National Blood Transfusion Committee

Emergency Preparedness, Resilience and Response Guidance for Hospital Transfusion Teams in England (2026)

Fateha Chowdhury[1,2], Julie Staves[3] and Serious Hazards of Transfusion (SHOT)[4]

on behalf of the National Blood Transfusion Committee Emergency Planning Working Group

Affiliations

[1]NHS Blood and Transplant – London

[2]Imperial College Healthcare NHS Trusts

[3]Oxford University Hospitals NHS Foundation Trust

[4]SHOT Team (https://www.shotuk.org)

National Blood Transfusion Committee

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EXECUTIVE SUMMARY

Objectives. To present an updated Emergency Preparedness, Resilience and Response (EPRR) guidance for Hospital Transfusion Teams on behalf of the National Blood Transfusion Committee Emergency Planning Working Group.

Background. The NHS Emergency Preparedness, Resilience and Response (EPRR) Framework provides the framework and principles needed to help all NHS funded healthcare organisations to incorporate the requirements of the Civil Contingencies Act 2004, the NHS Act 2006, the Health and Care Act 2022 and the NHS Standard Contract to demonstrate that they can deal with Major Incidents (MI) while maintaining critical services. The Covid 19 pandemic, cyberattack events and increasing number of major incidents, mass casualty events (MCE) have highlighted the evolving role of the Hospital Transfusion Team and the importance of transfusion-based resuscitation.

Methods. This multi-disciplinary advice is informed by recent national and global experience, the 2026 NHS England clinical guidelines for Major Incidents, and stakeholder workshops and lessons learnt from the Covid 19 pandemic, and the London/Southeast Cyberattack in 2024.

Guidance. Transfusion staff (clinical and laboratory) should be familiar with local Business Continuity and Incident Response Plans including command structure, casualty numbers and type their organisation may receive. Transfusion staff should undertake regular exercises together with and as part of wider Trust preparation, with documented roles and responsibilities.
In MI and MCE, transfusion support should be proactive and include blood component issues, sample handling, and ensuring regulatory compliance including traceability. Robust Laboratory Information Management System (LIMS) compatible with emergency identification systems are essential to minimise errors. Emergency stock management requires rapid assessment of existing universal stock and estimated demand before re-ordering. Initial demand for MI and MCE should be based on 3 RBC per Priority 1 casualty

admitted. Casualties with significant haemorrhage may require further red cells and early haemostatic support. Where 'universal' components are demanded, they should be gender and age appropriate. Key senior staff (i.e., Consultant Haematologist) or Pathology Service Manager with appropriate transfusion knowledge and skills should

- lead the response
- log and communicate key decisions
- lead the debrief (hot and cold) - focus on important areas of concern (including security and safeguarding) and staff well-being
- prepare for post-incident recovery

For business continuity incidents due to IT failure, power outage and cyberattack events, the Emergency Blood Management Arrangements (EBMA) and Emergency Blood Management Group (EBMG) should be activated if resumption of normal services is expected to be delayed beyond agreed contingency measures or time periods. In extreme situations, if support is needed from NHS Blood and Transplant (NHSBT), this should be escalated via NHS England as early as possible. **NHSBT does not have the capacity to provide routine crossmatching services without a pre-agreed Service Level Agreement (SLA).**

Conclusions. Transfusion teams have a vital role in ensuring continuity of transfusion support. Teams should develop their Business Continuity and Incident Response Plans based on local Hospital / Trust plans and national guidance. Emergency preparedness should include post-incident debriefing for ongoing staff support and future service improvement.

BACKGROUND

The NHS EPRR Framework [1], gives overarching guidance to the NHS in relation to incidents. It incorporates the requirements of the Civil Contingencies Act 2004 [2], the NHS Act 2006 [3], the Health and Care Act 2022 [4] and the NHS Standard Contract. [5] Providers of NHS funded care should be able to demonstrate that they can deal with major incidents while maintaining critical services. The healthcare community refers to this national program of work as Emergency Preparedness, Resilience and Response (EPRR)[6]. The programme is overseen locally by the NHS England regional EPRR teams and informs transfusion preparedness.

The National Blood Transfusion Committee (NBTC) Emergency Planning Working Group (EPWG) was convened in 2005 as a short-lived working group with representation from Hospital Transfusion Laboratories, Emergency Departments (ED), and NHS Blood and Transplant (NHSBT). The objective was to review the lessons identified following the July 7th London Bombings in 2005 [7-9], and to provide guidance to meet potential surge in demand for blood components and to optimise Hospital Transfusion Laboratory support following a Mass Casualty Event (MCE). In 2017, several major incidents (MI) in the UK [10, 11] and global events highlighted the need to revisit national transfusion emergency preparedness. [12] Subsequently, the group was reconvened later that year. Since then, more incidents have occurred, some affecting children (Wimbledon school and M53 school bus crash in 2023 and Southport stabbings in 2024) highlighting that children should not be overlooked in major incident planning also reported by Jenner and Piscitelli. [13] These incidents pose a range of challenging clinical scenarios, from blast injury, crush, and penetrating injury, unlike those seen in day-to-day practice. These experiences show the importance of earlier use of blood components in trauma resuscitation and the need to develop robust systems for sharing best practices beyond pre-hospital care. [14]

The first clinical guidelines for use in MI and MCE were developed by NHS England in 2018; the latest version is due to be published this year. [15] As part of the review of major incident

triage by NHS England Emergency Preparedness, Resilience and Response (EPRR) Clinical Reference Group (CRG), two new triage tools have been developed since this guidance was last updated: the NHS Major Incident Triage Tool (MITT),[16] and the Ten Second Triage Tool (TST) (figure 1). The latter facilitates simple priority labelling of the casualties to allow appropriate communication and resource allocation to flow to further responders. Both tools have undergone extensive field testing.

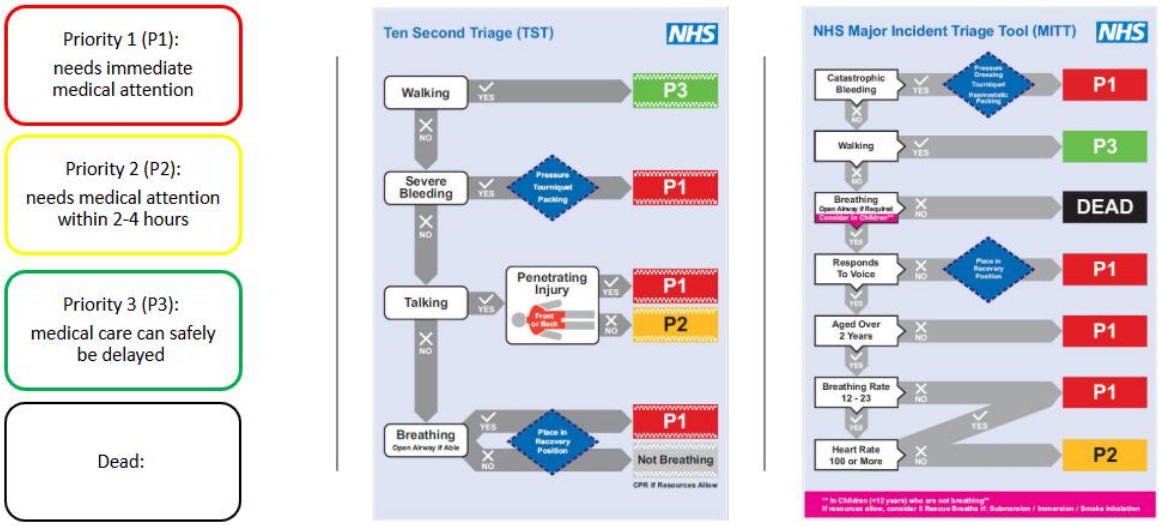
The primary purpose of this document is to provide revised guidance for Hospital Transfusion Teams to prepare for, and respond to not just conventional major incidents and MCEs but also to emergencies such as wide-scale disruption of computer services such as that seen in the London / Southeast cyberattack in 2024, [17] increasingly adverse weather [18] due to climate change causing IT failure or power outage, and the lessons learnt from the Covid 19 pandemic.[19-22] Cheim et al's systemic review[23] and meta-analysis of the impact of the Covid 19 pandemic on the transfusion services worldwide showed reduction in donations during and post pandemic with shortages across many countries. The increasing challenges seen in the blood supply chain make this an important consideration when preparing guidance for emergency planning. [19] All of these have the potential to significantly disrupt the provision of transfusion support. These events have necessitated a broadening of the scope of this document.

The development of effective contingency plans for planned and unplanned IT downtimes are crucial as the transfusion service is dependent on numerous IT systems within the laboratory i.e., laboratory information management systems (LIMS), electronic temperature monitoring systems of fridges, freezers and platelet incubators (ETM), electronic blood management systems (EBMS), online blood ordering systems (OBOS), procurement systems, quality management systems and the interface with wider NHS IT systems such as electronic patient record systems (EPR).[24] The expansion of pathology networks where multiple hospitals share the same LIMs places additional risks on data integrity, and system loss can lead to widespread delays in patient care and can impact the blood supply chain as seen in the

cyberattack on the London and Southeast Pathology Network SYNNOVIS in 2024. [17]

Figure 1: New Triage Tools

The Ten Second Triage Tool (TST) and Major Incident Triage Tool (MITT) can be used by all NHS responders to Major Incidents involving adults and paediatric patients. They allow for rapid, reliable, and reproducible triage. Priority 1 casualties are most likely to need transfusion support, and as such should be prioritised to have samples taken for blood grouping. Reproduced with permission from NHS England.



METHODOLOGY

Working Group and Writing Process

The multi-disciplinary working group was selected to represent the wider transfusion community together with academics and key users with recent experience of major incidents and cyberattacks. The final guidance format was based on the framework of an existing hospital-based plan and further developed using feedback from recent experiences of Hospital Transfusion Teams, Pathology providers, Regional Transfusion Committees' study days, Serious Hazards of Transfusion (SHOT) and NHS England. The guidance is designed to provide the foundation for local policy and practice.

Review of the Manuscript

The review of the manuscript was performed by members of the National Blood Transfusion Committee (NBTC), Haematology & Trauma group, Emergency Planning Working Group, EPRR Clinical Reference Group, and SHOT. The NBTC is accountable to the National Medical Director of NHS England through the Chief Scientific Officer. Membership includes Royal Colleges, specialist societies and other professional organisations, Chairs of the Regional Transfusion Committees and patient representatives, and colleagues affected by the SYNNOVIS cyberattack in 2024. It has also been reviewed by various groups within NHSBT, including the Business Continuity Team and representatives of the other UK Blood Transfusion Services. These organisations have commented on but do not necessarily approve or endorse the contents.

