support other clinical activities within QHB
- Maintain sufficient stock
- Liaise with the NHS Blood and Transplant if additional components are required to be delivered
- Call in additional scientific support staff if necessary
- Refer to the Transfusion Practitioner if clinicians appear to require further assistance.

10. General Management After Control of Bleeding

- Continued assessment and support of the airway and breathing
- Assess volume status. If perfusion pressure is inadequate despite apparently adequate volume replacement, vasopressors may be required. Seek advice from an Anaesthetist (ITU / Theatres) as this requires medical staff familiar with their use and using appropriate cardiovascular monitoring
- Aim for normal acid-base status and temperature

- Monitor FBC, PT, aPTT, Fibrinogen, U+E, Ca++ and ABG. Frequency will depend on the extent of ongoing bleeding and the stability of the patient
- Treat coagulopathy with blood components to maintain, if possible, platelets >50x10^9/L, INR and aPTTR ≤ 1.5, Fibrinogen >1.5g/L. For prevention of coagulopathy use 15ml/kg FFP, but if established coagulopathy then consider 30ml/kg before retesting. Maintain ionised Ca++ >1.0mmol/L with infusions of 10ml 10% calcium gluconate over 10 minutes. This available from pharmacy and is stocked in all high dependency areas. Seek advice from the Consultant Haematologist as required, particularly when considering the need for platelets and / or cryoprecipitate
- Consider the need for on-going critical care.

11. Specific Coagulopathy Problems

Tests of coagulation – Serial haemostatic tests, including platelet count, prothrombin time, activated partial thromboplastin time and fibrinogen, from before and after resuscitation should be used regularly, every 30-60 min depending on the severity of the haemorrhage, to guide and ensure the appropriate use of haemostatic blood components.

The prothrombin time (PT) and activated partial thromboplastin time (APTT) were developed to detect inherited coagulation disorders, not coagulopathy secondary to bleeding. If these are available, they can be used to aid the decision for infusion of fresh frozen plasma (FFP). Care should be taken with potentially false high values in disseminated intravascular coagulation (DIC), liver disease, renal disease, dysfibrinogenaemia and in those receiving anticoagulants.

Haemostatic testing - It is important to establish whether the patient is receiving anticoagulant or antiplatelet medication. The coagulopathy of bleeding is related to loss of blood, consumption of coagulation factors, activation of fibrinolysis and haemodilution by resuscitation fluids. Developing hypothermia, acidosis and hypocalcaemia will further worsen coagulation. It is important to monitor haemostatic changes to guide the use of blood components after initial resuscitation, with coagulation and platelet testing performed every 30-60 min, depending on the severity of blood loss, until bleeding ceases. There is a need for rapid turnaround times for coagulation tests in a major haemorrhage.

- **Dilutional coagulopathy.** The use of colloid or crystalloid for volume resuscitation should be restricted to that necessary to maintain perfusion prior to blood components being available. Both lead to dilution coagulopathy and colloids have a mild anticoagulant effect
- **Consumptive coagulopathy**. Excessive consumption of coagulation factors and platelets occurs, especially in obstetric haemorrhage, trauma (particularly following head injury) and if sepsis is present. Early haemostatic tests are therefore essential at the outset of resuscitation (ideally before any blood is given), and regularly throughout the management of massive haemorrhage
- **Hypocalcaemia** - Patients receiving massive transfusion are at risk of developing hypothermia, acidosis and hypocalcaemia which will further worsen coagulation. If there is clinical, biochemical or ECG evidence of hypocalcaemia, it should be treated with slow i.v. injection of calcium gluconate 10% (10 ml). Hyperkalaemia can occur during massive transfusions generally in patients who are hypothermic and acidotic
- **Platelet dysfunction.** This is particularly associated with cardiopulmonary bypass, renal disease and anti-platelet medication, hypothermia and acidosis

- **Hyperfibrinolysis** is associated with obstetric haemorrhage, liver disease and trauma
- **Anticoagulant drugs**. After confirming that the patient is on Warfarin or another Vit K antagonist assess clinical presentation: STOP WARFARIN. Send blood for INR, aPTT, FBC, U&E and LFT, but don't wait for results to continue. Give Vit K 5mg IV. Discuss with the on-call Haematology Consultant for advice as Prothrombinase Complex Concentrate (PCC) or FFP may be required. (Refer to the Warfarin Policy if further information is required)
- **Heparins** can be partially reversed by protamine
- The **novel anticoagulants** are not readily reversed, but advice can be sought from the on-call Consultant Haematologist if required
- Patients on **anti-platelet medication**, who continue to bleed, may require platelet transfusions, but this may only be partially effective. This should be discussed with the Consultant Haematologist
- **Recombinant Factor VIIa (Novo7**) is not recommended in massive haemorrhage. Blood Bank does maintain stocks of this.

12. Ordering of Specific Blood Components

Blood Bank Blood Samples – All blood samples for Blood Bank must be taken and labelled as per the Blood Transfusion Policy. This is regardless of the urgency of the blood request / patient condition. Blood Bank operates a 'Two Sample Rule' when providing any blood. In summary, in an emergency situation and in the absence of two valid ABO groups, the relevant O blood group will be provided. Refer to the Blood Transfusion Policy for further information on this.

