Major Haemorrhage Simulation Toolkit

A toolkit for effective simulation training

This toolkit has been created through a **collaborative effort between SHOT, the Royal College of Pathologists (RCPath) Transfusion Specialty Advisory Committee, and representatives from across the UK.** The toolkit has been endorsed by all the UK national transfusion committees including the **National Blood Transfusion Committee (NBTC), Northern Ireland Transfusion Committee (NITC), Blood Health National Oversight Group (BHNOG), and Scottish National Blood Transfusion Committee (SNBTC).**

National Blood Transfusion Committee

Northern Ireland Transfusion Committee

NHS National Services Scotland

BHNOG

The Royal College of Pathologists
Pathology: the science behind the cure

Major Haemorrhage Simulation Toolkit

Executive Summary

The Major Haemorrhage Simulation Toolkit helps healthcare teams improve safety and readiness when managing major haemorrhage (MH). Developed in line with UK patient safety guidance, it promotes realistic, multidisciplinary simulation training involving clinical, laboratory, and support staff. The toolkit explains different types of simulation, from scenario-based to virtual and augmented reality and offers practical guidance on planning, delivery, and debriefing. It recommends regular, inclusive training that reflects real clinical environments to strengthen teamwork, communication, and system reliability. By combining structured practice with clear follow-up through debriefs, audits, and action plans, the toolkit supports continuous learning and improvement. Its ultimate goal is to standardise MH response, reduce delays and errors, and improve outcomes for patients experiencing major haemorrhage.

Contents

*The resources and materials provided are intended to support local simulation training exercises. Their use is **not mandatory**, and we recognise that this is **not an exhaustive list** of available tools or approaches. Staff are encouraged to adapt, modify, or replace the scenarios and resources as needed to best meet their **local requirements**, operational needs, and professional judgement.*

INTRODUCTION

Major haemorrhage is a time-critical emergency that demands rapid, coordinated, and accurate responses across multiple departments. Failures in communication, delays in blood availability, and fragmented processes are well-recognised contributors to avoidable harm. The UK Patient Safety Alert (CAS Alert SHOT/2022/001) highlighted these risks, calling on all hospitals to implement regular simulation training to strengthen preparedness and reduce the likelihood of errors. Reports from the Serious Hazards of Transfusion (SHOT) and national audits have consistently demonstrated that delays in transfusion, miscommunication, and gaps in laboratory or logistical support directly impact patient morbidity and mortality.