DEFINITIONS

Each healthcare organisation should have plans in place for Major Incidents, Mass Casualty Incidents, Critical Incidents and Business Continuity Incidents. Definitions for each may vary but the following definitions may be useful:

Major Incident (MI):

An event or situation with a range of serious consequences that require special arrangements to be implemented by one or more emergency responder agency. “Emergency responder agency” includes any category 1 and category 2 responder as defined in the Civil Contingency Act 2004 [(2)] and associated guidance. Any occurrence that presents a serious threat to the health of the community, disruption to service, or causes (or is likely to cause) such numbers or types of casualties as to require special arrangements to be implemented.

Mass Casualty Incident / Event (MCI / MCE)

NHS England defines an MCI for the health services as an incident (or series of incidents)

causing casualties, on a scale that is beyond the normal resources of the emergency and healthcare services ability to manage.

Business Continuity Incident

An event or occurrence that disrupts or might disrupt normal service delivery to below acceptable predefined levels, requiring special arrangements to be implemented until services can return to an acceptable level. Examples include IT failure, power outage, adverse weather, [25, 26] cyber-security breaches, and loss of key buildings.

The decision to activate any pre-prepared incident plan should follow a decision-making framework. The triggers for activation and escalation will depend on the nature of the incident and the capability and capacity of the healthcare organisation. Established emergency plans, clear leadership, and the support of a flexible workforce are key to rapid recovery.[27]

1. EMERGENCY PREPAREDNESS - MAJOR INCIDENT / MASS CASUALTY EVENTS

1.1 Hospital Trusts must include the Pathology Department and the Hospital Transfusion Team in Major Incident planning. The role of the Transfusion Team is to provide transfusion support throughout the incident to optimise patient care and make the best use of resources.

1.2 NHSBT is responsible for ensuring the supply of critical biological products, including managing the controllable elements of disruption to maintain business continuity i.e., of transfusion support, together with related clinical services. NHSBT acts as a Category 1 responder with authority to enable blue-light vehicles to make emergency deliveries. See resilience and mutual aid sections.

1.3 The Ambulance Service is the lead for the delivery of pre-hospital healthcare. It is unlikely that blood will be used ‘on the scene’ during large scale incidents, where the

priority is rapid triage and transport of casualties. However, Ambulance Services should have arrangements with pre-selected Transfusion Laboratories for the provision of blood to scene in MCEs.

1.4 Recent events have demonstrated the value of proactively asking haematology /transfusion/pathology staff to move 'forward' into the emergency care pathway during a Major Incident,[28] especially where there are large numbers of casualties. Staff are best placed where most transfusion samples are being collected, and transfusion is undertaken; examples include the ED, resuscitation areas, and operating theatres.

1.5 Members of the extended transfusion team may be used to assist in a range of supporting activities, including transfusion triage; emergency issues of blood, the handling of blood samples, and communication with the laboratory. The use of staff will primarily be dependent on staffing levels and trust configuration together with individuals' background and experience. All staff should be appropriately trained, competent, and rehearsed for their role.

1.6 Hospital transfusion laboratories may consider moving blood component stock to key clinical areas (i.e., ED / theatres) for use in an MI. Where blood is moved, secure systems should be in place for blood selection, maintaining the cold chain, and traceability of records at all stages.

1.7 Each ward and department should hold their own action cards, ensuring that they are held centrally, with only the latest version being readily available, giving key instructions on what is expected of staff during an MI. The Consultant with responsibility for transfusion and the Transfusion Laboratory Manager are responsible for maintaining their own departmental major incident action cards. All staff members are responsible for knowing the location of their MI action card. Staff should be regularly trained to the content relating to their role in a major incident.[29]

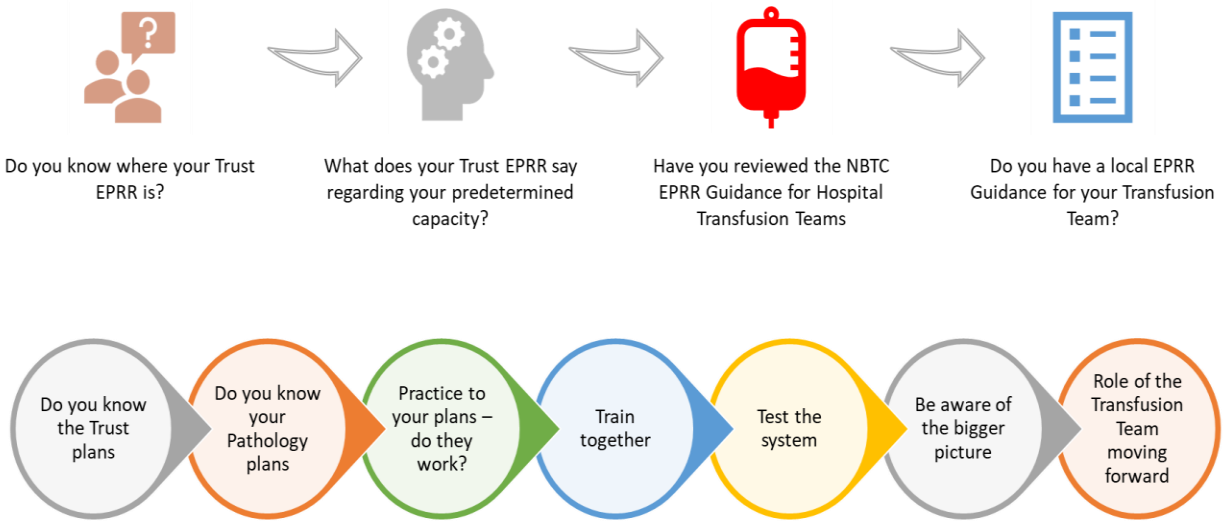
1.8 Hospital Transfusion Laboratories should be aware of their Trust's pre-determined casualty plan in the context of MCE. The casualty regulation and capability charts can be found within the NHS England Regional Incident Response plan.[30] The anticipated casualty numbers within the plan should be used to determine blood stock and consumable holdings, stock redistribution, and replenishment.

1.9 All hospital departments should be aware of their Major Incident, Mass Casualty plans and be trained and exercised together. The Transfusion Team should be notified of appropriate local training events and exercises by their Trusts. Additional training may be available from a range of sources including NHS England and NHSBT.

1.10 All hospitals should have major haemorrhage protocols (MHP) for adults and children. All clinical, and non-clinical staff (i.e., porters) and transfusion laboratory staff should be familiar with activation and blood component support in massive haemorrhage situations, [31-33]and be appropriately trained for MCE,[29] where possible through simulation-based training programs.[34] Figure 2 shows the summaries of the key steps in preparing for a major incident or an MCE.

Figure 2: EPRR for Transfusion Teams

Reviewing the Hospital documents for MI/MCE/EPRR will aid in the preparation of transfusion documents and response. Depending on local facilities and specialism, the local Emergency Planning team will have determined the number of casualties that can be accommodated in the first hour / 24 hours (pre-determined capacity).



2. INCIDENT NOTIFICATION AND COMMUNICATION

2.1 Incidents may be notified from internal or external sources. The traditional method for response activation is the Ambulance Service notifying ED via a designated hotline or switchboard; ED will then activate the Major Incident or Mass Casualty plan. The activation of emergency plans may activate security measures including controlling access and exit from the site, resulting in a 'Lockdown.' Trust identification badges MUST be worn by all staff attending hospitals in 'Lockdown' to gain timely access. Consideration should be given to the additional identification of transfusion/haematology staff, such as the use of tabards, when deployed to incident management areas. NHSBT drivers should be informed if changes to access and exit are in force, and ensure directions and access are given accordingly.

2.2 The initial internal communication cascade or call-out list must include the Transfusion Laboratory at all stages of the communication process from standby to stand-

down. Transfusion laboratories must have internal processes outlined to further cascade information to staff.

2.3 Hospital Transfusion Laboratories are currently advised to inform the Hospital Services department of the local NHSBT centre/stock holding unit once the hospital has been notified of a major incident using clear instructions such as "*my hospital is on standby or has been stood up for a Major Incident / Mass Casualty Event, please notify your Local Critical Incident Manage*r" when requesting additional blood components. This will initiate NHSBT's Critical Incident Plan to enable rapid movement of stock locally, regionally, or nationally depending on demand. Hospitals must inform NHSBT stock holding unit once advised to stand down from the incident.

2.4 Telephone communications may fail or be unreliable during a Major Incident. Trusts should have protocols for alternative means of internal and external communication if traditional or digital telecommunication technology fails. Methods include the use of runners, walkie-talkies, air wave radios, text messaging, WhatsApp, and other digital applications.

2.5 External communications are normally the responsibility of each Trust's strategic command. However, Hospital Transfusion Laboratories MUST be permitted to maintain ongoing communication with NHSBT.

2.6 Press enquiries should be referred to the Trust's Press Liaison Officer. The public (existing, lapsed or new donors) should be discouraged from contacting or attending hospitals or blood centres to attempt to donate blood during the major incident but encouraged to book appointments on the blood donation website (www.blood.co.uk) in the coming days and weeks. This will support in replenishing and preserving the continuity of the blood supply chain. All communications for potential blood donors should be led by NHSBT.

3. EMERGENCY RESPONSE TO MAJOR INCIDENT / MASS CASUALTY EVENT

Hospital Transfusion Laboratory Response on Notification

3.1 A senior member of the Hospital Transfusion Laboratory (i.e., Consultant Haematologist, Pathology/Haematology Manager or BMS lead for Transfusion) should assume responsibility for transfusion services and assess the required response (see section 9.4). A log should be started to record key decisions and handovers of senior staff and shifts. The following key areas should be considered:

3.1.1 *Staffing:* An initial assessment of current laboratory staffing should be undertaken along with determining the need for additional personnel during the incident and subsequent shifts / days. Other transfusion staff should be redeployed according to departmental plans. Off-duty staff should not report for duty until advised to do so. It is important to prevent over-committing staff in the initial phase, as additional resources may be needed in later phases depending on the duration of the incident. Staff reporting for work should use the pre-determined hospital check-in points according to Trust plans.

3.1.2 *Blood Stock & Critical Consumables:* Immediate assessment of stock levels of blood components (especially universal components) and products (e.g., Prothrombin Complex Concentrate (PCC), Human Albumin (HAS), clotting factors i.e., Fibrinogen Concentrate) within the laboratory and in remote fridges, i.e., ED, theatres and satellite fridges should be undertaken. It is also important to assess the availability of other critical consumables, including reagents and transport containers. Stock levels should be at sufficient levels to maintain business continuity during and after the event. The total available internal blood stocks should be quickly determined before arranging additional supplies from NHSBT.