Hand delivers the sample to the Blood Bank BMS - ***DO NOT USE THE POD SYSTEM TO TRANSPORT EMERGENCY SPECIMENS TO THE LABORATORY. THIS WILL ONLY CAUSE A DELAY***. At all handovers of samples, the urgency must be stated.

In the event of a life-threatening emergency situation blood or blood products can be requested by telephone. Telephone requests for blood should be kept to an essential minimum because of the risk of transcription errors.

You will be asked to provide the following information which will be recorded:

Table 1 – SBAR Communication during a Major Haemorrhage

S	• State the urgency of the situation (e.g Major haemorrhage)
B	• Your name and department, and the location of the patient • Patient's unit number, full name and date of birth
A	• What blood is required and • How quickly the blood is needed • The name of the doctor authorising the request (usually this is the most senior anaesthetist immediately involved with case)
R	• Extension number for Blood Bank to contact if query arises

Refer to Appendix C, E for the information Blood Bank will require for telephone requests. Commence the phone call by stating the severity of the clinical situation e.g. cardiac arrest, major haemorrhage etc. In such situations, Blood Bank staff can issue the blood without an electronic order as long as they are aware of the name of the ordering doctor. The prescription will still have to be written by a Doctor, but this can be done retrospectively. It is the responsibility of the prescribing doctor to request CMV negative or irradiated blood products if these are required. (Note – CMV negative and irradiated adult blood is not

routinely stocked in Blood Bank, so is therefore not available during a major haemorrhage. 2 paediatric units of CMV negative red blood cells are stocked.)

13. Red Cell Transfusion

Red cells are necessary for their oxygen-carrying capacity, and also contribute to improved haemostasis through rheological effect leading to axial flow, and thus margination of platelets and plasma. Although red cell transfusion can be life- saving, there are potential risks such as increased morbidity and mortality due to organ failure and transfusion-related acute lung injury and so exposure to red cells should be minimized (BSH, 2015).

The optimum target haemoglobin during haemorrhage is not established. Haematocrit and haemoglobin levels in bleeding patients are not reliable indicators of blood loss. These are though useful indicators if you are maintaining normovolaemia with clear fluid. The decision to transfuse blood will be made by the Team Leader.

For reference purposes, the updated European Guideline on Management of Bleeding following Major Trauma recommends a target Hb of 70-90 g/l (BSH 2015). Patients with cardiorespiratory morbidity may require a higher target of 80-90 g/l. BSH guidelines for red cell use in critical care recommend that anaemic critically ill patients with stable angina should have their Hb maintained >70 g/l, but transfusion to a Hb > 100 g/l has uncertain benefit. For patients suffering from acute coronary syndrome, the Hb should be maintained at >80–90 g/l. There is no indication for requesting 'fresh' red cells (e.g. under 7 days storage) in haemorrhage (BSH 2015).

Decisions / Communication. The Team Leader should assess the urgency of blood transfusion and states the blood required and ensures that the communication lead has conveyed this information to the named biomedical scientist in Blood Bank. It will be very helpful also to convey to Blood Bank an estimate of the likely total blood loss and component requirements, and where the patient may be moving to next.

According to the urgency for the transfusion of blood, red cells can be made available as follows:

Immediately (blood already cross-matched for the patient) - This is likely if patient is surgical or high risk obstetric.

Immediately (no cross-matched blood available) - Two units of O Rh D Negative (rr), K negative red blood cells are available at all times from the Blood Bank Fridge (Flying Squad Blood). The decision to transfuse the "Flying Squad Blood" lies with the consultant in charge of the patient. Flying squad units are retrospectively cross matched if an adverse reaction is suspected. Inform Blood Bank that the Flying Squad Blood has been used as soon as possible so that the most suitable blood can be issued for the patient. Ensure the patients name and B number is recorded on the Compatibility Tag.

In 5-10 minutes (no cross-matched blood available) – If uncross-matched blood is required, Blood Bank will issue the most appropriate blood for the patient based on the Blood Bank history of the patient. This will usually be available in 5 – 10 minutes. Historical ABO blood tests (from EPR) are used to issue the appropriate ABO group blood. If two historical tests confirm the patients ABO blood group, then "group specific" blood or "group compatible" blood will be issued. If two historical blood groups are not identified, the relevant O blood group blood is provided. This is likely to be O Rh negative blood but can sometimes be O Rh positive for males and females >51 years of age. When requesting 'uncross-matched" blood, the BMS will ask if the ordering Doctor is prepared to take responsibility for giving uncross-matched blood. If administering uncross-matched blood

(including Flying Squad or Group Compatible blood), a valid blood sample must be taken for crossmatch prior to administering the blood to determine the patient's blood group pre-transfusion. The sample will also allow the BMS to issue the most compatible blood to be issued as soon as possible. Note – when issuing group compatible/group specific blood against historical ABO results, the date the G&S or crossmatch test was taken is irrelevant.