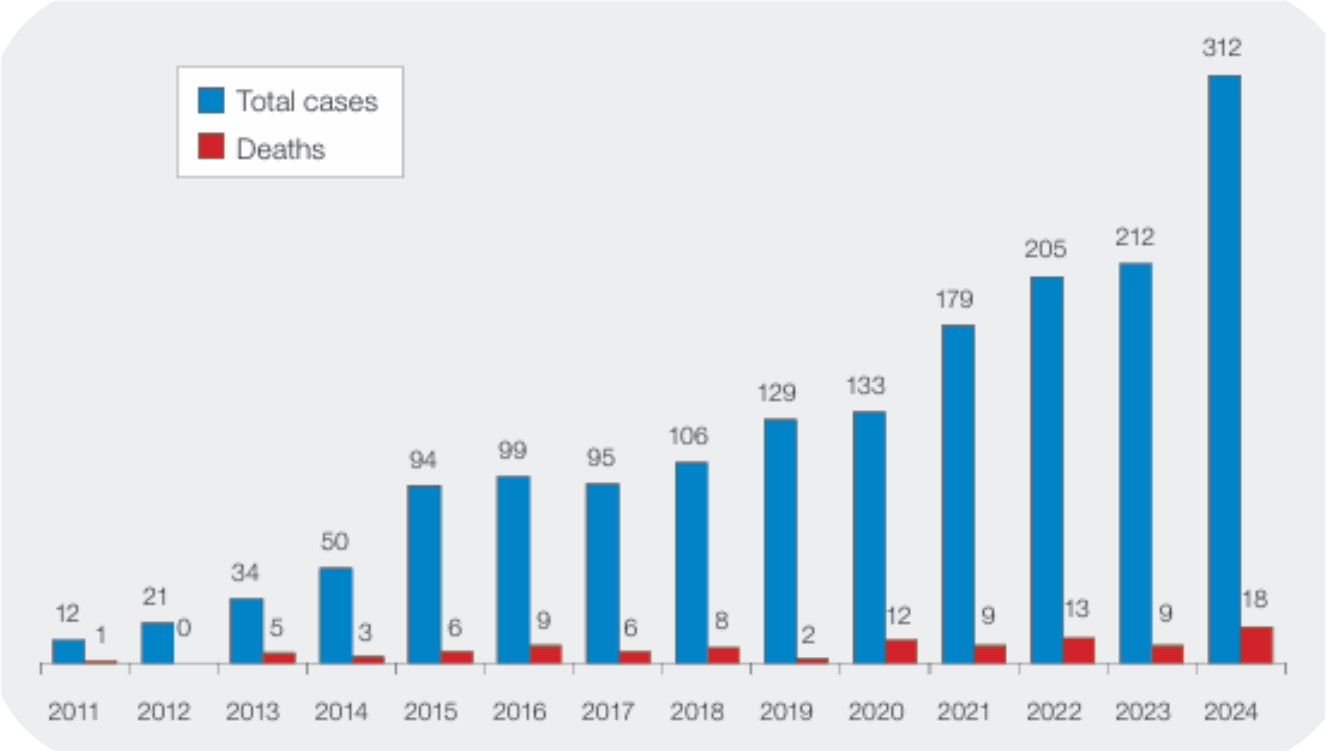

Figure taken from Annual SHOT Report 2024: Delayed transfusions by year 2011-2024 [(1)]

Back to Contents page

Despite this, many existing simulation exercises focus primarily on clinical teams, often excluding vital but less visible roles such as blood transfusion laboratory staff and portering services. Evidence shows that without this whole-system inclusion, latent safety threats remain undetected [2,3]. For example, a UK review of in situ simulations identified the "inability to activate the major haemorrhage protocol" as a critical systems vulnerability [1]. Similarly, in transfusion education, laboratory and support staff i.e porters are frequently overlooked, despite their essential contributions to patient safety [4].

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The educational value of simulation in major haemorrhage management is well established. Studies in the UK have shown that simulation significantly improves junior doctors' knowledge of major haemorrhage protocols compared with traditional training [5]. However, skills decay rapidly without reinforcement; performance in both technical and cognitive tasks has been shown to decline within months if practice is not maintained [6]. This highlights the need for structured, regular, and inclusive simulation-based training.

In January 2022, a UK-wide Patient Safety Alert reiterated the urgent need for hospitals to review their transfusion procedures and embed safe practices. Among its key recommendations was the implementation of regular simulation training in the management of major haemorrhage, with the aim of enhancing patient safety through system-level preparedness.

This toolkit has therefore been developed as a practical, dynamic repository of resources to support healthcare scientists, transfusion practitioners and wider clinical teams across the UK. Its purpose is to encourage inclusive simulation that reflects the entire transfusion pathway, incorporating clinical, laboratory, and logistical elements. By doing so, it aims to standardise practice, improve preparedness, and foster a culture of safety and learning.

Simulation training has long been recognised as an effective strategy for improving patient safety. It is defined as:

> ***"a technique that creates a situation or environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions"*** [(6)]**.**

Within healthcare, simulation has been shown to support crisis management, reduce error, enhance teamwork, and provide a safe environment for both technical and non-technical skill development [(7–11)].

Specifically, in transfusion medicine, simulation provides opportunities to perform critical tasks such as patient identification, blood component verification, activation of the massive transfusion protocol, and recognition of adverse transfusion reactions. Multidisciplinary simulations also foster clarity of roles, strengthen communication pathways, and help prevent "wrong blood to patient" errors. Importantly, they allow staff to learn from mistakes in a safe space, supported by structured debriefing to identify cognitive biases, system flaws, and opportunities for improvement. Simulation can also be used for induction of new staff, refresher training for experienced professionals, and standardisation of practice across different hospital departments.

In summary, this toolkit is designed to ensure that major haemorrhage simulation training is inclusive, evidence-based, and aligned with national safety priorities. It provides resources to empower transfusion staff to engage colleagues across disciplines in meaningful training, thereby embedding safer transfusion practices and improving outcomes for patients.

