

MASSIVE TRANSFUSION PROTOCOL (MTP) - PAEDIATRIC PROCEDURE[®]

DOCUMENT SUMMARY/KEY POINTS

- Massive transfusion can be defined as the replacement (or the anticipation of replacement) ≥ 1 blood volumes within 24 hours or, 50% of blood volume within 4 hours, or, 10% of the blood volume over 10 minutes or, 40mL blood/kg.
- The Massive Transfusion Protocol outlines the process for rapidly activating provision of blood products from Blood Bank to support the care of patients with major haemorrhage, particularly in the phases before additional information and laboratory testing is available.
- This procedure may be activated by any medical or nurse clinician when massive blood loss in a child is occurring or anticipated. The on call paediatric Haematologist will be involved to aid clinicians in management.
- There is mandatory minimum data set required by Blood Bank on activation
- Blood bank will dispense both red cell and plasma products in a 1:1 ratio.
- Frequent monitoring of venous blood gas, Full Blood Count (FBC) coagulation studies, electrolytes and calcium are indicated.
- Consideration should be given to viscoelastic testing (eg Rotem, TEG) in the management of MTP
- Westmead staff should use the [CHW Massive Blood Transfusion table](#)
- Administration of all blood products must comply with **SCHN Practice Guideline [Transfusion of Blood and Blood Components](#)**

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

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|------------------------|---|---|
| Approved by: | Policy, Procedure and Guideline Committee | |
| Date Effective: | 1 st May 2022 | Review Period: 3 years |
| Team Leader: | Staff Specialist – SCH and CHW | Area/Dept: Emergency/Haematology |

CHANGE SUMMARY

- Review of literature.
- Updated Definition
- Principles of viscoelastic testing.
- Combined Flow Chart
- **11/5/23:** Minor review. The Sydney Children's Hospital Blood Bank number has changed from 29145 to 23232. See pages 5 and 9.

READ ACKNOWLEDGEMENT

- Appropriate staff working in acute care areas and Haematology staff are to read and acknowledge they understand the contents of this document.

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

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Purpose

This document describes the **activation and deactivation procedure** to provide blood components to patients requiring massive blood transfusion in a timely manner.

Definition

Massive transfusion is defined as the transfusion (or anticipation of transfusion) of

- one or more blood volumes within 24 hours, **OR**
- 50% of blood volume within 4 hours, **OR**
- 10% of the blood volume over 10 minutes, **OR**
- 40mL blood/kg.

Abbreviations

| | |
|-------|---------------------------------------|
| MTP | Massive Transfusion Protocol |
| PRBC | Packed red blood cells |
| FBC | Full blood count |
| Coags | Coagulation Screen |
| VBG | Venous blood gas |
| APTT | Activated partial thromboplastin time |
| PT | Prothrombin time |
| FFP | Fresh frozen Plasma |

Activating Massive Transfusion Protocol (MTP)

Medical or nursing staff may activate the MTP if:

- Any child requiring more than 20mL/kg of packed red blood cells (PRBC) in 2 hours and anticipated ongoing blood loss;
- OR**
- Any child requiring more than 40mL/kg of PRBC in a 24 hour period with ongoing blood loss;

Blood Bank may activate the MTP if:

1. > 2 units of PRBC issued within 1 hour for child < 5 years old, **OR**
2. > 4 units PRBC issued within 1 hour for child ≥ 5 years old, **OR**
3. The Blood Bank technician anticipates likelihood of additional component needs. In this situation, the Blood Bank technician contacts the Paediatric Haematologist to activate the protocol, **OR**

Note: An exception to the above criteria is planned cardiac bypass surgery. If blood loss or usage is greater than anticipated, the MTP may be initiated by the surgeon or anaesthetist.

The massive transfusion protocol is activated by notifying the Blood Bank technician on-call.

At CHW, Westmead: call ext. 52284 or pager 6832
At SCH, Randwick: call ext. 23232

The Blood Bank technician will then notify the on-call Paediatric Haematologist, who will liaise with the clinical team.