The priority component required is expected to be Group O red cells. It is assumed that approximately 3 units are required per patient admitted with trauma.[35] The initial blood order should take into consideration the hospital admissions expected (or predetermined

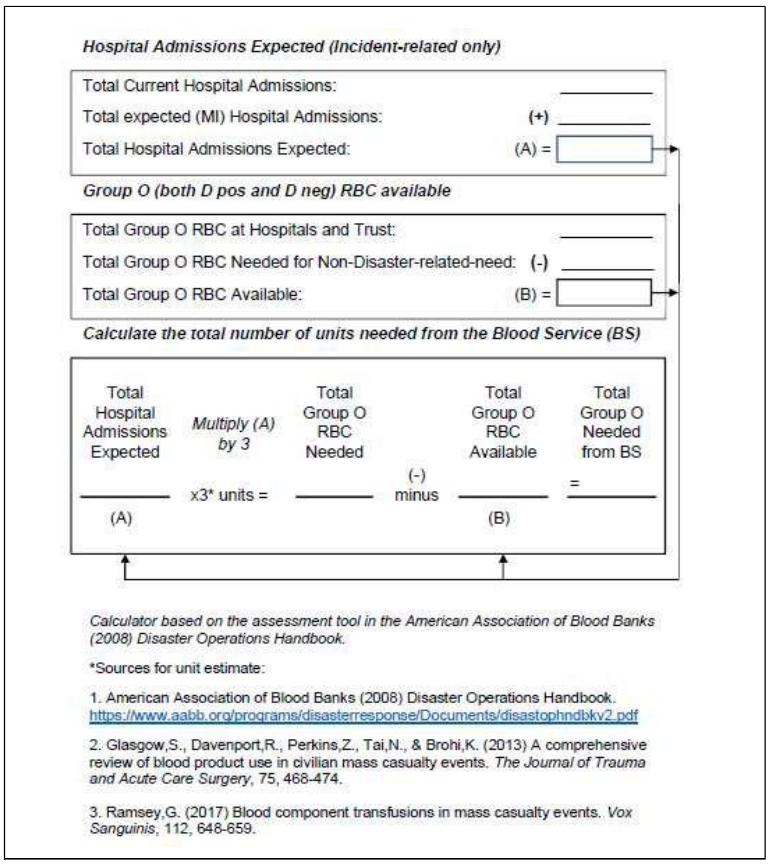
capacity if the numbers expected are unknown), the total stock of group O already held, and the group O needed for non-disaster-related patients. Where possible, conserve the use of universal stock in non-urgent/emergency situations. An example of a calculator to estimate the requirement is shown in Figure 3.

3.2 *Stock movement:* Trusts should initiate the movement and discharge of patients to create capacity for the reception of casualties from the incident to ED, theatres, and critical care areas. Routine surgery and day unit patient activity may be suspended. Blood already issued may no longer be immediately required for those cases. Consideration should be undertaken to de-reserve and re-centralise blood to the Transfusion Laboratory before re-issuing to emergency receiving areas to meet the potential surge in demand (figure 9). Clinical teams need to provide clear communication and updates to Transfusion Teams regarding changes to patient requirements.

3.3 *Plasma:* It is assumed that Trusts will hold enough frozen blood components to meet planned admissions for the first hour. Plasma may be pre-thawed and stored for 5 days for use in non-traumatic haemorrhage, however cryoprecipitate is rarely routinely pre-thawed. Hospitals who do not routinely use pre-thawed plasma may wish to have procedures and training in place to enable staff to pre-thaw plasma in preparation for urgent issues. The cold chain must be maintained throughout, and evidence be kept of this.

Figure 3: A calculator to estimate the initial blood required following a Major Incident.

The calculator serves as a guide and should be subject to local adjustments.[36]



Hospital Admissions Expected (Incident-related only)

Total Current Hospital Admissions: _____

Total expected (MI) Hospital Admissions: (+) _____

Total Hospital Admissions Expected: (A) = [ ]

Group O (both D pos and D neg) RBC available

Total Group O RBC at Hospitals and Trust: _____

Total Group O RBC Needed for Non-Disaster-related-need: (-) _____

Total Group O RBC Available: (B) = [ ]

Calculate the total number of units needed from the Blood Service (BS)

Total Hospital Admissions Expected	*Multiply (A) by 3*	Total Group O RBC Needed		Total Group O RBC Available	Total Group O Needed from BS
_____ (A)	x3* units =	_____	(-) minus	_____ (B)	= _____

Calculator based on the assessment tool in the American Association of Blood Banks (2008) Disaster Operations Handbook.

*Sources for unit estimate:

1. American Association of Blood Banks (2008) Disaster Operations Handbook. https://www.aabb.org/programs/disasterresponse/Documents/disastophndbkv2.pdf

2. Glasgow,S., Davenport,R., Perkins,Z., Tai,N., & Brohi,K. (2013) A comprehensive review of blood product use in civilian mass casualty events. *The Journal of Trauma and Acute Care Surgery*, 75, 468-474.

3. Ramsey,G. (2017) Blood component transfusions in mass casualty events. *Vox Sanguinis*, 112, 648-659.

3.4 *Platelets:* Early consideration should be given to the demand and storage of platelets, especially if Trusts are located some distance from their NHSBT stock-holding unit and do not routinely stock platelets. However, the literature suggests that platelets are rarely routinely required in MCEs, except for the most severely injured patients.[10, 35, 36]

3.5 *Pre-hospital transfusion:* In the context of major incidents, Transfusion Laboratories should anticipate the requirement for pre-hospital transfusion and the implications for blood stock management. Presently only trained staff in Pre-Hospital Emergency Medical teams can transfuse in the pre-hospital setting.

3.6 NHSBT will respond to hospital orders from its national pre-donated blood stock.

Current planning anticipates that several hospitals may order blood from the same stock holding unit/blood centre following an incident. It is assumed that most blood will be ordered as universal components and used within the first six hours. However, some patients may have an ongoing demand for blood, especially where repeat surgery may be necessary. [11, 37]

3.7 *Documentation.* Major incidents may be caused by criminal acts and are likely to be subject to subsequent investigations. All key decisions should be clearly documented, accurately, timely, and must be preserved (electronic and paperwork) dated and signed. It is recommended that laboratories keep an up-to-date signature list. White boards should be photographed before cleaning. No material or details should be shared with unauthorised individuals.

The Hospital Response to a Major Incident / Mass Casualty Event

3.8 Each hospital on activation should initiate their local command and control arrangements (figure 4), including a central control room, to manage the overall response to the incident. JESIP (Joint Emergency Services Interoperability Principles) highlights how UK emergency services (ambulance, police, and fire) work together at major or complex incidents with the primary aim of reducing harm, saving lives through better joint working using the five core principles outlined in figure 5; Co-locate, Communicate, Co-ordinate, Jointly Understand Risk and Shared Situational Awareness.

3.9 The initial information available may be incomplete, but situational understanding should evolve over time. The Joint Doctrine Edition 3.1 [38] sets out what response staff and those that support them should do and how they should do it in a multi-agency working environment (figure 5 and 6).

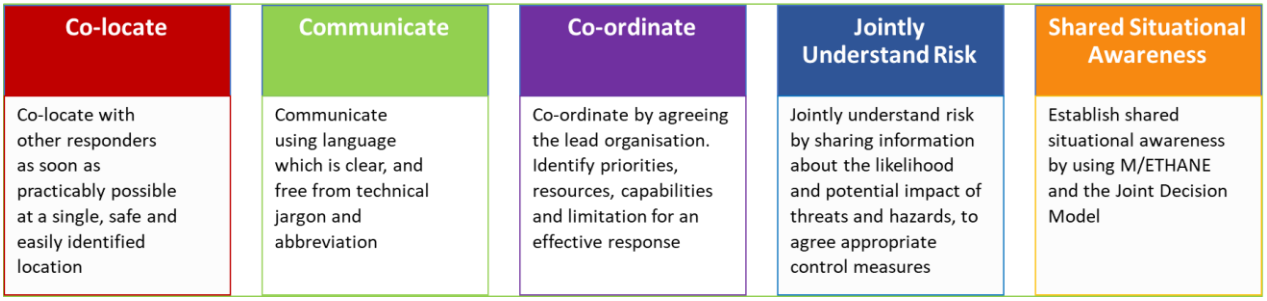
Figure 4: Command Structure

This generic command structure based on the *Strategic, Tactical and Operational* hierarchy is nationally recognised, accepted and used by emergency services. It can be applied to the resolution of both spontaneous incidents and planned operations.

3.10 In most Trusts, all major incident patients will be received directly by the ED. Patients should be assessed, if needed re-triaged and treated as necessary by the ED staff supported by 'surgical triage.' Patients requiring admission are commonly sent to Surgical Emergency Units or '*Receiving Ward*' where on-going assessment and treatment are undertaken. In major incidents affecting paediatric cases only, children requiring admission from the incident should be sent to a children's ward or designated receiving area. In MCEs keeping patients admitted from the incident in one ward (unless needing high dependency or critical care), staffed by a dedicated team enables additional (including specialty) resources to be focused in one place. [39] This can improve patient monitoring and reduce missed injuries or complications through consistent care and repeated evaluations.[9] This makes tracking patients easier, allows families to stay together, and has proven to aid patients' psychological recovery. [37] Depending on their injuries, some patients may need to be sent directly to theatres, High Dependency Units, or Intensive Care Units (ICU).

Figure 5: Principles of Joint Working

The principles of joint working support the development of a multi-agency response, helping to provide a structured response which is especially important in the early stages of any incident when clear, decisive, robust decisions and actions are needed often in a rapidly changing environment. The principles can be applied during any phase of an incident, including the recovery phase. The diagram below illustrates an indicative sequence; however, these can be applied in different orders depending on the situation.



Taken from Home - JESIP Website

Figure 6: Incident Communication / Declaration – The M/ETHANE Method

This is an established reporting framework which provides a common structure for responders and their control rooms to share incident information. It is recommended that this format is used for all incidents and be updated as the incident develops. For incidents falling below, the major incident threshold M/ETHANE becomes an 'ETHANE' message.

Taken from M/ETHANE - JESIP Website

3.11 All patients seen in ED related to the incident should be documented. Staff in reception areas are responsible for recording the demographic details as incident patients

arrive in ED. Most Trusts will set up a temporary reception desk. A pre-numbered casualty card should be issued to each incident patient, together with bar coded identification bands and pre-printed labels for samples.