SIMULATION TRAINING

Simulation is an enhanced learning experience that replicates real-life situations and scenarios providing healthcare professionals the opportunity to refine their skills in a safe environment. It enables healthcare professionals to practice essential techniques such as surgery, patient care, and emergency management in a risk-free environment while fostering collaboration, effective communication, and teamwork. By simulating real-life medical situations, simulations can enhance patient safety without any risk to actual patients.

Different types of simulation training

Simulation training can take many different forms, each offering unique advantages depending on the learning objectives and available resources. From highly realistic live scenarios to innovative digital technologies such as virtual and augmented reality, these approaches allow healthcare teams to practise technical and non-technical skills in safe but engaging environments. Understanding the different types of simulation training available helps educators select the most appropriate method to meet the needs of learners and the clinical context. Here we present a range of simulation methods that are available, with some methods being more suited to enhance training in major haemorrhage settings than others.

Back to Contents page

High-Fidelity Simulation

High-fidelity simulation uses advanced manikins or immersive technologies to replicate realistic physiological responses and clinical environments. It can be delivered in two ways:

- **Classroom-Based High-Fidelity Simulation:** Conducted in simulation centres or dedicated training facilities, this method allows teams to practise complex clinical skills using state-of-the-art manikins that can simulate breathing, circulation, and other physiological functions. It is particularly valuable for rehearsing technical procedures such as airway management, vascular access, and blood administration, as well as for developing communication and leadership skills in a controlled environment.
- **In-Situ High-Fidelity Simulation:** This form of simulation uses the same state-of-the-art manikins but takes place in the actual clinical environment such as theatres, emergency departments, or maternity units and is especially powerful for testing systems as well as staff. By using realistic equipment and clinical spaces, in-situ simulation helps teams identify latent safety threats such as equipment availability, communication breakdowns, and logistical barriers that may not be apparent in a classroom setting.