14. Blood Component Transfusion

Fresh Frozen Plasma (FFP)

FFP has been the component of choice to manage the coagulopathy of bleeding, but there is little high-quality data to inform optimal replacement of coagulation factors in major bleeding (BSH, 2015).

Fresh frozen plasma (FFP) should be as part of initial resuscitation in major haemorrhage of at least 1 unit of FFP to 2 units of red cells ratio until results from coagulation monitoring are available. Consider 1:1 ratio in bleeding secondary to trauma.

Once bleeding is under control, further FFP should be guided by abnormalities in laboratory tests with transfusion trigger of PT and / or APTT > 1.5 times normal for a standard dose e.g. 15-20 ml/kg.

If laboratory results are not available, and bleeding continues, further FFP may be transfused in at least a 1:2 ratio with red cells, prior to moving on to blood product use guided by laboratory results (BSH 2015).

Use of FFP should not delay fibrinogen supplementation if it is required.

FFP will take approximately 20 minutes to defrost and issue. AB FFP will be issued to patients with an unknown blood group. A therapeutic dose of FFP for an adult patient of 70kg is 4 units.

Platelets

Thrombocytopenia is considered a late event in massive haemorrhage, typically seen only after a loss of at least 1.5 blood volumes. In major haemorrhage, aim to keep platelets >50 x 10^9/l (BSH 2015).

Platelet transfusion should be given as one adult therapeutic dose (one unit) when the platelet count falls below 50 x 10^9/l. (Blood Transfusion Task Force, 2003).
Blood Bank does not keep platelets in stock and therefore this may require ordering from NHSBT. Therefore, we suggest that platelets should be requested if the platelet count has fallen below 100 x 10^9/l and there is on-going bleeding. It is important to discuss this with the on-call Haematology Consultant early in major haemorrhage (e.g. when the platelet count has fallen below 100 x 10^9/l).

Cryoprecipitate

Hypofibrinogenaemia is common in massive haemorrhage and it is reported that fibrinogen is the first factor to fall to critical levels; fibrinogen levels of < 1 g/l are likely after 1 - 1.5 times total blood volume replacement (BSH, 2015). There is inadequate evidence to define critical levels of fibrinogen concentration on which to base decisions to administer fibrinogen supplementation and this may vary in different clinical settings (e.g. see later section on obstetric haemorrhage). Note – A fibrinogen test has a turnaround time of approximately 15 minutes.

Fibrinogen supplementation should be given if fibrinogen levels fall below 1.5 g/l (1C). Cryoprecipitate is the standard source of fibrinogen. A typical adult dose is two units containing 3−6 g fibrinogen in a volume of 200 to 500 ml. One such treatment administered to an adult would typically raise the plasma fibrinogen level by about 1 g/l. In the absence of fibrinogen results consider cryoprecipitate after the replacement of 1 to 1.5 of the patient's total blood volume.

Discuss with the Haematology Consultant as soon as possible if larger doses of cryoprecipitate are being considered (patients with very low levels of fibrinogen concentration (<0.5 g/l and/or heavier individuals) or if fibrinogen levels are critically low.

15. Collection of Blood Components from the Laborotory

Only staff who are trained and competency assessed to collect blood can do so, regardless of the urgency of the situation. Prior to collecting blood, the person collecting will require documentation which has three patient identifiers typed on it. This must include the full name, date of birth and patient ID number. This must be checked against the patient's ID wrist band prior to collection. The collection checking process must be undertaken in accordance with the Blood Transfusion Policy regardless of the urgency of the situation.

In order to comply with the Blood and Safety Regulations multiple units of RBC and FFP must be packed in a Helepet cool box in a defined way. Refer to the Blood Transfusion Policy for further information.

16. Administration of Blood During a Major Haemorrhage

Refer to the Blood Transfusion Policy for administration of blood. The following information relates to administration during major haemorrhage only.

Bionectors – The Trusts Intravenous Therapy Policy for Adults advocates the use of bionectors. During a major haemorrhage advocated bionector is not required.

Infusion Administration Sets – All blood components must be transfused through an approved sterile blood infusion set, which incorporates a 170u – 200u (micron) in-line filter.

Infusion Rates - The rate of transfusion will be guided by the rate of blood loss and the degree of haemodynamic compromise with the aim of maintaining Hb at a level to support adequate oxygen delivery to the tissues. Rapid infusion (e.g. 1 unit over 5 minutes) may be required with assessment to determine if fluid overload is occurring.

Blood Warming – When transfusing blood quickly during a major haemorrhage, every effort should be made to ensure blood is administered through a Ranger warming device to minimize the development of hypothermia (NICE, 2008). Rangers can be obtained from the Medical Equipment Library. Refer to the Medical Equipment Library staff or (during out of hours) the Clinical Site Practitioners for assistance if required. High flow cartridges are available in theatre, and should be used where available.

Pressure Devices - Pressure devices / infusers may be used. The maximum pressure that should be applied to a blood transfusion is 300mm Hg. A pressure device can be used when administering blood via a Ranger Unit.