3.12 Guidelines for identifying 'unknown' patients in emergency and mass casualty situations recommend ***non-sequential*** unique patient identifiers and gender as a minimum requirement. This is particularly important if several unknown patients are admitted together. All samples, whether from known or unknown patients, MUST also include the date and time of sampling and signature of the person taking that sample. [40]

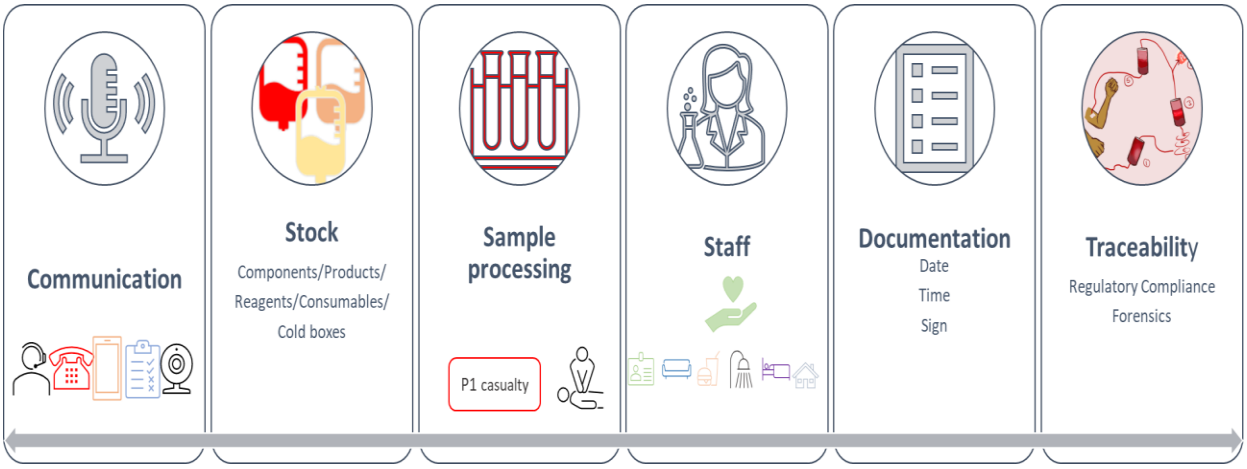
3.13 The patient administration system (PAS), or manual equivalent, must be used to document all patient attendances, clearly noting that they are part of a major incident. However, not all patients attending ED will be admitted. Defer changing from 'Major Incident' identifiers' to 'Routine' identifiers, until after emergency surgery has taken place and the patient is stable in a ward or critical care setting.

3.14 Patient identification following a mass casualty incident is difficult, with paediatric casualties posing a significant challenge. [37] In the event the patient demographics is available before the patient is clinically stable, ensuring the major incident identifier remains on the patient until two independent transfusion samples can be taken with the patient's demographics will prevent delays in transfusion support (see section 4.7).

3.15 Transfusion laboratory priorities are shown in figure 7.

Figure 7: Blood Transfusion Priorities

A summary of the key priorities is shown in the diagram. Alternative modalities of communication should be planned for in case usual routes are unavailable. Undertake a quick internal stock inventory of available universal components, products, consumables, reagents and cold boxes to determine if sufficient according to predetermined capacity before requesting further stock from NHSBT. Expect to receive samples from Priority 1 casualties; these should be processed urgently. Obtaining a confirmatory sample will enable moving to group specific components, thereby reducing pressure on universal stock. Depending on time of incident declaration, additional staff may need to be called in the early phase. This should be considered in relation to expected workload and staffing needs over subsequent shifts / days and recovery phase. Measures to ensure staff well-being (physical and mental) should be planned for. All documents should be dated, time stamped, and signed as these may need to be reviewed after the incident. Stock should be released securely, maintaining the cold chain to clinical areas and measures taken to ensure all components are traceable.



4. TRANSFUSION SAFETY AND COMPONENT SELECTION

Patient Identification and Blood Samples

4.1 The biggest transfusion risk in the context of major incidents is the accidental transfusion of ABO(D) incompatible blood due to misidentification (see section 3.11, 3.12). The 2018 Patient Safety Alert has provided further guidance for temporary identification to accommodate hospital transfers which covers names, temporary numbers, and options

for indicating age.[24] Transfusion teams should discuss this alert and have local clinical agreements in place that are compatible with their Laboratory LIMS.

4.2 Baseline blood samples for pre-transfusion testing should be obtained before administration of any blood components. A second confirmatory sample for transfusion should be taken as soon as possible and labelled independently from the first sample to confidently determine the patient's ABO and D group. [40] If an electronic process for collecting blood samples is available, this should be used to avoid the need for a second sample.

4.3 The use of group-specific blood is normally recommended once the patient's blood group has been confirmed. There are advantages both to the individual patient, the wider population, and blood supply chain if the patient can be safely transfused with group-specific blood components. However, it is recognised that in some chaotic situations this may not be possible, and the initial use of group O blood may be the safest option.

4.4 The (assumed or confirmed) gender of the patient should be included on both the blood sample bottles and request forms/orders to optimise blood group selection. Individuals of child-bearing potential are at risk of developing atypical antibodies following blood transfusions which may harm future pregnancies. These patients therefore should receive D negative and K negative red cells. [17] Standard operating procedures (SOP) should have guidance for situations where insufficient O negative, K negative red cells are available to make sure concessionary release of non-compliant red cells is possible. [41] It is acceptable to use D positive red cells for all unknown patients who do not have childbearing potential. See section 4.16.

4.5 Pathology disciplines should default to the female gender in the event of an unidentified casualty where the gender has not been specified.

4.6 Requests (either electronic or paper forms) should include treatment priority, age or

estimated age and special requirements if known. Distinguishing children from adults enables age-related criteria to be applied to component selection. [32] In addition, the treatment priority may influence the timely selection of component substitutions (see section 4.15 on selection and issue of components) or alternatives to transfusion (section 4.11-12). Additional details associated with the request for transfusion testing should include any recent transfusion, including pre-hospital transfusion and blood use in other treatment facilities.

4.7 There should be clear guidelines regarding the change from the Major Incident identifier to the routine hospital identifier, particularly in relation to transfusion samples. In most Trusts, this change takes place after the immediate resuscitation and surgical phase, i.e., once the patient is clinically stable in ICU or ward setting. A new 'group and save' transfusion blood sample and a second confirmatory sample will be required using the new Identifiers. If available, an electronic process for collecting blood samples should be used to avoid the need for a second sample.

Guidance for Clinical Blood Use

4.8 Major incidents may not result in many casualties with traumatic haemorrhage. In incidents classed as MCEs, current national EPRR planning is based on triage systems in which Priority 1 (P1) requires immediate life-saving intervention, P2 require intervention that could be delayed, and P3 are 'walking wounded' or with minor injuries (figure 1).[15, 42] However, clinical conditions may change rapidly, necessitating re-triaging. Only the P1s and P2s will require admission to hospital.

4.9 Reviews of past MCEs recommend planning for red cell demand of 2-4 units for each casualty admitted with bleeding. [35, 36, 43, 44] An early estimate for more severely injured casualties admitted to trauma centres, i.e., P1 casualties with massive haemorrhage, is nearer to 6 units of RBC in 24 hours.[35] Many of these patients may also require plasma, platelets, cryoprecipitate, and fibrinogen as guided by Major Haemorrhage Protocols

(MHP).[33]

4.10 Trusts should ensure that they have a policy for the management of massive haemorrhage and massive transfusion for adults and children, [13, 31, 33] (see section 1.10) and this should be incorporated into the Major Incident plan to promote prompt and appropriate use of haemostatic blood components in this setting. [45]

4.11 Transfusion support should be optimised using the principles of *Patient Blood Management* (PBM). The two pillars most relevant to the immediate care of the patient with traumatic haemorrhage are: minimise blood loss, i.e., haemorrhage control, together with tranexamic acid; and tolerance of anaemia. Measures to 'optimise red cell mass' using iron (oral or intravenous) may be considered in the post-operative phase. These principles also apply to non-operative patients.

4.12 Definitive haemorrhage control often requires surgery. Patients may require repeated surgery.[11] Trusts should consider having an Intra-Operative Cell Salvage (IOCS) service for use in major haemorrhage, including traumatic haemorrhage to reduce reliance on allogeneic blood.

4.13 Trusts should have contingency plans for major blood shortages incorporated into their Major Incident plans. National integrated blood shortage plans include guidance for the clinical prioritisation of red cells [41], platelets,[46] and plasma.[47]

Selection and Issue of Blood Components

4.14 All patients admitted to hospital should have a baseline and second sample taken for transfusion testing of blood group (ABO and D) and atypical antibody screen, ideally prior to transfusion. If an electronic process for collecting blood samples has been utilised this should avoid the need for a second sample. Blood grouping should be initially prioritised to the most urgent cases (P1 and P2 cases), i.e., those who are bleeding and most likely to require

blood components. Laboratory procedures should be in place to prioritise and handle emergency samples.

4.15 It is anticipated that 'universal components' may be used where the ABO and D group are unknown. Appropriate blood group substitutions should be considered to optimise stock management of all blood components. An example is the use of group A high titre (HT) neg plasma as a substitute for group AB plasma. [31, 33]

4.16 Group O D positive red cells should be used in male patients with unknown blood group and patients with no childbearing potential i.e., women >50 years of age. D and K negative blood should be prioritised for female patients of childbearing potential (i.e., under the age of 50) whose blood group is unknown. [17] The LIMS should be capable of supporting suitable substitutions whilst blocking the issue of inappropriate components. To prevent delays in blood components in emergency situations, procedures should be in place to allow concessionary release of components, this includes the provision of O positive blood to patients of childbearing potential (whose ABO D group is unknown) if this would be life-saving in the event of shortage of O negative blood. [41]

4.17 Age-appropriate components should be used wherever they are available. In emergency situations, it may not be possible to meet all additional paediatric (i.e., children <1 year of age) specifications. In these situations, selection [32] and concessionary release of substitutions should follow national guidance.[48]

4.18 Samples from patients who received ABO D non-identical blood may subsequently show two populations of cells during blood grouping. For example, if multiple Group O red cells are transfused into a non-O patient, this could make it difficult to obtain a clear ABO D group. Group O red cells should be issued where there is uncertainty. In addition, such patients may not be eligible for subsequent electronic issue of blood, and alternative arrangements must be in place for the timely release of blood components. Where ABO D grouping is certain, switch to

providing ABO D compatible components as soon as possible.

4.19 Tracking blood components once they have been issued may be challenging if an electronic tracking system is not available, especially if sent to multiple areas. Consideration should be given to using paper logs or whiteboards to record the issue of blood components, shock packs, or other products. Where available, electronic blood management systems should be used to fate units.

4.20 Arrangements must be in place for the traceability of blood components sent to other hospitals and the Ambulance Service.

4.21 Hospital Transfusion Laboratories should be able to provide details of blood component usage following a Major Incident to NHSBT Customer Services within 72 hours, to guide the management of patients and blood stocks in relation to future events.

5. REGULATORY REQUIREMENTS

5.1 Transfusion support in the context of an incident must comply with legislation (BSQR, 2005)[49] and best practice as defined by NBTC and BSH guidelines and SHOT recommendations. Records should be retained for both regulatory and forensic purposes.

5.2 Consideration must be given to securely maintaining the cold chain of any blood components stored and transported during an incident. Special care is required when Hospital Transfusion Laboratories move 'stock' of blood components to treatment areas in a major incident.

5.3 Hospital Transfusion Laboratories should have protocols for the timely thawing and issue of plasma together with the option of post-thaw storage of FFP at 4^{o}C for up to five days.[50]

5.4 The transfusion of any blood component must be documented in the clinical notes and in the Hospital Laboratory Management System (LIMS) using the unique number of both the blood unit and the patient. These records must be kept for at least 30 years for compliance with the Blood Safety and Quality Regulations 2005.[49]

5.5 Hospital Transfusion Laboratories should have procedures for maintaining the systems for traceability of blood components, used and wasted, in a major incident setting. Examples include the use of electronic systems or manual peel off tags attached to patient notes.