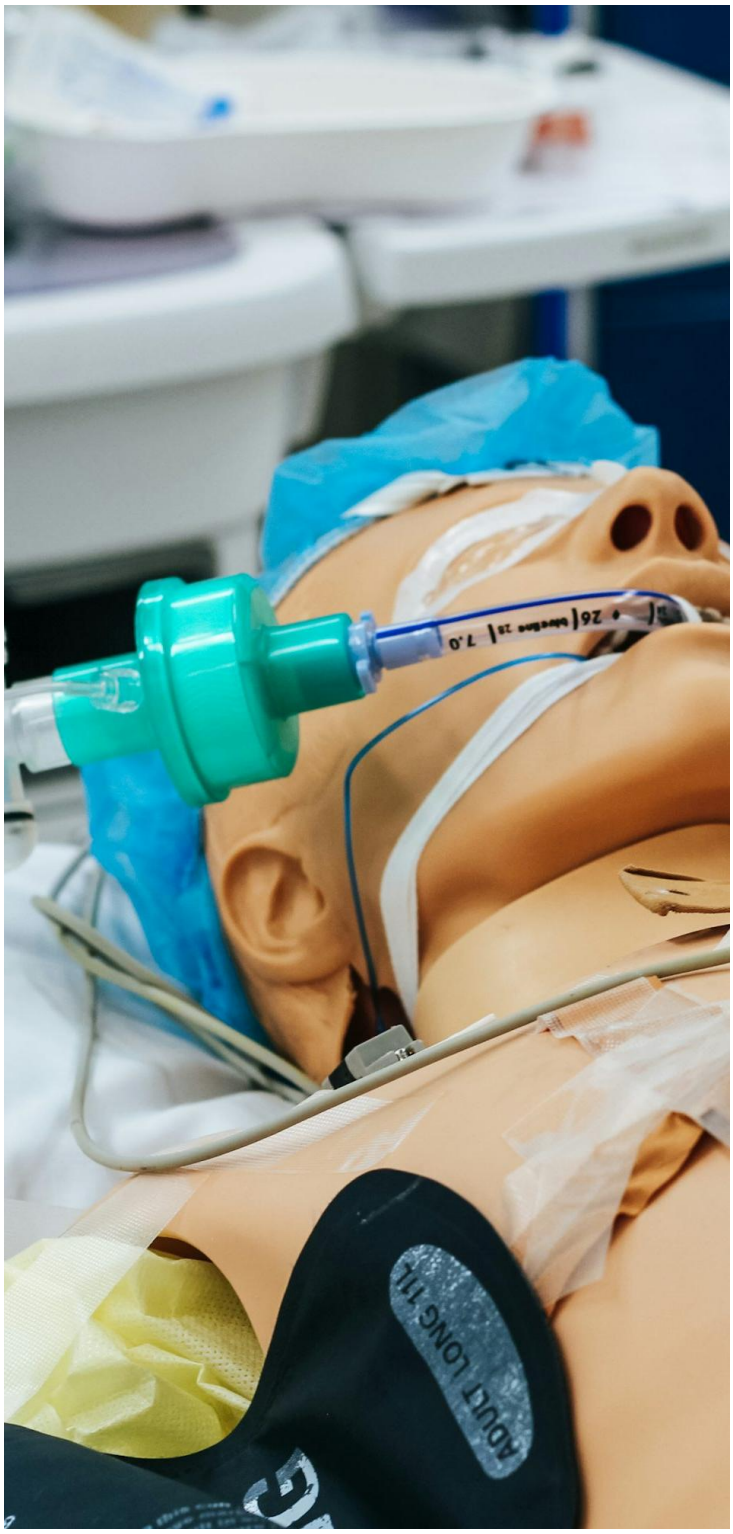

Photo by Tim Cooper on Unsplash

Mock scenarios-based learning

Mock scenario-based learning involves the enactment of structured case studies that mirror real-life clinical situations. Unlike high-fidelity simulations, these do not necessarily require advanced manikins or complex technology. Instead, they rely on carefully designed scenarios and role-playing to provide hands-on learning opportunities in a controlled setting. This approach helps bridge the gap between theory and practice, reinforcing clinical knowledge, teamwork, and communication skills without the need for highly technical equipment.

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Virtual Reality Simulation

VR simulation immerses participants in interactive, three-dimensional environments, usually accessed through a headset. This method allows learners to explore clinical scenarios in a fully digital space where they can practise procedures, rehearse decision-making, and respond to emergencies. VR provides high levels of immersion and standardisation while reducing reliance on physical resources, making it particularly useful for remote training or situations where access to simulation centres is limited.

Augmented Reality (AR) Simulation

AR simulation overlays digital information onto the physical environment, enriching the learning experience by combining real-world equipment with computer-generated guidance. For example, AR can provide visual prompts or highlight equipment during transfusion practice, helping staff understand processes step-by-step. By blending theoretical knowledge with practical application, AR promotes skill retention and confidence. It also allows for contextualised training in live clinical environments, supporting learners to translate knowledge directly into practice.

Key elements to simulation-based events

Effective simulation is built on a set of key design and delivery principles that ensure training is both realistic and impactful. These elements help create a structured learning environment where participants can practise safely, receive feedback, and refine their skills. By combining technical accuracy with opportunities for teamwork, reflection, and adaptation, these features maximise the value of simulation and support the transfer of learning into real clinical practice:

Realistic and Safe Simulations

Provide immersive, risk-free environments that ensure emotional support that mirror real-world conditions

Interactive and Immersive Tools

Use VR/AR and model-based learning for active engagement

Adaptive and Scenario-Based Learning

Tailor and vary scenarios to learner skill levels and organisational goals

Collaborative Role-Play

Foster teamwork and realistic decision-making through defined roles

Preparation

Ensure clear practical learning objectives before sessions to bridge the gap between theory and practice

Feedback and Continuous Improvement

Deliver real-time feedback, metrics, and iterative practice opportunities

Debriefing and Reflection

Use structured discussions to analyse performance and reinforce learning

Back to Contents page

Key Considerations Across Modalities

Regardless of the type of simulation used, all methods share essential features that underpin effective learning. Scenarios should be realistic and adaptable to different learner levels, supported by structured debriefs to reflect on performance. Emotional safety is critical, ensuring participants feel able to make mistakes and learn from them. Iterative practice, performance feedback, and the use of collaborative, cross-disciplinary approaches further strengthen the value of simulation. Finally, organisations should consider combining different modalities for example, classroom-based high-fidelity sessions with periodic in-situ drills to maximise both individual learning and system-level preparedness.

