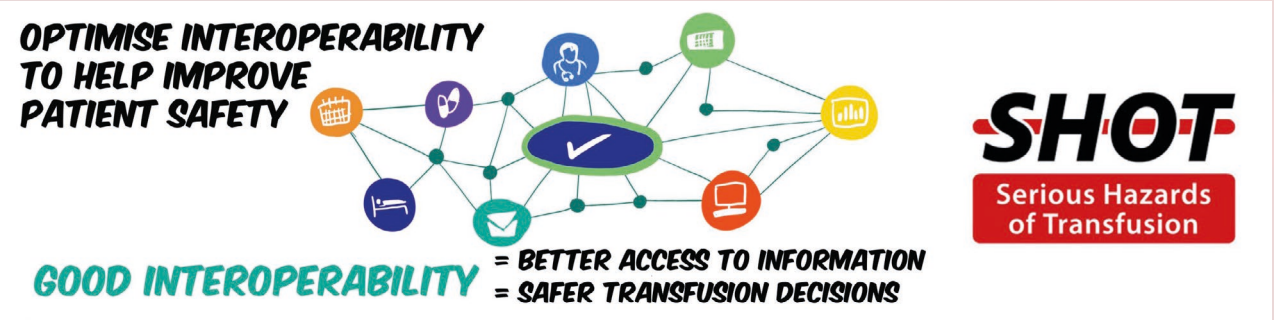
Using Information Technology for Safe Transfusion

SCRIPT

The **SHOT UK Collaborative Reviewing and reforming IT Processes in Transfusion (SCRIPT)** group aims to improve transfusion safety through improved IT systems and practices. IT can have a positive impact on transfusion safety, however for this to occur it must be properly designed, configured, and maintained. SHOT data has also shown individuals may have an over-reliance on IT systems, therefore they must have appropriate alerts and hard stops built in to prevent unnecessary overrides and prompt human decision making where appropriate. SHOT would like to acknowledge the members of the SCRIPT working group for their input in the development of this document.



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Why is this document needed?

Feedback from the SCRIPT user survey in 2020/21 suggested that transfusion services would appreciate more guidance on the functionality of transfusion IT. Actions for SCRIPT included reinforcing recommendations that electronic transfusion systems should be implemented, and to provide documentation on transfusion IT.

What does it contain?

This document has been created to support the implementation of safe IT systems within hospitals and transfusion laboratories. It details how properly developed and configured IT systems can be used in collaboration with staff skills and knowledge to improve patient safety.

How do I use it?

It is arranged in two sections, firstly by *Ten steps in the transfusion pathway* and secondly by *IT system*. Each section contains identical information, however, is arranged differently for ease of use. Please use the index page for each section to navigate the document.

Section 1: To access by transfusion step, click here

Section 2: To access by IT system, click here

This document is not a standard, but a guide.

Individual transfusion services should determine what functionality would be possible or beneficial to them.

Please refer to the British Society for Haematology (BSH) Guidelines for the Specification, Implementation and Management of IT Systems in Hospital Transfusion Laboratories https://b-s-h.org.uk/guidelines/guidelines

Please contact shot@nhsbt.nhs.uk if you have any queries regarding this document.

ABBREVIATIONS USED IN THIS DOCUMENT ▶

Using Information Technology for Safe Transfusion

Abbreviation	Definition
AIHA	Autoimmune haemolytic anaemia
BSH	British Society for Haematology
cffDNA	Cell-free fetal DNA
CMV	Cytomegalovirus
EBMS	Electronic Blood Management System
EDN	Electronic dispatch note
EPR	Electronic Patient Record
Hb	Haemoglobin
HLA	Human leucocyte antigen
HPA	Human platelet antigen
HSCT	Haemopoietic stem cell transplant
ID	Identification
Ig	Immunoglobulin
IT	Information technology
IUT	Intrauterine transfusion
LIMS	Laboratory information management system

Abbreviation	Definition
MCV	Mean cell volume
MHRA	Medicines and Healthcare Regulatory Agency
NHSBT	National Health Service Blood and Transplant
OC	Order Comms
PCC	Prothrombin complex concentrate
SaBTO	The Advisory Committee on the Safety of Blood, Tissues and Organs
SCD	Sickle cell disease
SHOT	Serious Hazards of Transfusion
SOT	Solid organ transplant
TACO	Transfusion associated circulatory overload
VMI	Vendor managed inventory
DOB	Date of birth
SCRIPT	SHOT UK Collaborative Reviewing and reforming IT Processes in Transfusion
GP	General Practitioner
UK	United Kingdom

THE TEN STEPS ▶

Ten steps in the transfusion pathway

Please use this part of the document to assess how IT in transfusion can be utilised within each of the 10 steps of the transfusion. Each step details how different IT systems can be used to improve transfusion safety. It may be useful for those evaluating the use of IT in a specific transfusion process or developing IT specific actions, or looking to implement transfusion IT. For example, when investigating recurrent incidents at a specific step.