Compatibility of Blood Components During Administration – During routine transfusion the practice of changing the infusion set when changing the type of blood component is encouraged. During major haemorrhage the Anaesthetist may feel there is an increased risk if this is done. Red cells and FFP may be given through the same cannula via a binector provided the connection to the cannula is a short line. Platelets should **not** be transfused through an administration set which has previously been used for other blood components. Platelets are ideally infused through a separate line, or after a clear flush with 0.9% saline with a short connection to the cannula, but the mixing must only occur after the platelets have passed through. Intravenous solutions which contain calcium, such as Ringer Lactate, and calcium-containing colloids, such as Haemaccel™ or Gelofusine™ may antagonise citrate anticoagulant and allow clots to form in the blood component. Hypotonic intravenous solutions, such as 5% dextrose in water, may cause haemolysis of red cells.

IV Drug Administration During the Administration of Blood - No medication, additives or solutions other than 0.9% Sodium Chloride should be used to prime or flush blood infusion sets during transfusion as many can lead to clotting/haemolysis of transfused component. If the administration of drugs through the same IV line cannot be avoided, the line must be flushed well with 0.9% Sodium Chloride before and after drug administration. Do not exceed the transfusion time for the blood component as a result of this action and do not stop the transfusion for a prolonged period.

Observation Monitoring – Physiological observation monitoring will occur as per the blood transfusion Policy and be recorded on a recognised blood transfusion observation monitoring chart / anaesthetic chart as defined within the Blood Transfusion Policy.

Documentation - Accurate documentation of blood components given and the reason for transfusion is necessary in order to satisfy the legal requirement for full traceability (Department of Health, 2005) and to enable audit of outcomes.

Blood Travelling Out With A Patient To Another Hospital - Transfusion of blood in transit is discouraged. Adult ambulance crews are not trained to administer blood. If an unstable patient who has blood prepared for them is transferred out to another hospital, ensure Blood Bank is contacted. The BMS will prepare the blood and documentation to go with them, and ensure that the receiving hospital is aware that the blood is being transferred to them. Once in the receiving hospital, the blood should be immediately transported to Blood Bank.

Consent – The decision to transfuse should ideally be made following consideration of the potential risks and benefits of, and the alternatives to, transfusion. Where possible this is discussed between the clinician and patient (or their legal guardian) in advance of transfusion. The urgency of the patient's situation may limit the quantity of information that can be given, and the documentation recorded, but should not affect its quality. Where possible, a statement should be recorded confirming the reason for the transfusion, the transfusion plan, and any possible risks (e.g. TACO). The documentation should also include if the patient has provided verbal consent for the transfusion and if appropriate, alternatives that may have been offered.

Patients who unknowingly received blood components should be informed that they have received a blood transfusion as soon as they are able to understand. It is the responsibility

of the prescribing Doctor to ensure that this takes place. The patient will need to be given an NHSBT patient information leaflet relevant to the blood product received, and also a copy of the NHSBT leaflet “Information for Patients Who Have Received an Unexpected Blood Transfusion”. The later provides information to the patient stating that they can no longer be a blood donor, and where to find out additional information about blood transfusion.

Refer to the Blood Transfusion Consent Policy (QHB) for further information.

17. Actions Following a Major Haemorrhage

When the massive haemorrhage situation has stabilised or finished:

- If blood has been ordered, and the patient’s clinical situation changes so blood is no-longer required, inform Blood Bank as soon as possible.
- Inform Blood Bank with information related to details of patient movement, further transfusion requirements (if known) and details of what has been transfused.
- Return any unused blood components or blood products to the Blood Bank BMS as soon as is possible.
- Ensure all the blood components used are prescribed, and administration is documented.
- Complete all the documentation.
- Complete traceability documentation on the Blood Compatibility return to Blood Bank immediately.
- If there have been significant problems with obtaining or administering the blood, the clinical team should complete an adverse incident report, and the Blood Bank Manager or Transfusion Practitioner should consider reporting the incident to SHOT (Serious Hazards of Transfusion).
- When appropriate, the patient must be told that they received a blood transfusion. The patient must be provided with the relevant NHSBT leaflets including the leaflet “I’ve Received an Unexpected Blood Transfusion”. An interpreter must be used if there is a language barrier. Whilst every effort should be made to use an interpreter, in an emergency it may be appropriate to use a family member as an interpreter. An approved interpreter should be sought at the earliest opportunity.
- Thromboprophylaxis should be given after major haemorrhage and should be considered as soon as possible after bleeding ceases.

18. Transfusion Problems that May Arise Due to Major Haemorrhage

Adverse reactions can occur during any transfusion and at any time. Refer to the Blood Transfusion Reaction Policy for further information related to diagnosis and treatment.

Atypical antibodies. In a patient with known red cell antibodies or positive antibody screen, the risk of a haemolytic transfusion reaction will need to be assessed against the risk of withholding transfusion until compatible blood can be provided.

Dilutional coagulopathy if insufficient plasma and platelets have been given with large amounts of red cells or clear resuscitation fluids.