In summary, simulation training provides healthcare professionals with a safe and structured environment to practise essential skills, strengthen teamwork, and test system processes. Whether delivered through live scenarios, mock cases, or immersive technologies such as VR and AR, simulation fosters confidence, reduces error, and enhances preparedness for real-life emergencies such as major haemorrhage. By combining realistic practice with structured feedback and reflection, simulation ensures continuous learning and lasting improvements in patient safety.

KEY PERSONNEL

Managing major haemorrhage is a multidisciplinary task that requires the seamless coordination of clinical, laboratory, and logistical teams (such as porters). Effective simulation must therefore involve all key players in the transfusion pathway. Including laboratory staff and portering services ensures a truly end-to-end systems test, revealing weaknesses that traditional, clinically focused training may miss. This section outlines who should be involved in simulation sessions and why their role is critical to patient safety and protocol adherence. These are not prescriptive and may vary dependant upon staff availability and skill mix.

Clinical Educators / Simulation Facilitators

Rationale: Lead education and simulation delivery. Ensure clinical teams are prepared.

Responsibilities:

- Design and deliver simulation scenarios in alignment with current guidance
- Liaise with key personnel during the planning (e.g. Laboratory teams, Haematologists, Portering Managers)
- Conduct structured debriefs and support team reflection and learning
- Provide a report for the Clinical governance and/or Patient Safety Committee on the number of simulation sessions that occurred and participant feedback

Blood Transfusion Laboratory Staff

Rationale: Provision of blood components and products during emergencies. Simulation drills test lab communication, provision of emergency/group specific/cross-matched red cells as well as other blood components and products upon activation of the major haemorrhage protocol (MHP)

Responsibilities

- Team coordination
- Contribute to the design of the simulation planning
- Response times
- Component support until stood down
- Communication
- Be part of and actively contribute to the clinical debrief post event

Transfusion Practitioners

Rationale: Ensure safe transfusion practice, identify risks, and reinforce compliance with guidelines and recommendations to reduce patient harm and drive quality improvement.

Responsibilities

- Provide expert input into clinical transfusion simulation scenario planning in conjunction with the Clinical Educators / Simulation Facilitators
- Liaise with key personnel during the planning (e.g. Laboratory teams, Haematologists, Portering Managers)
- Provide feedback/debrief at the simulation session
- Trend MHP events within the organisation, reporting delays (in conjunction with local reporting systems to SHOT) and focusing on key areas for simulation training in conjunction with the Clinical Educators / Simulation Facilitators based on this data
- Offer follow up education if gaps are identified
- Provide a report for the Hospital Transfusion Committee on the number of simulation sessions that occurred and participant feedback

Porter Services

Rationale: Role in safe and timely collection and delivery of blood components. Ensure efficient delivery of emergency/group specific/cross-matched red cells as well as other blood components after activation of the major haemorrhage protocol (MHP)

Responsibilities

- Collections/delivery of urgent samples/blood components
- Response times
- Be part of the clinical debrief post event

Nurse and Midwives

Rationale: Early recognition of deteriorating patient, activation of MH, team coordination, and documentation

Responsibilities

- Identification of deteriorating patient
- Escalation
- Blood collection from satellite fridges/laboratory
- Safe blood administration
- Documentation
- Be part of the clinical debrief post event

Photo by Artur Tumasian on Unsplash

Lead Clinician (e.g., Anaesthetist, Obstetrician, Intensivist)

This will depend on the specific setting, scenario, and staff availability

Rationale: Lead resuscitation, management of patient

Responsibilities

- Lead resuscitation
- Team-based communication
- Safe blood administration
- Advice on the use of specific blood components or products
- Documentation
- Be part of the clinical debrief post event

Photo by CDC on Unsplash

Operating Department Practitioners

Rationale: Support, team coordination, and documentation

Responsibilities

- Blood collection from satellite fridge
- Prepare equipment
- Partake in blood component pre-administration checks
- Administer blood components if suitably trained and competent and this has been locally agreed within scope of practice
- Be part of the clinical debrief post event

Haematology Consultants and Resident Doctors

Rationale: Provide expert advice on complex transfusion decisions and use of specific blood components/products/haemostatic agents (e.g. fibrinogen, tranexamic acid) where required

Responsibilities

- Expert guidance
- Support
- May join debriefings or simulation planning sessions.