5.6 All adverse reactions and events related to either the provision of transfusion services and/or the use of blood components should be reported to the Hospital Transfusion Team, SABRE and SHOT, as appropriate. It is recognised that acute transfusion reactions may be difficult to diagnose during resuscitation of the critically ill.

6. RESILIENCE AND RECOVERY

Staff Support and Welfare

6.1 The welfare and well-being of all staff during and after a major incident is highly important.[51] During the event, the tasks required by staff may be overwhelming. In addition, on the announcement of a major incident, there is often an immediate response from staff to assist. Therefore, there is a risk that staff will be exhausted swiftly if a high percentage of members of staff attend immediately. Staff attendance should be managed.

6.2 Consequently, Hospital Transfusion Laboratories should have policies for the organisation of staff in a major incident with systems for provision of additional staff only if needed. Off-duty staff should be advised to avoid coming into work until they are called in. Staff contact details should be maintained and easily accessible.

6.3 Trusts should consider having policies and easy access to funds for providing food, rest facilities, accommodation and taxis for staff unable to travel home. Specific provision may be required for hospital transfusion staff unable to leave the laboratory area.

6.4 Major incidents can be traumatic events which cause stress, [10] whatever their source or scale. Staff and patients may need some psychosocial support following the incident. [51] In some circumstances those affected may need additional support for a considerable period. Debriefing may help individuals and support the transfusion team.

6.5 Hospitals should have policies that enable staff easy access to obtaining psychological support;[51] ideally pathways should be accessible 24/7, allowing both managerial referral and self-referral.

6.6 At the command "Major Incident Stand Down" the transfusion team should hold a short 'hot debrief' meeting addressing

- serious issues that presented problems where improvements can be made
- to check on the well-being of staff
- check that staff can get home safely especially if public transport has been disrupted
- debrief should be repeated for each new shift and provided to individuals as required

6.7 Refer any staff requiring support to Occupational Health and/or staff well-being services.

6.8 Hospital/Trust hot debrief membership should include a representative from the transfusion department who should attend their hospital hot debrief meeting normally initiated by the director leading the gold control team. The time should normally be no later than a few hours after the incident. It is recommended that debriefs should be recorded to help with sharing of learnings and investigations later.

6.9 Hospital/Trust cold debrief are usually 1-2 weeks post incident. Membership should also include representation from the Transfusion team and where concerns are present

about delivery of blood components, NHSBT (customer services) so that transfusion support and delivery is reviewed from local, regional, and national perspective. This will inform debrief at NHSBT.

6.10 Any documentation and experience from the incident should be used to capture lessons identified, and feedback to other stakeholders including NHSBT to support service improvement.

Recovery Phase from a Major Incident

6.11 Response and recovery are not two discrete activities but may occur simultaneously. The recovery team should begin to plan recovery activities at the onset of the incident. As soon as the initial response phase is over, the focus should be on returning to 'Business as Usual,' or normality, as soon as possible.

6.12 A Trust level recovery coordinator should be appointed to coordinate the response. The Transfusion Department is responsible for planning local recovery but will need to be aware of the wider Trust plan. The recovery strategy will normally cover some or all the key following objectives:

- Managing the return to normal service delivery
- Priority of elective services including the impact on targets
- Staffing levels in the immediate future
- Identify patients who require further surgical intervention or follow-up arrangements following the incident
- Number of beds occupied by Major Incident casualties, including critical care beds and other specialist beds
- Support to staff welfare including appropriate counselling
- Re-stocking of supplies and equipment including blood components
- Infrastructure and estate issues
- Auditing and reporting of the incident

- Communication, internally and externally, to core stakeholders
- Financial implications and financial recovery plan

6.13 Transfusion Laboratories should reassess their blood stocks in the light of these future activities and adjust standing orders with NHSBT as required. Consideration should be given to the redistribution of short shelf-life components within the Trust network or to other Trusts to prevent wastage due to time expiry.

6.14 Transfusion Laboratories should complete their traceability audits and account for all blood components issued during the incident.

6.15 Summary of key actions Hospital Transfusion Laboratories should undertake during and after a major incident are illustrated in figures 8 and 9.

Figure 8: Illustration of the key actions to be undertaken in a Major Incident /MCE

On activation, senior staff onsite should assume responsibility for transfusion. All staff should follow their major incident action card. The hospital may be in 'lockdown' (i.e., due to terrorist attack or safeguarding concerns) staff should ensure that identification badges are worn at all times especially if asked to come in to assist. Internal stock take of emergency universal components should be undertaken with the assumption that 3 units of blood will be needed per Priority 1 casualty. The recommended ratio of blood and FFP for traumatic haemorrhage is 1:1. Moving transfusion staff forward to ED / theatres will aid communication, appropriate sampling and transfusion support. Ensure all decisions are recorded, and measures are taken to maintain traceability. Blood transfusion samples should be taken from Priority 1 casualties and labelled with non-sequential unique patient identifiers and gender as a minimum. A second confirmatory sample should be taken as soon as possible and labelled independently from the first sample to confidently determine the patients' ABO D group. Until then group O red cells should be issued. Early move to ABO D blood is advised. On 'stand down' transfusion staff should undertake a local debrief within transfusion and attend the Hospital 'hot debrief' (usually with 1-2 hours of standdown) and 'cold debrief' (usually 2-3 weeks later), to share learnings with the rest of the transfusion team. The MI/MCE guidelines and action cards may need to be updated. Unused stock should be retrieved from clinical areas as soon as possible to prevent wastage, where possible excess stock should be shared with nearby hospitals.

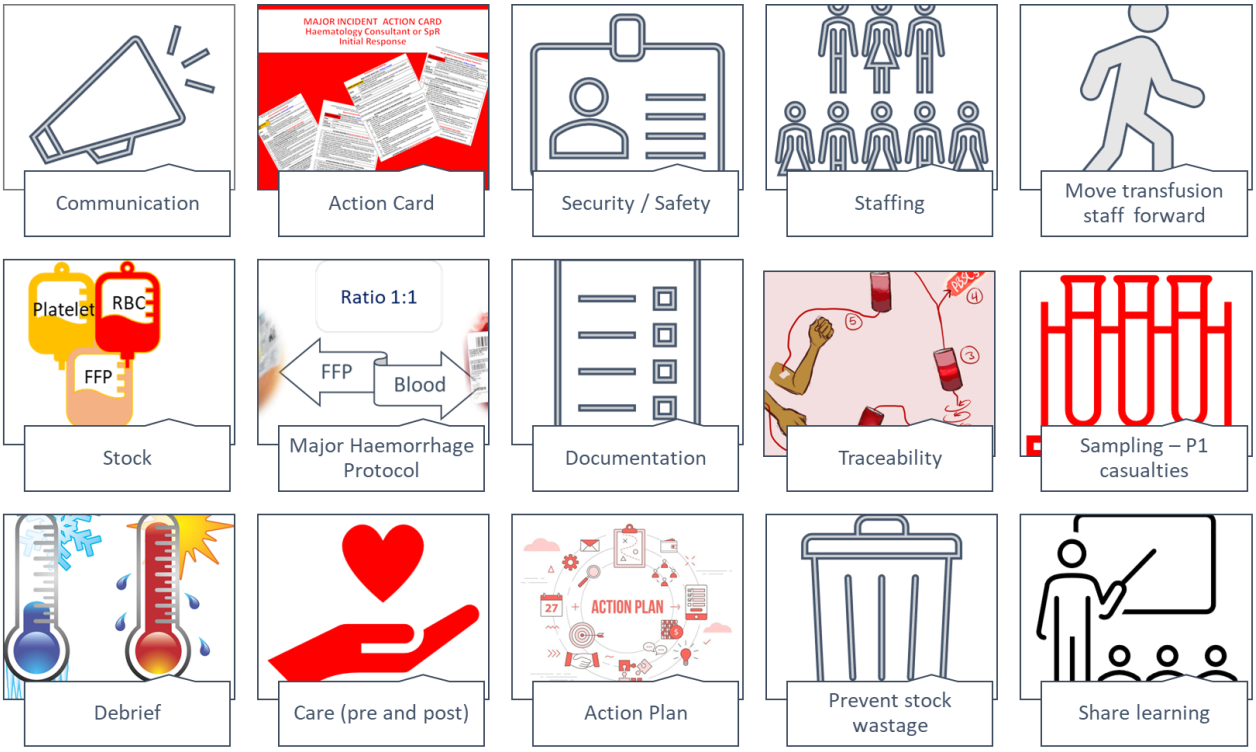
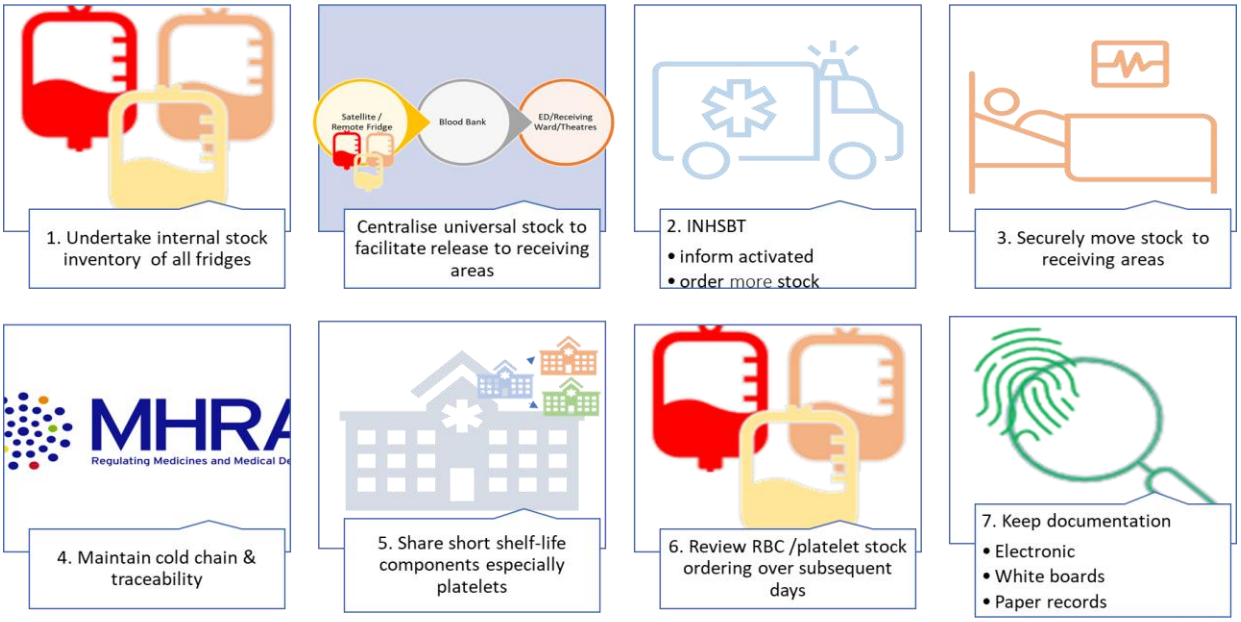


Figure 9: Management of blood stock during and following a MI/MCE

On activation: Undertake a quick internal stock count of all universal components in blood bank and satellite fridges and centralise to enable secure movement to receiving areas (i.e., ED/theatres). Also check consumables / reagents / cold boxes. If stock is insufficient for numbers of expected casualties, notify local NHSBT stock holding unit and order additional stock. Consider thawing plasma especially if pre-thawed FFP is not available. Securely move stock to clinical areas whilst maintaining cold chain and traceability.