If any of the following is suspected, please ensure Blood Bank has been informed as soon as possible. This will allow appropriate investigation and advice to be given. To aid investigation a Clinical Adverse Incident must also be submitted (under the Transfusion category). The following may require reporting to external agencies; SHOT / SABRE / NHSBT (to be agreed and reported by the HTT).

Transfusion-Associated Circulatory Overload (TACO). Particularly in elderly patients, or those with cardiac or renal dysfunction it is easy to over-transfuse with resultant pulmonary oedema. Treatment is cautious use of diuretics. An adverse incident must be entered if TACO is suspected.

Transfusion-related acute lung injury (TRALI). This may occur especially after use of plasma containing products such as FFP or platelets. The patient may present with acute dyspnoea occurring 2-6 hours after a transfusion, with low central venous pressure, and a 'white-out' on CXR. Treatment is ventilatory support usually on GCC. An adverse incident must be entered if TRALI is suspected.

Metabolic changes, such as hypocalcaemia and hypomagnesaemia (due to citrate toxicity), and hyperkalaemia (due to K+ leakage from stored red cells), need to be watched for, and treated if detected.

19. Paediatric Major Haemorrhage

Although this is rare, it can occur when a patient is too unstable to be transferred directly to a tertiary paediatric unit. There are a few specific variations from the adult guideline, mainly in the form of weight-based dosing. The protocol to be used still uses RBC:FFP in a 1:1 ratio.

Discuss with Blood Bank blood sample requirements to avoid unnecessary sampling.

Paediatric transfusions should be prescribed in mls. This may also be appropriate for very low body weight adults, as may the use of smaller volume paediatric packs. This should be discussed with the hospital transfusion laboratory, and specific guidance given to the clinical staff administering these unfamiliar components.

Triggers for Paediatric MHP
The same as adult and if the child requires > 20ml/kg/hour red cells, or >40ml/kg/hour of any resuscitation fluid in the preceding hour.

Tranexamic acid dose
15mg/kg as bolus IV/IO, followed by 2mg/kg/hour for 8 hours.

Refer to the Blood Transfusion for Paediatrics - Full Paediatric Clinical Guideline (QHB).

20. Obstetric Major Haemorrhage

In major obstetric haemorrhage, blood component management should follow a similar pathway as for non-pregnant patients, except that meticulous attention should be paid to fibrinogen levels and consideration given to the early use of fibrinogen supplementation when fibrinogen levels are <2.0 g/l and there is on-going bleeding.

In major obstetric haemorrhage, consideration should be given to using tranexamic acid.

Refer to the obstetric haemorrhage Policies. For major haemorrhage activation telephone switchboard 2222. You will be asked to remain on the line to speak to blood bank.

21. Gastro-intestinal (GI) Major Haemorrhage

GI bleeding is a common indication for transfusion of blood components. In gastro-intestinal non-massive haemorrhage a restrictive strategy of red cell transfusion is recommended for many patients at 70 g/l (post-transfusion target 70-90 g/l). Follow a restrictive approach to

the use of FFP and platelets in patients with acute upper GI bleeding unless there is massive life-threatening haemorrhage or evidence of severe derangements in laboratory tests.

Refer to the Upper Gastrointestinal Haemorrhage Protocol.

22. Emergency Department and Trauma Major Haemorrhage

QHB is not a designated major trauma centre, so is unlikely to receive such patients. Current transfusion advice recommends that adult trauma patients with, or at risk of, massive haemorrhage should initially be transfused empirically with a 1:1 ratio of plasma: red blood cells. The early use of platelets should be considered. Adult trauma patients with, or at risk of major haemorrhage, should be given tranexamic acid as soon as possible after injury, at a dose of 1 g intravenously over 10 min followed by a maintenance infusion of 1 g over 8 h (BSH, 2015).

In the event of a pre-alerted actively bleeding patient to the emergency department by the ambulance service, it may be appropriate to have two units of emergency blood in the department prior to arrival in case of a need for immediate transfusion.

The patient should fulfil either of the following criteria (assessed from the pre-alert information) before emergency blood is obtained:

- Injury mechanism suggestive of major trauma or history suggestive of uncontrolled bleeding with haemodynamic instability.
- Cardiac arrest with suspected haemorrhagic cause.

Clinical discretion may be used in applying these parameters. Ensure early involvement of senior emergency department staff in all bleeding patients requiring transfusion. The decision to transfuse emergency blood is at the discretion of a middle grade doctor or consultant.

On arrival to the Emergency Department, two blood samples for cross match should be taken prior to transfusing any blood unless this is impossible due to the patient's condition. The two-sample rule still applies in an emergency situation.

Always inform Blood Bank at the earliest opportunity if requiring emergency blood. Provide as much patient identification detail as is known. Blood bank will prepare additional blood and assist in the transfusion management of your patient. They may advise to obtain the emergency blood from the blood issue fridge. In the event of an unknown male patient, or a woman of non-childbearing age, they may issue O Rh-D positive blood. In the event of not being able to discuss this with blood bank in advance of collecting the emergency blood, then collect O negative red cells. Inform blood bank as soon as you can. They will need to replenish the fridge stocks immediately.