Code Crimson and Activation

- At CHW the MTP is automatically activated when a [“Code Crimson”](#) is activated by either Pre-Hospital or In-Hospital clinicians. (Refer to ACI [Trauma “Code Crimson” Pathway](#) 2017 for further information.)
 - At SCH discuss with relevant consultant or ED senior doctor re Code Crimson criteria and activation process

Details required by Blood Bank

When providing (verbal) information to Blood Bank, the following details are required:

- **Name and contact (phone/pager) of contact person.**
(It is best to identify one person who will co-ordinate with Blood Bank. e.g. anaesthetist in Operating Suite, surgeon or emergency physician in the Emergency Department.)
- **Name and medical record number of patient.**
- **Weight of patient.**
- **Location of patient and phone number of location.**
Note: Clinical team must notify Blood Bank if the patient location changes.
- **Initial blood results**
e.g. full blood count (FBC), coagulation screen (coags), venous blood gas (VBG), cross match.
- **Blood components transfused prior to arrival at hospital/activation of the Massive Transfusion protocol.**
- **Urgency of need for blood products**
e.g. immediate or over next 30 minutes. This will help determine what products will be despatched. Refer to [Time for Blood Product Availability table](#). Massive Transfusion Packs

Immediate Dispatch

The following “pack” will be despatched immediately upon activation of the MTP according to patient weight:

| Weight of Child | | | |
|--------------------------|-------------------------|-------------------------|-------------------------|
| < 15kg | 15 – 30kg | 30 – 50kg | > 50kg |
| 1 unit PRBC ⁺ | 2 unit PRBC | 3 unit PRBC | 4 unit PRBC |
| 1 unit FFP* | 2 unit FFP | 3 unit FFP | 4 unit FFP |
| 2 units cryoprecipitate | 4 units cryoprecipitate | 6 units cryoprecipitate | 8 units cryoprecipitate |

Specimen tubes for sample collection from patient after administration of products will be sent with each pack. Pathology form (with required tests pre-printed) will be included.

⁺ PRBC = Packed Red Blood Cells

* FFP = fresh frozen plasma

Second Dispatch

Upon request for a second lot of blood products, the following will be issued according to weight:

| Weight of Child | | | |
|-------------------------|-------------------------|-------------------------|-------------------------|
| < 15kg | 15 – 30kg | 30 – 50kg | > 50kg |
| 1 unit PRBC | 2 unit PRBC | 3 unit PRBC | 4 unit PRBC |
| 1 unit FFP | 2 unit FFP | 3 unit FFP | 4 unit FFP |
| 1 unit pooled platelets | 1 unit pooled platelets | 1 unit pooled platelets | 1 unit pooled platelets |

Specimen tubes for sample collection from patient after administration of products will be sent with each pack. Pathology form (with required tests pre-printed) will be included.

By this stage, the on-call paediatric Haematologist will be involved, and will direct further products in consultation with the clinical team

The principles of further replacement will be:

- 1:1 ratio of PRBC to FFP,
- Alternating platelets and cryoprecipitate, with adjustment according to laboratory results.
- Factor concentrates such as activated factor VII (“Novoseven”) or prothrombin complex concentrates (“Prothrombinex”) may be indicated, and this will be the decision of the on-call paediatric Haematologist in consultation with the clinical team

Evidence supporting the benefit of a MTP suggests that the key feature is the creation of clear pathways to rapidly deliver a balance of blood products for transfusion. There is some evidence at this stage that ratios of FFP:Red Cells close to 1:1 may be associated with a lower 24 hour mortality in paediatric patients. There is not adequate evidence to support a

specific ratio for platelets. Published research in the area does not address the question of the best ratio for cryoprecipitate usage.

Note: Administration of all blood products *must comply* with the local SCHN Practice Guideline [Transfusion of Blood and Blood Components](#)

Responsibilities

The following points outline the responsibilities throughout the activation of the massive transfusion protocol (MTP) for Blood Bank and the clinical service/team involved.

Blood Bank Service

- Prioritise testing and product distribution to patient.
- Despatch massive transfusion package to the appropriate location.
- Maintain communication with clinical team and ensure continuous availability of products. Commence thawing of next batch of frozen products immediately upon despatch of previous pack.
- Notifies and communicates with on-call paediatric Haematologist.

Clinical Service

- Ensure availability of runner to transport products rapidly to patient location.
- Informs Blood Bank as soon as possible if patient location changes.
- Deactivates MTP by notifying Blood Bank.