On stand down: Retrieve stock from clinical areas and prevent wastage by sharing stock with other sites. Review stock ordering regularly over subsequent days until all services return to business as usual. Keep all documentation relating to stock/decision making as this may be needed for regulatory and forensic purposes.



7. BUSINESS CONTINUITY THREATS

Business Continuity is regarded as a separate process from major incident/mass casualty planning although it is recognised that there are potential overlaps. Business Continuity has its own strategy, alert, and escalation process.

7.1 Local business continuity plans with clear escalation pathways, communications and leadership structure should be held in readiness in the Transfusion Laboratory as well as in the emergency planning and command control rooms. [27] There are normally four levels of activation for a business continuity incident.

7.2 The core business continuity threats to Trusts (figure 10) which may impact on the delivery of hospital-based transfusion services include,

a. Loss of staff due to infectious illnesses such as pandemic flu, or an infectious pandemic such as Covid-19. [20, 22, 23, 25, 52] Outbreaks may have a secondary impact with loss of staff due to childcare commitments or dependents' illness. These illnesses may have an impact on blood donation, resulting in blood supply chain challenges. Other causes of loss of staff include severe weather, fuel crisis, and local/national power outages.

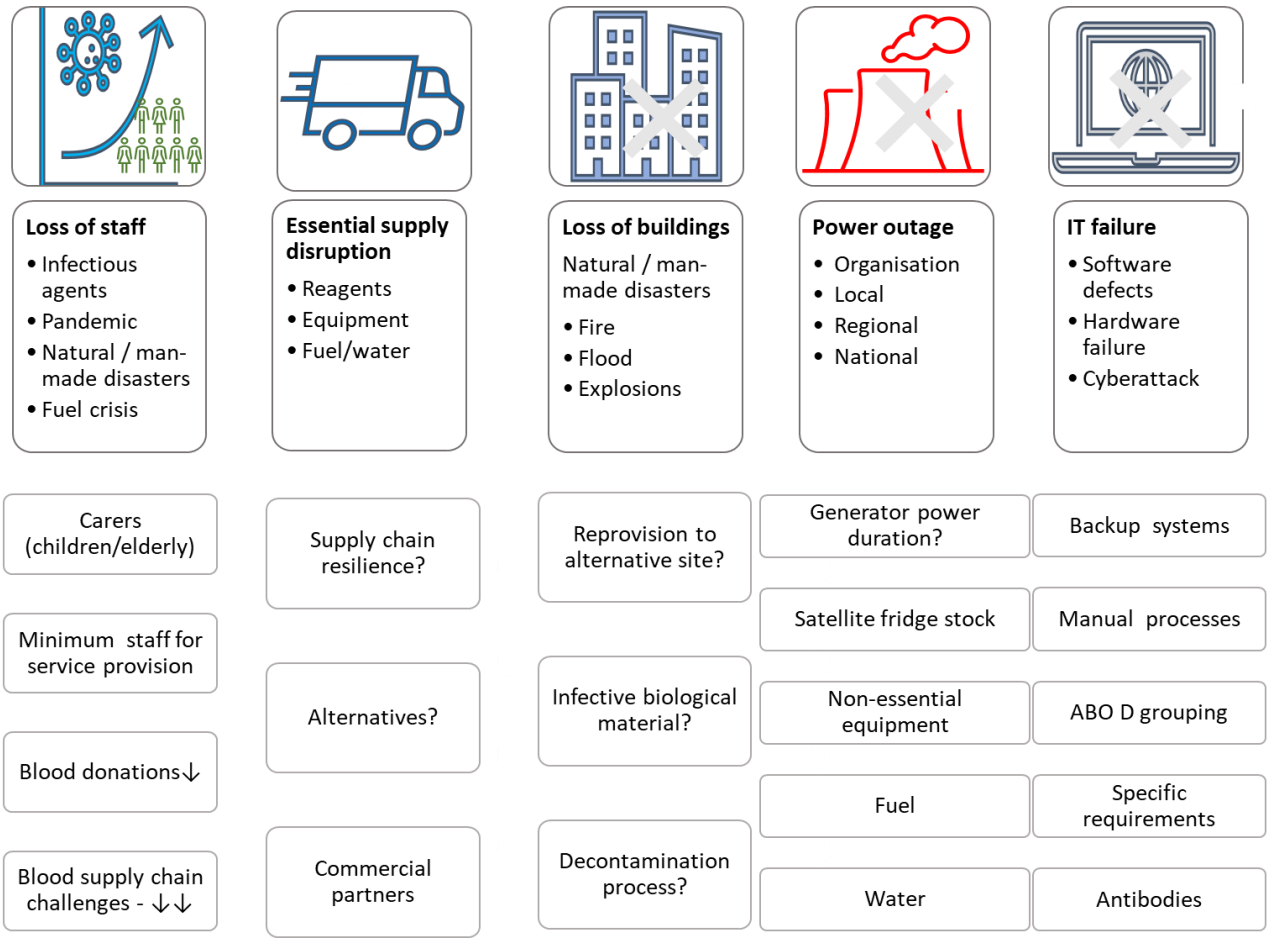
b. Interruption to essential supplies other than blood. Examples may include reagents, consumables, and failure of critical equipment. Departments should ensure that there is enough stock of critical consumables and be aware of the risks in the supply chain. Transfusion Laboratories may be required to work closely and proactively with other departments and commercial partners to ensure continuity of supply.

c. Loss of buildings due to fire, bomb threats, or contamination, especially when dealing with potentially infective biological material. Systems should be in place to safely handle known infective samples and to decontaminate where required.

d. Power outage / IT failure - business continuity plans [20, 53] should be in place to maintain essential services. Hospital Transfusion Laboratories should maintain the capability to use manual techniques for testing and non-electronic record keeping. Procedures should be set in place to update IT records during the recovery phase.

Figure 10: Core Business Continuity Threats

Summary of business continuity threats are shown graphically with important considerations for service provision listed below each key threat.



7.3 It is explicitly recommended that records of regularly transfused patients who have clinically significant antibodies and specific requirements are regularly maintained, either as non-electronic records or on different electronic platforms to enable timely transfusion in the event of a cyberattack or power failure. Keeping non-electronic records up to date may be challenging, this should be taken into consideration before undertaking any transfusion(s) based on these records. Where not available, the Consultant Haematologist should be contacted for advice on requirements (e.g., irradiated) if needed.

7.4 Disaster planning and training should include cyber security, and the actions required to minimise impact. Trusts and pathology services should comply with cyber and data security good practices to reduce the risk of IT failure. Examples of current guidance and best practice are available via NHS Digital and the National Cyber Security Centre.[54]

Resilience and Mutual Aid

7.5 Mutual aid is defined as an arrangement between Category 1 and Category 2 responders and other organisations not covered by the Civil Contingencies Act 2004.[2] Mutual aid may occur within the same sector or across sectors and across boundaries, to provide and assist with additional resources during an emergency that may overwhelm the resources of a single organisation. In situations where the impact of the incident is likely to require involvement of NHS England or has the potential to impact the blood supply chain, the National Critical Incident Manager for NHSBT should be contacted immediately by NHS England.

7.6 Where consideration is given to providing or requesting assistance from another NHS organisation this should be agreed on, through local strategic command. The requirements, roles, and responsibilities should be clearly set out in an SLA. Examples of mutual aid for transfusion might include movement of blood stock and emergency use of fridges, freezers, and plasma thawers. It is recommended that hospitals should consider this in their business contingency planning and have a pre-agreed SLA with other neighbouring hospitals or NHSBT if this is not possible.

7.7 NHSBT aims to manage supplies of blood components and critical services to all customers during emergencies. Response to orders may be staged, and substitutions used where appropriate. Priority will be based on clinical needs.

7.8 Emergency deliveries will be made in NHSBT liveried vehicles, [8] if these are unavailable NHSBT can use couriers to deploy emergency blood component deliveries,

usually directly to the Transfusion Laboratory. NHSBT should update the Transfusion Laboratory with courier details. It may be necessary for a rendezvous point (RVP) to be established when the security of a hospital is compromised. In such circumstances, an individual should be designated as the point of contact for the receipt of blood products.

7.9 Guidance for the arrangements for specialist chemical and biological antidote services is provided by NHS England.

8. BUSINESS CONTINUITY PLANS FOR POWER OUTAGE

8.1 Business contingency plans should cover LIMS, and equipment failure [55] loss of utilities such as electricity (power outage), gas, or water (i.e., drought). Power failure is not uncommon; it may involve one hospital site or multiple sites. If multiple sites are affected, NHS England should be notified. NHS England incident manager should contact the National Critical Incident Manager (NCIM) for NHSBT immediately.

8.2 Resilience measures and mutual aid should include the ability to use other sites and potentially the wider pathology networks as well as non-affected organisations outside these networks.

8.3 Staff escalation procedures should be in place, to enable staff to obtain immediate advice out of hours and include methods of communication other than landline (including transfusion management, reference laboratories, and medical staff).

8.4 Validated contingency procedures should be clear, always accessible, and should be read by all staff members. Training and competency assessments for all business continuity procedures should be undertaken regularly. Staff should be confident to follow these when needed. Practice sessions/drills must be incorporated to maintain awareness and address any emerging concerns.

8.5 In the event of a national power outage (NPO) it is likely that there will be secondary impacts which will lead to a loss of internet connection, telecommunications, and running water.

a) National communication may be transmitted through FM radio broadcasts from the BBC (Radio 2 and Radio 4).

b) NHSBT's priority will be to maintain critical blood supply, especially universal components, i.e., group O blood. Blood Donation teams will continue to collect blood where possible. Apheresis collections will be suspended at sites without power. During an NPO source plasma will not be collected, and recovery of plasma for medicines will be suspended.

c) During an NPO, NHSBT will likely declare a "R*ed Alert"* for all components immediately. Hospital Transfusion Service should factor this into local Business Continuity Plans (see section 4.13). This should include keeping local paper copies of all the NBTC shortage plans, as Hospitals may not be able to download a copy during a NPO or receive timely communications from NHSBT.

d) Due to the impact of NPO on transport, IT systems and communications, hospitals may not be able to place orders to NHSBT Hospital Service in the initial stage of an NPO. It is likely that hospitals located close to NHSBT Hospital Services departments (i.e., within 1-2 miles) may send hospital staff to place and collect orders. NHSBT will issue to anyone who was able to place an order, on a first come first serve basis.

e) Business continuity plans should clearly state expectations on staff attendance to work i.e., staff living nearby may need to be prioritised to attend work, especially if they can walk or cycle.