When administering emergency blood, ensure the patient’s identification demographic details are completed on the transfusion traceability tag and returned to Blood Bank as soon as possible.

23. Oncology Major Haemorrhage

Haemorrhage can be a highly distressing symptom for patients, carers and health professionals. Multidisciplinary assessment, identification and discussion of those at risk of major haemorrhage should facilitate advance care planning in case of a major event

occurring. Early recognition of patients thought to be at significant risk of bleeding can lead to effective treatment and future care planning.

In the event of severe haemorrhage, or if the risk of a bleed is thought to be significant, a decision should be made regarding the most appropriate care for the patient. Depending on where the patient is, discussion may be needed to reach an informed decision about possible treatment options. Equally it may not be appropriate for patients at the end of life to be subjected to transfer to another location for interventions that may not provide significant survival benefit or add to their quality of life. Decisions regarding what is required to manage a patient's bleeding problem should be made at an early stage, so that clinical teams can act appropriately in the patient's best interests.

Seek advice from oncologist. Consider the use of tranexamic acid.

In the event of an acute bleed where there is felt to be no definitive treatment available to halt haemorrhage:

- Patient support and non-drug interventions may be more important than crisis medication
- Ensure that someone is with the patient at all times
- If possible, nurse patient on their side to keep airway clear
- Stem / disguise bleeding with dark towels / sheets
- Apply pressure to the area if bleeding from external wound with adrenaline soaks if available
- Administer crisis medication if available (e.g. Midazolam 10mg) which can be repeated after 10 minutes if needed.

24. Major Haemorrhage within the Community Hospitals

Arrange for urgent transfer to the main hospital site via 999 for an ambulance and alert A&E that the patient will be arriving. Inform the Senior Nurse.

25. Training

Blood transfusion training is mandatory and is delivered as described in the Blood Transfusion Policy, the Overarching Developing Our People Policy for UHDB. Generic aspects of dealing with massive haemorrhage are delivered during mandatory training. However, specialities such as 'obstetrics' must deliver local specialty-specific training. Within specialities, regular practices of the management of massive haemorrhage should be held and learning points documented to inform protocol development.

26. Monitoring Compliance

Effectiveness of the Blood Transfusion Major Haemorrhage Policy will be discussed at the HTT and HTC. Individual major haemorrhage events will be reviewed by the HTT. Such events will also be discussed at the relevant Emergency Department and obstetric governance meetings / post obstetric haemorrhage wash-up meetings. The HTC will report non-compliance of this Policy at the Patient Safety Group.

27. Staff Compliance Statement

All staff must comply with this Trust-wide Policy. Failure to do so may be considered a disciplinary matter leading to action being taken under the Trust's disciplinary Policies.

28. Reference and Bibliography

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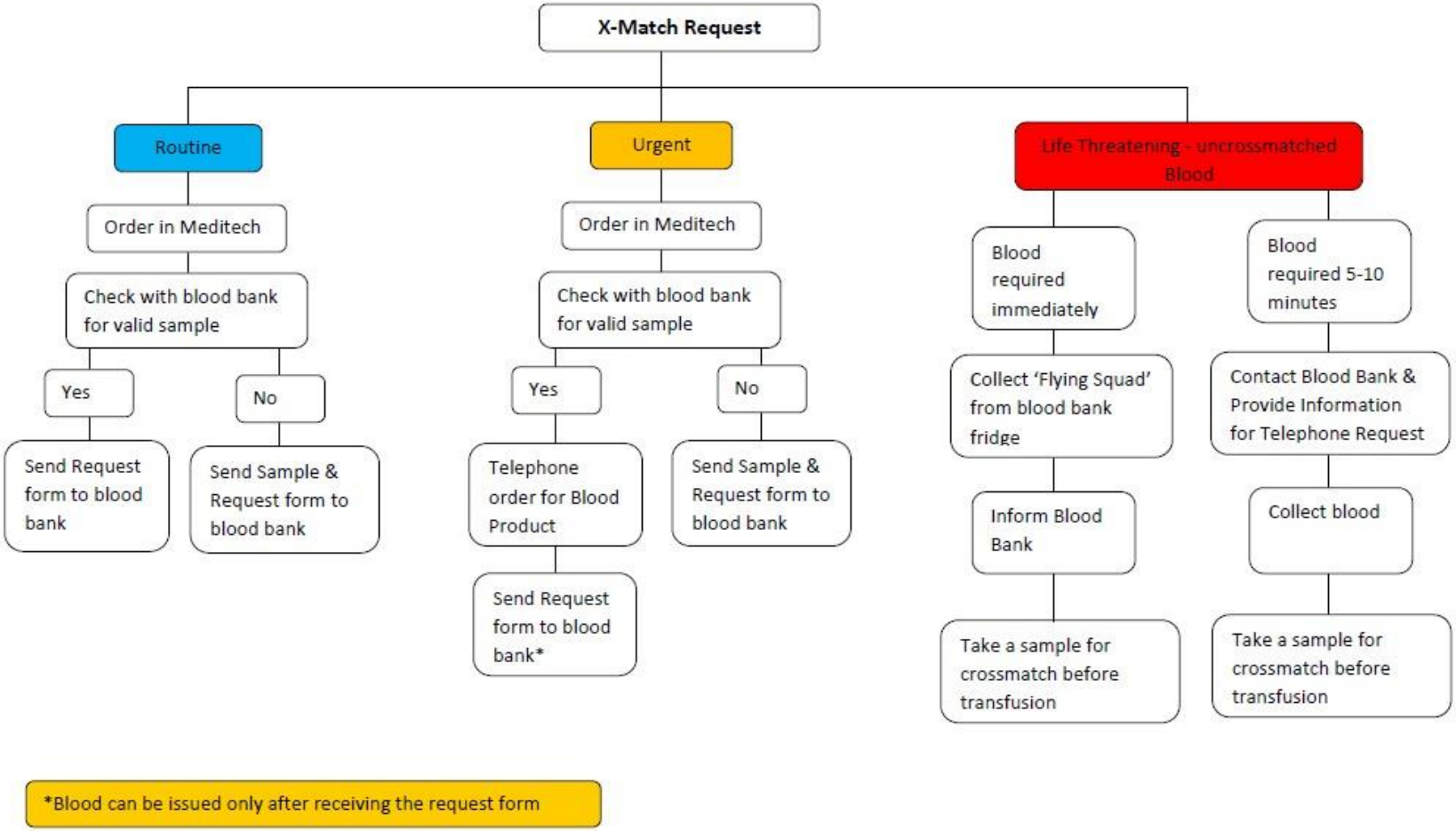
- United Kingdom Blood Services (2014) *Handbook of Transfusion Medicine*. 5th Edition. Editor Dr D. Norfolk. Accessed on-line March 2021 at https://www.transfusionguidelines.org/transfusion-handbook.