Time for Blood Product Availability

| Product | Time Until Despatch From Blood Bank |
|------------------------------------|---|
| O negative PRBC, Platelets | Immediate |
| ABO specific PRBC (uncrossmatched) | Up to 5 – 10 minutes (NB: dispatch is immediate if group has already been verified by Blood Bank) |
| Crossmatched PRBC | Up to 40 minutes (NB- if screen already processed and no antibodies are detected a crossmatch product will be available much sooner) |
| FFP | 20 – 30 minutes |
| Cryoprecipitate | 10 minutes |

Laboratory Criteria – target values

As a general guideline in massive transfusion, the following target values are reasonable to aim for:

| Test | Target value |
|--|--|
| Haemoglobin (Hb) | > 70 g/L |
| Platelets | > 50 x 10 ⁹ /L (or > 100 x 10 ⁹ /L if neurological injury) |
| Activated partial thromboplastin time (APTT) | < 40 seconds |
| Prothrombin time (PT) | < 20 seconds |
| Fibrinogen | > 1 g/L |
| Acidosis and hypothermia should also be vigorously corrected, as these exacerbate coagulopathy (refer to Ongoing Clinical and Laboratory Assessment). | |

Ongoing Clinical and Laboratory Assessment

The following points need to be actioned/considered:

- Strict compliance with identification, documentation and product administration is mandatory as per local [Transfusion of Blood and Blood Components](#) policy.
- Laboratory tests (FBC, coags) after administration of each “pack”.
- Additional crossmatch samples may be required. Clinical team will be notified by Blood Bank technician.
- Frequent monitoring of venous blood gas, electrolytes and calcium as indicated.
- Achieving patient normothermia is important. Warm all blood products being transfused until patient normothermia is achieved.
- Consider use of cell saver (available in Operating Suite) to scavenge blood or to wash blood products and also the rapid transfuser in children >30kgs. Inform theatre floor manager as early as possible if you require cell saver as the clinical perfusionists may need to be called in to set this up. Allow about 30 minutes for this to happen.

Deactivation of MTP

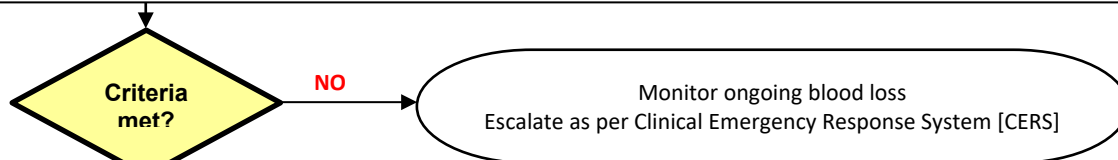
When deactivating the MTP the following will occur:

- The clinician in charge of the patient (or delegate) will notify Blood Bank of decreasing needs for products or termination of the massive transfusion protocol.
- Blood Bank technician will notify on-call paediatric Haematologist.

Flowchart – Paediatric Massive Transfusion Protocol

A medical or nurse clinician can activate the Massive Transfusion Protocol (MTP) if:

- Greater than 20mL/kg of packed red blood cells (PRBC) transfused in 2 hours and anticipated ongoing blood loss
- Greater than 40mL/kg of PRBC transfused in a 24 hour period with ongoing blood loss



Activate MTP by notifying the Blood Bank technician on call
CHW Westmead: ext 52284 or pager 6832
SCH Randwick: ext 23232

- Details required by Blood Bank:**
- Name and contact (phone/pager) of contact person
 - Name and medical record number of patient
 - Weight of patient
 - Location of patient and phone number of location
 - Urgency of need for blood products
 - Initial blood results if available.

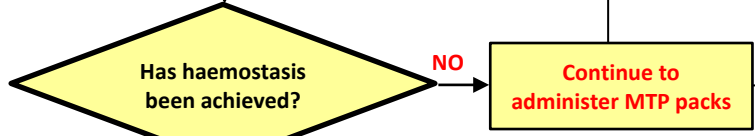
- Considerations:**
- Code Crimson**
 - CHW- Activate [Trauma Code Crimson](#) if criteria met
 - SCH- Discuss relevant consultant or ED Senior Doctor re Code Crimson criteria
 - Tranexamic acid (especially in trauma)**
 Dose of 15mg/kg by slow IV infusion over 10 – 15 min
 (dose range 10-20mg/kg, maximum dose 1g)

Blood Bank will prepare and dispatch the 1st massive transfusion pack containing PRBC, FFP and cryoprecipitate.

As soon as the 1st pack is dispatched, Blood Bank commences preparing the 2nd massive transfusion pack containing PRBC, FFP and platelets.

Ensure clinical focus on stopping blood loss is a priority
 Contact necessary subspecialty consultants directly
 Administer the massive transfusion pack.
 Collect blood samples and send to lab

Blood Bank continues to prepare and alternate packs 1 and 2 until the MTP is deactivated.