8.6 Hospital blood transfusion laboratory teams should confirm that the laboratory and

satellite fridges are on the priority generator power list with local emergency planning teams. Blood components located in satellite fridges located in areas which are not on the generator priority list should be centralised to the laboratory within 30 minutes to prevent wastage of components.

8.7 Staff should be aware of how long their fridges and transport boxes can maintain an acceptable temperature. Staff should avoid opening fridges or freezers where possible with specific consideration given to the maintenance of the cold chain of components. The cold chain may be compromised during.

- air-conditioning failure, particularly during hot weather
- prolonged electricity failure / power outage

8.8 Laboratories should ensure that critical equipment (including laboratory PCs) is identified and powered through the backup generator circuit. In addition, the use of Uninterruptable Power Supply (UPS) systems will provide a short bridging supply (approximately 20 minutes) during the transition between mains to generator power.

8.9 UPS should be available for all critical equipment which requires controlled power down, for example blood grouping analysers. In the rare event of secondary power supply failure, UPS also provide a period to safely close-down equipment and issue components. Note UPS may only be able to provide power for a brief period i.e., approximately 20 minutes. UPS should be checked periodically to ensure they are working correctly, ready for future power failures.

8.10 Other critical equipment (e.g. blood fridges, selected LIMS terminals and plasma thawers) should be supplied by the back-up generator. Consider additional back-up solutions such as battery-controlled temperature graphs and loggers for blood storage fridges to enable temperature monitoring and log in a power outage. Note smart fridges have their own temperature monitoring which can be used if the main system is not working. If available, temperature loggers may provide a useful emergency back-up for individual components units.

8.11 Non-critical equipment should be switched off to preserve generator power. Hospitals should keep an easily accessible updated list of all non-critical equipment.

8.12 All backup procedures must attempt to maintain the quality of components / products including frozen components.

8.13 Non-standard procedures should only be undertaken for clinically urgent cases and should be discussed with medical staff. Decisions and discussions regarding concessionary release should be documented, in a structured log with the clinical team, including laboratory advice given to clinical staff should be maintained.

8.14 Documented information regarding the groups of all components to be released in emergency situations should be available (e.g. O red cells and A platelets and plasma components). SOPs and training should be in place to control the process.

8.15 All patients who need transfusions should have x2 separate samples sent to confirm grouping. If manual crossmatching is needed, ensure additional staff are available to provide an independent second check. This is applicable to any manual work, including handwritten compatibility labels. Maintain meticulous paper records of components issued and results of any serological investigations.

8.16 Business continuity plans should cover how to issue frozen products in the absence of a thawer and a process for approval must be in place for component issue outside of SOP. Resilience measures include the use of pre-thawed plasma (or Lyoplas) and preparation elsewhere. If power is available to thaw frozen components in an improvised water bath (acceptable temperatures between 33°C and 37°C) or other equipment designed for the purpose, components should remain within a vacuum-sealed overwrap bag according to a validated procedure.

8.17 A record should be kept regarding cleaning, and the appropriate products used in

improvised water baths and components post exposure to tap water. Plasma components should not be left unattended when using non-standard procedures.

8.18 Ensure an emergency supply of pre-printed/prepared and accessible manual compatibility labels and other documentation are available (including manual result forms, SOPs, tracking forms etc).

8.19 Ensure essential resources such as torches are available in case lighting is compromised. When available ensure these are checked on a regular basis to ensure the batteries have not run out.

9. INTERRUPTION/LOSS OF IT SYSTEM DUE TO CYBER ATTACK

9.1 Modern clinical laboratory services, including transfusion services, are highly dependent on the LIMS for all aspects of blood banking and the Online Blood Ordering System (OBOS). In the event of a significant cyber-attack that impacts a LIMS, it is expected that NHSBT senior on call will be contacted for large scale incidents by NHS England's national on call officer.

9.2 OBOS is available on a mobile platform such as a smartphone which may be used if the Hospital network is down. If it is not possible to use OBOS on this platform, or if OBOS is not available, inform local NHSBT Hospital Services and follow downtime procedures for requesting blood components. It is recommended that 'FRM536/7.1 - Standard Component Request' is downloaded from https://hospital.blood.co.uk/components/order-forms/ and copies kept for emergency use. Keep a log of all units requested.

9.3 If the IT systems / LIMS have been cyber attacked, obtain a preliminary understanding of the scale of the impact on clinical and laboratory services, before declaring a major incident. Inform your local Medical Directors Office, NHS England, and NHSBT Customer Services / Hospital Service who will in turn notify NHSBT's National Critical Incident Manager.

9.4 Identify senior Transfusion Team members (i.e., Consultant Haematologist or Pathology Managers) and set out roles and responsibilities to help co-ordinate incident management, attendance of local, regional, and national meetings

- define clear lines of communications
- identify how to distribute expertise and define how additional staffing needs are to be met
- prioritise restoration and implementation of IT / LIMS / network

9.5 Activate local command structure and emergency blood management group (EBMG) to

a. gather information
b. postpone all non-urgent procedures
c. identify emergency / urgent procedures which may need diverting to other hospitals
d. centralise stock from remote fridges to blood bank.
e. help triage patients in different high user groups (i.e., surgery, trauma, vascular, cardiovascular, transplant, haematology and maternity).
f. have agreed criteria for use of ABO components in the SOP.
g. if unable to issue ABO compatible components safely, stop routine work and triage patients who need emergency / urgent blood component support with emergency stock.

9.6 Undertake risk assessments on all processes where deviation from routine practice is likely to be necessary.

9.7 Establish regular (i.e., at least daily) meetings with high users to establish urgency and appropriateness of requests. All patients who need transfusions should have x2 separate samples sent to confirm grouping. If undertaking manual crossmatching, ensure additional staff are available to double check. Maintain meticulous paper records of components issued and results of any serological investigations.

9.8 Ensure all PBM measures are scaled up i.e., use of iron, tranexamic acid, cell salvage,

restrictive transfusion policies.

9.9 Ensure alternative methods (i.e., manual methods) are available to maintain traceability if electronic systems are not available.

Resilience and Recovery from IT Failure/ Power Outage/ Cyberattack

9.10 Review mutual aid alternatives - see section 7.5, 7.6 and 8.2

9.11 Recruitment of additional/external staff to support manual processes. Plans should be in place for incidents which are prolonged (beyond 1-2 weeks) to provide support for existing staff, to aid with double checking of processes, to cover planned/unscheduled leave.

9.12 Plan for additional resources required to enable retrospective data input of all patients test results and transfusions during and after the incident

- scanning paper charts
- data input (date/time stamp)
- Traceability logs

9.13 All staff should be actively involved in all debriefs to capture learning from experience to recognise achievements and areas for improvement.

9.14 Ensure all SOPs, and business continuity plans are updated with lessons learnt during and after the incident.

9.15 Analysis of incident reports submitted during and post incident to ensure corrective actions and preventative actions (CAPA) have been implemented where incidents could have led to harm.

9.16 All transfusion related patient adverse events should be reported to SHOT.

REFERENCES

1. NHS Emergency Preparedness Resilience and Response Framework. Version 3, July 2022 [Available from: https://www.england.nhs.uk/wp-content/uploads/2022/07/B0900-NHS-Emergency-Preparedness-Resilience-and-Response-Framework-version-3.pdf.
2. Parliament of the United Kingdom. The Civil Contingencies Act 2004 (c 36). 2004 [Available from: http://www.legislation.gov.uk/ukpga/2004/36/contents. 2004.
3. National Health Service Act 2006 2006 [Available from: https://uk-legislation.com/national-health-service-act-2006
4. The Health and Care Act 2022 [Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1115453/health-and-care-act-2022-summary-and-additional-measures-impact-assessment.pdf
5. NHS contract 2022 [Available from: https://www.england.nhs.uk/nhs-standard-contract/
6. Makin S, Groves S. Summary of latest NHS England Emergency Preparedness Resilience and Response (EPRR) guidance. BMJ Mil Health. 2020;166(1):12-6.
7. Hughes G. The London bombings of 7 July 2005: what is the main lesson? Emerg Med J. 2006;23(9):666.
8. Glasgow SM, Allard S, Doughty H, Spreadborough P, Watkins E. Blood and bombs: the demand and use of blood following the London Bombings of 7 July 2005--a retrospective review. Transfus Med. 2012;22(4):244-50.
9. Lohn J, Fong K, Dewar D, Mallucci P, McGuinness A, Floyd D, et al. The 7 July 2005 London suicide bombings: Lessons learnt from University College London Hospitals (UCLH).
10. Chowdhury F, Doughty H, Batrick N. London 2017: Lessons learned in transfusion emergency planning. Transfus Med. 2021;31(2):81-7.
11. Moran CG, Webb C, Brohi K, Smith M, Willett K. Lessons in planning from mass casualty events in UK. BMJ. 2017;359:j4765.

12. Doughty H. Transfusion emergency preparedness for mass casualty events. . ISBT Science Series 2019. p. 77-83.
13. Jenner R, Piscitelli S. Don’t forget the children—paediatric patients in mass casualty events and major incident planning. British Journal of Hospital Medicine. 2024;85(7):1-11.
14. Spahn DR, Bouillon B, Cerny V, Duranteau J, Filipescu D, Hunt BJ, et al. The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition. Crit Care. 2019;23(1):98.
15. NHS England. Clinical guidelines for major incidents and mass casualty events [Available from: https://www.england.nhs.uk/publication/clinical-guidelines-for-major-incidents-and-mass-casualty-events/. 2026.
16. Vassallo J, Moran CG, Cowburn P, Smith J. New NHS Prehospital Major Incident Triage Tool: from MIMMS to MITT. Emerg Med J. 2022;39(11):800-2.
17. NBTC: The appropriate use of group O D negative red cells [Available from: https://www.nationalbloodtransfusion.co.uk/recommendations.
18. Van Denakker TA, Al-Riyami AZ, Feghali R, Gammon R, So-Osman C, Crowe EP, et al. Managing blood supplies during natural disasters, humanitarian emergencies, and pandemics: lessons learned from COVID-19. Expert Rev Hematol. 2023;16(7):501-14.
19. Drews SJ, O'Brien SF. Lessons Learned from the COVID-19 Pandemic and How Blood Operators Can Prepare for the Next Pandemic. Viruses. 2022;14(10).
20. Hall T. Business continuity beyond COVID-19: Lessons learned and the 'illusion of preparedness'. J Bus Contin Emer Plan. 2022;16(1):45-52.
21. Rajbhandary S, Shmookler A, Cohn CS, Nunes E, Karafin MS, Stubbs J, et al. Hospital transfusion service operations during the SARS-CoV-2 pandemic: Lessons learned from the AABB hospital survey in preparation for the next infectious disease outbreak. Transfusion. 2021;61(11):3129-38.
22. Schiroli D, Merolle L, Molinari G, Di Bartolomeo E, Seligardi D, Canovi L, et al. The impact of COVID-19 outbreak on the Transfusion Medicine Unit of a Northern Italy Hospital and Cancer Centre. Vox Sang. 2022;117(2):235-42.