Healthcare Support Workers

Rationale: Support, team coordination, and documentation

Responsibilities

- Simulation inclusion ensures full MDT understanding of situational needs
- Documentation

Clinicians

Rationale: Contribute to decision making in emergency situations

Responsibilities

- Team-based communication, activation of MH, management of patient
- Need for Resident Doctors to be involved with consultant support
- Be part of the clinical debrief post event

Major haemorrhage simulation requires the active involvement of a wide range of professionals to ensure an authentic, end-to-end test of the transfusion pathway. From clinical educators who design and deliver scenarios, to transfusion practitioners, laboratory scientists, and portering services who test logistical systems, each role contributes essential expertise. Nurses, midwives, anaesthetists, ODPs, clinicians, and support staff are responsible for patient recognition, escalation, resuscitation, and safe administration of blood components. Haematology specialists provide expert transfusion guidance, while governance and patient safety leads ensure that lessons learned are embedded into wider organisational practice.

By engaging the full multidisciplinary team, simulation exercises not only improve individual performance but also strengthen communication, coordination, and system resilience in the management of major haemorrhage.

FREQUENCY OF TRAINING

Timely and regular simulation is essential for maintaining readiness, especially in rare but high-acuity events such as major haemorrhage. Clinical and laboratory teams can experience skill decay without reinforcement, and staff turnover can disrupt team dynamics. This section explores how often simulation training should occur, and which formats and frequencies are best suited to different environments and resource levels. It also addresses the value of in-situ training and the evidence base for low-dose, high-frequency models.

Training Frequency

Skills acquired through simulation-based training can deteriorate significantly within 6 to 12 months without reinforcement [(12)]. Evidence suggests that low-dose, high-frequency (LDHF) training (short, repeated sessions) is more effective in sustaining performance over time compared with infrequent, high-intensity events [(13)].For this reason, at a minimum, major haemorrhage (MH) simulation training should be delivered annually. However, biannual or even quarterly sessions are preferable in high-risk or high-turnover environments such as obstetrics, trauma, emergency departments, and theatres. Smaller-scale drills, including tabletop exercises or virtual simulations, can be used to complement full-scale events and help maintain readiness between larger training sessions. The Defence Medical Services (UK) recommend frequent and realistic MH simulations across all transfusion-capable sites, reflecting the rare but critical nature of MH and the challenges of frequent staff turnover. [(14)]

Photo by Agê Barros on Unsplash

In-situ, multidisciplinary simulations have also been shown to improve adherence to MH protocols, strengthen communication, and increase team confidence in decision-making [(15)]. Whenever possible, simulations should therefore be performed in the actual clinical environment, where they are best placed to reveal system-level issues and test real-world workflows.

Timing and Realism

In addition to routine scheduling, simulations should also be triggered opportunistically following certain events, for example, after a near miss or adverse incident, following updates to protocols as part of the change control process, during staff induction or rotation, or before and after the introduction of new equipment such as a LIMS upgrade, portable coolers, or point-of-care devices.

To maximise realism, training should not be confined to normal working hours; both nightshift and weekend simulations are valuable for testing system resilience. Using a combination of announced and unannounced exercises can further challenge teams and highlight hidden vulnerabilities, ensuring that training reflects the unpredictable nature of real emergencies. Although care should be taken when performing unannounced exercises to ensure that there is suitable staffing in all areas to ensure adequate patient safety when training is taking place.

FOLLOWING SIMULATION

Simulation is only valuable if it drives learning and improvement. Post-simulation activities such as structured debriefs, audits, and action planning are critical for embedding change, improving safety, and closing the loop on systems improvement. This section discusses how to capture learning from simulation events, engage staff in meaningful reflection, and use data to guide service development and education strategies.