Appendix A

Blood Product Request Process



*Blood can be issued only after receiving the request form

Appendix B

Blood Sampling During a Major Haemorrhage

Contact the Blood Bank on 4087 or if out of hours (any time other than 09.00-17.30 Monday - Friday) bleep the on call BMS on 367 to check if there is a possibility that the laboratory might already have a valid sample from the patient. Use of such sample will save time.

Sample Validity and Timing of Sample Collection in Relation to Previous Transfusions

Routine Blood Bank cross-match samples are able to be kept / used for a period of 7days prior to the proposed transfusion date. Exceptions to this include patients who have had transfusions or a pregnancy within the last three months.

Patient Type	Sample validity
Patient transfused or pregnant in the last 3 month	72 hours *
Patient not transfused and not pregnant in the last 3 month	7 days*

*This is the time between the sample being taken and subsequent transfusion

A formal deviation from the 3 day rule may be considered for pregnant women with no clinically significant alloantibodies who require blood standing for potential obstetric emergencies (e.g. placenta previa).

Details required on blood samples for Blood Bank

Known Patient	**Unknown Patient**
Surname (in full) Forename (in full) Date of birth Patient Identification Number Gender Date and time of sample Signature of the person taking the sample *must be handwritten.	If the patient is unknown the following data must be included: Unknown Male or Unknown Female Patient Identification Number Date and time of sample Signature of the person taking the sample On confirmation of patient details inform Transfusion Laboratory and re-bleed the patient labelling the samples with: Surname (in full) Forename (in full)

	Date of birth Patient Identification Number Gender Date and time of sample Signature of the person taking the sample

Note:
Incorrectly labelled blood samples cannot be accepted by Blood Bank regardless of the urgency of the situation.
Patient Identification Number

- The B number is the preferred identification.
- A NHS number can be used if the B number is not available.
- If neither of these are available, the first line of the address can be used.

Ensure that the identifier used on the sample is the same identifier used on the request form.

Red Blood Cells Issued Based on Samples Provided

Samples provided	**Cross-matched blood** (note; cross-matching will take 45 minutes)	**Emergency situation - Blood Issued is the same or compatible ABO group as the patient**	**emergency situation – O -/+ blood issued**
0 samples			✓
1 historical			✓
1 valid sample (G&S or Cross-match)			✓
2 historical tests identifying ABO group		✓ (requires an order for blood components)	
1 historical 1 valid (G&S)	✓ (requires an order for blood components)		
1 historical & 1 valid Cross-match or blood request	✓		

Avoid the use of O RhD Neg where possible to preserve stocks for urgent transfusion.

Telephone Blood Product Request for Life Threatening Emergencies

When requesting blood components during life threatening emergencies, decide what blood you require and how quickly you need it. Blood Bank will need to know the following details so they can provide the correct product without any delay. The information below will be required prior to making the phone call. The request for the blood will come from the doctor, but the phone call (bleep out of hours) to Blood Bank can be made by member of staff.

Emergency Blood Bank Telephone #6980
(Routine Contact: office hours 4087. Bleep out of hours 367).