23. Chiem C AK, Nguyen T, Han JH, Huo H, Jackson D. . The Impact of COVID-19 on Blood Transfusion Services: A Systematic Review and Meta-Analysis. . Transfusion Medicine and Hemotherapy 2021;30:1-12.
24. NHS Improvement. Safer temporary identification criteria for unknown or unidentified patients (NHS/PSA/RE/2018/008). Safer Practice Alert 2018 [Available from: https://www.england.nhs.uk/2018/12/safer-temporary-identification-criteria-for-unknown-or-unidentified-patients/
25. Gammon RR, Rosenbaum L, Cooke R, Friedman M, Rockwood L, Nichols T, et al. Maintaining adequate donations and a sustainable blood supply: Lessons learned. Transfusion. 2021;61(1):294-302.
26. Jacobs JW. The impact of climate change and emerging infectious diseases on the blood supply. Transfus Apher Sci. 2021;60(6):103272.
27. Morgan SJ, Rackham RA, Penny S, Lawson JR, Walsh RJ, Ismay SL. Business continuity in blood services: two case studies from events with potentially catastrophic effect on the national provision of blood components. Vox Sang. 2015;108(2):151-9.
28. Deelen R CE, Moss R, Akers, C. Disaster planning: the role of the transfusion practitioner. ISBT Science Series2019. p. 98-103.
29. Hoth P, Roth J, Bieler D, Friemert B, Franke A, Paffrath T, et al. Education and training as a key enabler of successful patient care in mass-casualty terrorist incidents. Eur J Trauma Emerg Surg. 2023;49(2):595-605.
30. Incident Response Plan (National) version 5.0, July 2025 [Available from: https://www.england.nhs.uk/wp-content/uploads/2017/07/PRN02102-incident-response-plan-v5.pdfhttps://www.shotuk.org/script/script-resources/it-downtime/
31. Hunt BJ, Allard S, Keeling D, Norfolk D, Stanworth SJ, Pendry K, et al. A practical guideline for the haematological management of major haemorrhage. Br J Haematol. 2015;170(6):788-803.
32. Reece JT, Sesok-Pizzini D. Inventory Management and Product Selection in Pediatric Blood Banking. Clin Lab Med. 2021;41(1):69-81.
33. Stanworth SJ, Dowling K, Curry N, Doughty H, Hunt BJ, Fraser L, et al. Haematological

management of major haemorrhage: a British Society for Haematology Guideline. British Journal of Haematology. 2022;198(4):654-67.

34. Katz-Dana H, Shiri R, Netzer E, Dana E, Fayyaz J, Rosenbloom E. Improving Mass Casualty Event Response: A Simulation-Based Program in a Rural Hospital. Cureus. 2025;17(8):e91025.

35. Ramsey G. Blood transfusions in mass casualty events: recent trends. Vox Sang. 2020;115(5):358-66.

36. Disaster Operations Handbook. AABB Task Force Disaster Operations Handbook Coordinating the Nation's Blood Supply During Disasters and Biological Events 2003 Bethesda. US 2003, last updated 2008.

37. Craigie RJ, Farrelly PJ, Santos R, Smith SR, Pollard JS, Jones DJ. Manchester Arena bombing: lessons learnt from a mass casualty incident. BMJ Military Health. 2020;166(2):72-5.

38. The Joint Doctrine- Edition 3.1 [Available from: https://www.jesip.org.uk/downloads/joint-doctrine-guide/.

39. Jolly Graham A, Platt A, Knutsen K, Fletcher E, Gallagher D. Impact of geographical cohorting, multidisciplinary rounding and incremental case management support on hospital length of stay and readmission rates: a propensity weighted analysis. BMJ Open Quality. 2024;13(2):e002737.

40. Robinson S HA, Atkinson S, et al. The administration of blood components: a British Society for Haematology Guideline. Transfusion Medicine 2018;28(1):3-21.

41. National Blood Transfusion Committee. A Plan for NHS Blood and Transplant and Hospitals to Address Red Cell Shortages. 2023 updated Oct 2024 [Available from: https://www.nationalbloodtransfusion.co.uk/recommendations.

42. NHS England Emergency Preparedness, Resilience and Response. Concept of Operations for managing Mass Casualties 2019 [Available from: https://www.england.nhs.uk/wp-content/uploads/2018/03/concept-operations-management-mass-casualties.pdf

43. Ramsey G. Blood component transfusions in mass casualty events. 2017;112,(7):648-59.

44. Lozada MJ CS, Li M, Davidson SL, Nix J, Ramsey G. The Las Vegas Mass Shooting: An

analysis of blood component administration and blood bank donations. Journal of Trauma and Acute Care Surgery. 2019;86(1)::128-33

45. NICE. National Institute for Health and Care Excellence guidelines [NG39] Major trauma: assessment and initial management. [Available from: https://www.nice.org.uk/guidance/ng39. .

46. National Blood Transfusion Committee. A Plan for NHS Blood and Transplant and Hospitals to address Platelet Shortages. 2023 [Available from: https://www.nationalbloodtransfusion.co.uk/recommendations.

47. National Blood Transfusion Committee. A Plan for NHS Blood and Transplant and Hospitals to address Plasma Shortages. 2022 [Available from: https://www.nationalbloodtransfusion.co.uk/recommendations

48. New HV, Berryman J, Bolton-Maggs PH, Cantwell C, Chalmers EA, Davies T, et al. Guidelines on transfusion for fetuses, neonates and older children. Br J Haematol. 2016;175(5):784-828.

49. BSQR. Blood Safety and Quality Regulations 2005 UK Statutory Instrument No.50. 2005. [Available from: www.opsi.gov.uk.

50. Green L, Cardigan R, Beattie C, Bolton-Maggs P, Stanworth SJ, Thachil J, et al. Addendum to the British Committee for Standards in Haematology (BCSH): Guidelines for the use of fresh-frozen plasma, cryoprecipitate and cryosupernatant, 2004 (Br. J Haematol 2004,126,11-28). Br J Haematol. 2017;178(4):646-7.

51. Drury J, Stancombe J, Williams R, Collins H, Lagan L, Barrett A, et al. Survivors' experiences of informal social support in coping and recovering after the 2017 Manchester Arena bombing. BJPsych Open. 2022;8(4):e124.

52. Stanworth SJ, New HV, Apelseth TO, Brunskill S, Cardigan R, Doree C, et al. Effects of the COVID-19 pandemic on supply and use of blood for transfusion. Lancet Haematol. 2020;7(10):e756-e64.

53. Kaye D. Challenges and opportunities for business continuity within 21st-century business models. Journal of Business Continuity & Emergency Planning. 2006;1(1):47-54.

54. NHS Digital Cyber and Data Security [Available from: https://digital.nhs.uk/cyber.

55. SHOT Safety Notice 01: Emergency preparedness in the transfusion laboratory in case of total power outage. [Available from: https://www.shotuk.org/resources/safety-alerts-and-safety-notices/safety-notices/

DISCLAIMER

While the advice and information in these recommendations are believed to be true and accurate, neither the authors nor the National Blood Transfusion Committee accept any legal responsibility for the content of these recommendations.

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REVIEW PROCESS

The members of the writing group will inform the working group chair if any new evidence becomes available that would alter the recommendations made in this document or render it obsolete. The document will be reviewed regularly by the group and amended as required. The document will be archived and removed from the NBTC website if it becomes obsolete.

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APPENDIX 1 - Membership of NBTC EPWG 2026 review group

F Chowdhury (Chair), Consultant Haematologist, NHSBT & Imperial College Healthcare NHS Trust.

J Staves, (Deputy Chair) Transfusion Laboratory Manager, Oxford University Hospitals NHS Foundation Trust. Current Chair of Lab Manager's Group.

S Narayan, Medical Director SHOT/ NHSBT.

L Baxter, Specialist Practitioner of Transfusion, Salford Royal Foundation Trust.

T Cowdrey, Head of Business Continuity, NHSBT.

S Glasgow, Consultant Surgeon, St Mary's Hospital, & Imperial College Healthcare NHS Trust.

A Jackson, Transfusion Practitioner, United Lincolnshire Hospitals NHS Trust.

A Rennie, Clinical Lead, Greater Manchester Trauma Network & Consultant in Emergency Medicine, Salford Royal Foundation Trust, Associate Medical Director for NW ambulance.

Y Sorour, Consultant Haematologist, Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust Deputy Chair NBTC.

J Uprichard, Consultant Haematologist, St George's University Hospitals NHS Foundation Trust.

A Weaver, Consultant in Emergency Medicine & Pre-hospital Care / Clinical Director for Trauma Royal London Hospital.

C Philips, National Customer Service Manager, NHSBT.

P Baker, Blood Transfusion Laboratory Manager, Royal Liverpool University Hospitals.

E Carpenter, Transfusion Practitioner, London TP Group & National TP Network.

R Moss, Senior Transfusion Practitioner, Great Ormand Street Hospital.

A Turner, Advanced Practitioner/Deputy Laboratory Manager Blood Transfusion, Lincoln County Hospital.

N Kirkham, Blood Transfusion Laboratory Manager, University Hospitals of Derby and Burton NHS Foundation.

I Sullivan, Blood Transfusion Laboratory Manager, Royal Cornwall Hospitals NHS Trust.

S Wheeldon, Consultant Haematologist, NHSBT and Royal Devon University Healthcare NHS Foundation Trust.

APPENDIX 2 - Glossary

Abbreviation	Meaning
BSQR	Blood Safety Quality Regulations
BAU	Business As Usual
CAPA	Corrective Actions and Preventative Actions
CRG	Clinical Reference Group
EBMA	Emergency Blood Management Arrangement
EBMG	Emergency Blood Management Group
EBMS	Electronic Blood Management System
ED	Emergency Department
EPR	Electronic Patient Record
EPRR	Emergency Preparedness, Resilience and Response
ETM	Electronic Temperature Monitoring
HAS	Human Albumin Solution
HDU	High Dependency Unit
ICU	Intensive Care Units
IOCS	Intra-Operative Cell Salvage
IT	Information Technology
JESIP	Joint Emergency Services Interoperability Principles
LIMS	Laboratory Information Management System
MCE	Mass Casualty Event
MI	Major Incident
MITT	Major Incident Triage Tool
MHP	Major Haemorrhage Protocol
NBTC	National Blood Transfusion Committee
NCIM	National Critical Incident Manager
NHSBT	NHS Blood and Transplant
NPO	National Power Outage
OBOS	Online Blood Ordering System
PAS	Patient Administration System
PBM	Patient Blood Management
PCC	Prothrombin Complex Concentrate
RTC	Regional Transfusion Committee
SHOT	Serious Hazard of Transfusion
SLA	Service Level Agreement
SOP	Standard Operating Procedure
TST	Ten Second Triage
UPS	Uninterruptable Power Supply