Simulation does not end when the scenario stops, the real value comes from the structured, intentional follow-up. The post-simulation phase should serve as a bridge between training and meaningful change. This section outlines three key follow-up steps:

Debrief

Debriefing is a structured and psychologically safe discussion following the simulation. It helps teams explore what occurred, why it happened, and what could be improved. Effective debriefs uncover communication gaps, process breakdowns, or latent threats that may not be apparent during the event.

Audit

Auditing allows teams to quantify the outcomes of the simulation and identify both clinical and system related performance indicators. By comparing outcomes to national standards, local protocols, or benchmarks, simulation can reveal critical areas for service improvement.

Action

The ultimate goal of simulation is to drive change in behaviour, policy, workflow, and system design. After identifying issues through debrief and audit, concrete steps should be taken to improve practice and prevent harm.

Together, these components create a continuous cycle of quality improvement, learning, and safer patient care.

DEBRIEF

Best Practices:

- Use structured models (e.g., **PEARLS** – Promote Excellence and Reflective Learning in Simulation link)
- Focus on systems, not individuals
- Include all participants: clinical, laboratory, and portering staff
- Consider video-assisted debriefing for deeper reflection
- Have an experienced facilitator or simulation educator lead the session

There are several debriefing frameworks available; one is highlighted in the toolkit as an example, but this does not imply it is superior to others. Participants are encouraged to explore different options, as the key is to use a structured format and maintain an inclusive approach. See Resources section.

AUDIT

Key Metrics to Consider:

- Time from MH protocol activation to blood issue
- Time taken to deliver blood to the bedside
- Lab turnaround time for group & screen or crossmatch
- Number and types of communication delays or errors
- Use of correct blood component for the clinical indication

ACTION

Action Steps:

- Revise or update SOPs or MH protocols based on findings
- Deliver focused re-training or skill refreshers if gaps are identified
- Share lessons learnt via safety bulletins, governance meetings, or internal newsletters
- Track implementation of changes and re-audit if needed
- Engage patient safety teams or quality improvement leads for broader support

Back to Contents page

RESOURCES

To support the implementation of major haemorrhage simulation training, this toolkit includes a range of resources from clinical scenarios to practical tools for mock transfusion. These materials are designed to be flexible and adaptable across different hospital environments. They also include guidance on incorporating laboratory systems, setting up simulated patients in LIMS, and sourcing appropriate equipment. This section provides a consolidated list of these resources and relevant links for further support.

Clinical Major Haemorrhage Simulation Scenarios

Click here to access all major haemorrhage simulation scenarios

Template

All scenarios were created on this template which was based on the NHS Education for Scotland (NES) Clinical Skills Simulation Scenario [(16)]

Neonatal and Paediatric Major Haemorrhage

This paediatric scenario was developed by the team at Leeds Children's Hospital (please see acknowledgements for further details)

Major Obstetric Haemorrhage

The Obstetric scenario was created with the support of Clare Cook (see acknowledgments) and based on the information available from: Green-top Guideline No. 52 [(17)] and NICE Guidance NG235. [(18)]

Gastrointestinal Bleed

This scenario was created based on the information available from the simulation scenarios available from: Transfusion Ontario [(19)] and The Faculty of Intensive Care Medicine [(20)]

Surgical Bleed

This scenario was created based on the information available in the scenario developed by the Royal College of Anaesthetists [(21)]

Clinical Major Haemorrhage Simulation Tools

Blood Bags

Blood bag resources for different components and blood groups have been generated in line with ISBT 128 standards. The pack includes:

- **Red Blood Cells:** 4 x O neg, 4 x O pos, 4 x A neg, 4 x A pos, 4 x B neg, 4 x B pos
- **FFP:** 4 x A neg, 4 x B neg, 4 x AB neg
- **Cryoprecipitate:** 2 x A neg, 2 x B neg, 2 x AB neg
- **Platelets:** 2 x A neg, 2 A pos, 2 x B neg, 2 xB pos, 2 x AB neg, 2 x AB pos

Click here to access the blood bag resources for major haemorrhage simulation

Using 'Mock' Patient for Major Haemorrhage Simulation

This guidance document aims to provide helpful tips for successfully including electronic systems in major haemorrhage simulations.