Your name	
Your designation	
The clinical situation	**E.g. Major haemorrhage.** **Be clear about conveying the urgency of the situation. Avoid the term "urgent" as multiple callers to blood bank state their request is urgent.**
Patients Hospital Number	
Patient First Name	
Patient Last Name	
Patients Date of Birth	
Patient Location	
Name of the doctor authorising the blood	
What blood is required	**E.g. 1 unit of red blood cells**
How quickly the blood is required	**E.g. The porter is on their way to you now.**
Contact name and number	**This will help blood bank to contact a member of the team in the event of any query**
Specific requests you may have	**E.g. When will the blood be ready? Please phone ext. 1234 when the blood is ready for collection.**

The Blood Bank BMS will enter the order for the blood on EPR against the given Doctors name. The requesting Doctor will enter the prescription for the blood on the relevant documentation when time allows.

Appendix D

A Guide to Blood Components used in Major Haemorrhage in Adults

Blood component	Volume per pack	Dosing regimes	Additional points
Red cells in additive solution	MPV: 282 ml +/- 32 ml	Order 4 units initially, see text for choice of group	Rate of administration guided by rate of blood loss and haemodynamic compromise, aiming to maintain oxygen delivery to tissues. At high rates, blood should be given through a warming device.
Fresh Frozen Plasma (from one donor)	FFP MPV: 273 ml +/- 17 ml	FFP: order 15-20 ml/kg in first instance.	Allow time for thawing – order in anticipation Use a blood-giving set with integral filter (170-200 µm).
Platelets. Apheresis from a single donor or pooled from 4 whole blood donations	Apheresis MPV: 215 ml +/- 53 ml. Pooled MPV: 310 ml +/- 33ml	Order 1 adult therapeutic dose, monitor platelet count and aim to maintain platelet count > 50 x 10^9/l	Anticipate need for platelets in on-going bleeding as platelet count falls below 100 x 10^9/l. Discuss with the Haematology Consultant.
Cryoprecipitate.	MPV: 152 ml +/- 12 ml.	Order 2 packs and aim to keep fibrinogen > 1.5 g/l. See text for further details	Allow time for thawing – order in anticipation.

Adapted from National Health Service Blood and Transfusion

RECOGNISE ADULT MAJOR HAEMORRHAGE (QHB)

RESUSCITATE

- Administer hi flow oxygen
- Resuscitate according to ABCD principles
- Establish large bore IV access
- Take baseline blood samples
- (FBC, G&S, COAGSC including Fibrinogen, U&E)
- Limit clear fluid resuscitation to that required to maintain tissue perfusion
- Keep the patient warm **(Use a fluid warmer)**
- Monitor and maintain serum ionised Calcium >1.0 mmol/l (give 10ml of 10% Calcium gluconate)

ALLOCATE ROLES

Send for senior help and establish:-

- Team leader
- Communication lead
- Runner / porter (Phone Switchboard on 3333. Ask for a radio message to the Porters' stating 'Porter required for major haemorrhage Porter to report to …. Department).

Summon appropriate expertise to control bleeding. Contact theatres or endoscopy suite and arrange transfer if appropriate. Alert Blood Bank.

If Trauma and < 3 hours from injury, give Tranexamic acid 1g bolus over 10 minutes, followed by an infusion of 1g over 8 hrs (Also consider Tranexamic acid in non-traumatic bleeding).

TEAM LEADER TO ESTABLISH WHICH BLOOD COMPONENTS ARE REQUIRED (See Major Haemorrhage policy)

- Generally 4 units of red cells and 4 units of FFP
- Contact the Consultant Haematologist (via switchboard) if platelets or PCC are required

To Activate Massive Haemorrhage dial 2222

For MOH: Switchboard 2222

(Blood Bank routine extension 4087. Out of hours bleep 367)

Provide the following information:-

S The urgency of the situation (e.g. Major haemorrhage)

B Your name and department, and the location of the patient
Give Patient's unit number, full name and date of birth

A What blood is required and how quickly
The name of the doctor authorising the request (usually this is the most senior doctor present)

R Extension number for Blood Bank to contact if query arises.

Blood bank staff will advise on sample requirements and the availability of blood in the required time frame, and the requirement for blood samples.

- 2 units of 'flying squad red cells are immediately available in the blood bank fridge (blood bank to be notified when this is used)
- O red calls are provided until blood group identified (O neg in females 50 and under).

COLLECT BLOOD

- Print the Patients ID on a local printer (**typed** name, DOB, B number required) and check against the patient's wrist band (In theatres use the designated form) and give this to the collector.
- Trust porter required? –Telephone 5400 and Print ID sheet to HAEM11 printer (next to the blood fridge)

UNTIL LAB RESULTS ARE AVAILABLE

- Give Red cells and FFP in a 1:1 ratio
- Consider Cryoprecipitate if fibrinogen result unavailable after replacement of 1-1.5 x total blood volume
- Platelet transfusion should be based on lab results

IF LAB RESULTS ARE AVAILABLE

IF	GIVE
Hb < Target (70-90 g/l)	Red Cells
PT and/or APTT ratio >1.5	FFP 15-20ml/kg
Fibrinogen <1.5 g/L	Cryoprecipitate 2 units
Platelets <50x10^9/L	Platelets 1 Adult Therapeutic Dose (order when <100 x109/L)