- Consider use of Viscoelastic testing**
 Consult Paediatric Haematologist for further advice & consideration of factor concentrates, including factor VIIa (Novoseven), as required
- Monitor:**
 FBC, coagulation, ionised calcium, ABG/VBG
- Aim For:**
- Plts >50 x 10⁹/L
 - PT/APTT <1.5 x normal
 - Fibrinogen >1 g/L
 - Ca >1.1 mmol/L
 - pH >7.2

MTP deactivated by contacting Blood Bank
CHW Westmead: ext 52284 or pager 6832
SCH Randwick: ext 23232

KEY POINTS

Clinical Service

- One clinician to maintain communication with blood bank technician to ensure continuous availability of products.
- Clinical team leader decides on order and rate of product delivery.
- Administration of all blood products must comply with the [SCHN Practice Guideline Transfusion of Blood and Blood Components- Paediatrics](#)

Blood Bank

- Notifies on-call paediatric haematologist when the MTP is activated. Commences thawing of next batch of frozen products immediately upon despatch of previous pack
- Continue to prepare and alternate packs 1 and 2 until the MTP is deactivated.

On-Call Haematologist

- The paediatric on-call haematologist will discuss the need for further products in consultation with the clinical team

Code Crimson- CHW

- Is activated when a patient with a potential acute life-threatening haemorrhage is requiring transfer to theatre for possible immediate life-saving surgery. It can be activated pre-hospital by Ambulance retrieval services or in CHW by the Surgical Registrar/Consultant and/or the ED Fellow/Consultant

Situation-Specific Considerations for the MTP

Tranexamic acid (Cyclokapron)

The use of intravenous tranexamic acid in trauma has been established for adult patients (CRASH-2 trial) and administration is likely to be beneficial in children as well:

- Tranexamic acid at a dose of 15 mg/kg (dose range 10-20 mg/kg; max 1g) by slow intravenous infusion over 10-15 minutes; up to the first 3 hours after trauma.
- Follow up doses can be given at the decision of the treating team and can be as IV boluses or continuous infusion
- Precautions:
 - Avoid rapid infusion or push injection as it may cause hypotension.
 - Tranexamic acid should be used with caution in patients with haematuria, renal haemorrhage and bleeding into other bodies cavities (e.g. pleural space, joints) as inhibition of fibrinolysis may result in retention of blood clots in those spaces.
 - Dose/interval adjustments for subsequent doses are required in renal impairment
 - Do not use in conjunction with factor IX complex concentrates

Viscoelastic Testing

The general MTP is designed to facilitate the process of transfusion of an appropriate balance of blood products rapidly, with appropriate reminders to address potential contributors to coagulopathy supported by the availability of traditional testing methodologies. It adapts well to most clinical settings where major haemorrhage may occur.

Viscoelastic Testing (e.g Rotational Thromboelastometry or Thromboelastography) may have a role in supporting clinical decision-making during the management of major haemorrhage. There are some facilities utilising this option routinely with guidelines and treatment algorithms in place. There is some evidence that incorporating Viscoelastic Testing into transfusion management may result in an overall reduction in transfusion. There may also be differences in the blood products chosen for transfusion. The understanding of how best to incorporate this form of point-of-care testing into paediatric patient care is rapidly changing.

In some clinical scenarios and on a site-specific basis, clinicians who have viscoelastic testing available to them may choose to utilise their expertise to incorporate this in their decision-making during a massive transfusion situation. The following broad principles are important to follow when incorporating viscoelastic testing into decision-making:

- Where available, a documented policy detailing a TEG/ROTEM-guided approach to transfusion should be utilised such as:
 - Practice Guideline SCH: [ROTEM use- SCH](#)
- Results from viscoelastic testing must be interpreted with appropriate consideration of the particular scenario and clinical assessment of the patient.

- Use of viscoelastic testing should still be accompanied by ongoing measurement of FBC, coags, ionised calcium and pH.
- The clinician utilising viscoelastic testing must have appropriate experience and expertise with the methodology available to them.
- Use of viscoelastic testing does not alter the importance of ongoing liaison with the Blood Bank and the On-Call Haematologist. As the use of viscoelastic testing may lead to significantly different product ratios compared to the usual MTP, actively discussing this with Blood Bank will assist them as they support the clinical team.
- Documentation of results of TEG/ROTEM and the transfusion decision made as a result of that result is optimal.

Context Specific Guidelines in Major Haemorrhage

The MTP is suitable to guide transfusion management in major haemorrhage in most situations. In some unique settings specific guidelines are available to support the work of clinical teams and the blood bank and should be used as an alternate option. An example of this scenario is the Cardiac Bleeding Protocol utilised by CHW PICU.

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