Click here to access the 'mock' patient for major haemorrhage simulation

Debrief Tool

This document is aimed to support effective debrief following a Major Haemorrhage simulation and provides some guidance on what information to collect following the simulation

Click here to access debrief tool for major haemorrhage simulation

Additional debrief tools and related resources to support effective simulation training

Other tools and information to support with debriefing following a simulation event include:

- NHS Education for Scotland: Simulation Debriefing Guide
https://www.csmen.scot.nhs.uk/resources/simulation-toolbox/
- SHARE Debriefing Framework
https://www.england.nhs.uk/wp-content/uploads/2022/08/B1465-SHARE-Debrief-v1-FINAL.pdf

Click here to access the further resources for major haemorrhage simulation

Extending a MH scenario to a dual area and multi-team simulation

Leeds Children's Hospital

CASE STUDY

A cross department, multidisciplinary approach was undertaken in Leeds Children's Hospital to test our current processes of major haemorrhage using a high-fidelity simulation.

The scenario is the same as outlined in the paediatric major haemorrhage.

A patient was brought in by ambulance crew for initial trauma stabilisation by the emergency department team. As per protocol, the major trauma team was activated and the patient was subsequently transferred and managed in theatre.

Expanding the scenario to test handover between different teams and locations provided excellent insight into our current processes for major haemorrhage blood management (pre-hospital, emergency department and theatre). Post simulation analysis has informed changes that need to be made to our current workflows. Furthermore, there were specific key issues that were only identified due to the testing of a scenario across multiple departments/teams.

Examples of key learning outcomes, identified by testing the process across multiple locations rather than a single setting:

- Awareness in all departments of how to initiate a major haemorrhage and location of protocol
- Early blood samples for cross matching and named person to take sample to laboratory.
- Continuous communication with laboratory about severity of major haemorrhage, need for further blood components, location of patient, upcoming transfer to different locations and most appropriate blood fridge for delivery of blood components
- Need to include porters in this communication loop.
- Need to make additional teams aware of major haemorrhage (e.g. theatre coordinator, appropriate consultant colleagues (e.g. critical care, anaesthetics, surgeons).
- Need for dedicated scribe for blood components and subsequent documentation, ensuring documentation follows through for each location.
- Awareness of how a patient with significant blood loss can deteriorate following induction of anaesthesia and how to be prepared for this both surgically and anaesthetically
- We had the added benefit of having transfusion practitioners observing the simulation, their feedback was extremely helpful and gave the following learning points. If the transfusion laboratory receives a sample after emergency stock is given then it will be a "mixed field" result. This then requires ongoing provision of emergency group O blood which is then an ongoing cycle if patient requires further transfusions.
- Ensure everyone is aware where blood bank is located and who collects/delivers blood products.

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Back to Contents page

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Acknowledgements

This toolkit represents the collaborative efforts of transfusion specialists and clinical teams across the four nations of the UK. Developed with the support of SHOT and in alignment with national safety guidance, it reflects a shared commitment to enhancing patient safety through system-wide training. We gratefully acknowledge the contributions of all who provided insight, resources, and expertise in shaping this toolkit.

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Catherine Booth	Consultant Haematologist NHSBT and Barts Health NHS Trust

Special thanks to the following individuals and organisations who have supported the development of this toolkit:

Leeds Children's hospital for their input into creating the Neonatal Major Haemorrhage Scenario and providing the case study, with specific thanks to the following individuals:

Dr Hannah Shore
Consultant Neonatologist
Associate Director for Simulation and Technology enhanced learning
Leeds Children's hospital

Dr Louise Flynn
Consultant Paediatric Anaesthetist
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Dr Beverley Parker
Consultant Paediatric Anaesthetist
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For support with developing the Obstetric Major Haemorrhage simulation scenario:

Clare Cook
Registered Nurse and Midwife
Patient Blood Management Practitioner
NHS Blood and Transplant

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The Transfusion laboratories who supported the testing of the blood bag units:

NHS Dumfries and Galloway Health Board
Blood Transfusion Department
Dumfries and Galloway Royal Infirmary

Scottish National Blood Transfusion Service Dundee
Clinical Transfusion Laboratory
Ninewells Hospital

Bolton NHS Foundation Trust
Blood Transfusion Department
Royal Bolton Hospital

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Version 1. Effective from 7th January 2026