Please click on the icon for the relevant step on the left to access the corresponding step in the document.

STEP ONE ▶

Clinical decision support for appropriate transfusion of blood components in accordance with British Society for Haematology (BSH) guidelines in Electronic Patient Record (EPR), Order Comms (OC) systems or stand-alone/equivalent systems specific for transfusion:

Reduce inappropriate transfusions:

- Functionality within systems enables best practice alerts for inappropriate blood component orders linked to relevant laboratory parameters (e.g., haemoglobin (Hb), platelet count, coagulation results, point of care testing results, clinical diagnosis)
- Supports interoperability with other clinical systems and devices that include information relevant to transfusion, with associated data flow (e.g., pharmacy/cell salvage/chemocare/EPR/blood tracking – stand-alone decision support)
- Functionality within systems to provide best practice alerts for consideration of alternatives to transfusion based on mean cell volume (MCV) and Hb levels
- System provides functionality to support individualised care pathways for chronically transfused patients based on Hb or other parameters for that patient
- System supports single red cell transfusion policy for haemodynamically stable adult patients
- System supports an alert where requests are out with local policy (e.g., excessive number of units (e.g., request for 10 units/pools of cryoprecipitate))
- System supports single unit platelet transfusion policy for defined conditions
- System displays clear transfusion history including component type, specific requirement, previous reactions, date/time of transfusion, volume transfused
- System displays and highlights transfusion specific patient history including red cell or platelet antibodies, known clinical conditions and specific requirements
- System provides functionality for hyperlinking to local or external sources of information supporting safe and appropriate decision-making practice

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1. DECISION TO TRANSFUSE AND CONSENT PATIENT

2. REQUEST

3. SAMPLE TAKING

4. SAMPLE AND REQUEST RECEIPT

5. TESTING

6. COMPONENT SELECTION

7. COMPONENT LABELLING

8. COMPONENT COLLECTION

9. PRESCRIPTION/AUTHORISATION

10. ADMINISTRATION, MONITORING FOR ANY REACTIONS AND DOCUMENTATION

- System could alert the user if the patient has previously refused blood components
- System can retain and update information relating to refusal of blood components
- System supports use of cell salvage, including booking devices for use and interoperability with devices for transfer electronic of data

Reduce risk of delays in transfusion:

- Functionality within systems provides best practice alerts to avoid delay in transfusion where multiple red cell antibodies (e.g., patient has autoimmune haemolytic anaemia (AIHA)) and Hb <60g/L
- Functionality in systems to support appropriate use are configured for non-urgent transfusion and do not impede provision of blood components in major haemorrhage scenarios
- Systems support local requirements for triggering the major haemorrhage, or trauma, pathways for rapid access and ordering of component ‘packs’ and specifies trigger phrases
- System supports appropriate and rapid access to, and prescription of, prothrombin complex concentrate (PCC)
- Clear notification to users indicating that the patient has specific requirements that may cause delay in transfusion. For example presence of (or historic presence) red cells antibodies, irradiated components needed, washed components, human leukocyte antigen (HLA)/ human platelet antigen (HPA) matched platelets

Reduce risk of failure to meet specific requirements:

- System provides ability to indicate any special requirements for transfusion (e.g., irradiated, cytomegalovirus (CMV) negative, HbS negative, washed components, HLA/HPA matched, blood warmer) that are electronically transferred to the prescription/authorisation record and to the laboratory information management system (LIMS)
- System has the ability to accept information from other electronic systems (e.g., pharmacy, chemotherapy, LIMS) that relates to transfusion (e.g., requirement for irradiated components, laboratory results)
- System supports hyperlinking to local and external guidance for best practice
- System provides the ability to indicate where certain patient groups may require specialist testing (e.g., phenotyping in chronically transfused groups including sickle cell disease and thalassaemia

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Reduce risk of pulmonary complications, over and under transfusion:

- System supports use of transfusion associated circulatory overload (TACO) risk assessment for at risk patients (e.g., paediatric, low weight adults, heart failure, pulmonary oedema, significant positive fluid balance)
- System support calculation of red cell transfusion requirements based on patient weight and target Hb (weight adjusted red cell dosing)
- System support calculation of platelet or plasma component transfusion requirements based on internationally recognised formula
- Provision of integrated red cell calculator, this might be an integrated option, or as a separate pop-up box

Supports appropriate management of anti-D Ig in pregnancy:

- System has functionality to support management of anti-D Ig in pregnancy (see anti-D Ig document)

Support for consent for transfusion of blood components in accordance with SaBTO in Electronic Patient Record (EPR), Order Comms (OC) systems or stand-alone/ equivalent systems specific for transfusion:

- Systems include a prompt/field for confirmation of patient consent for transfusion
- Systems provide access/prompt to information about transfusion suitable for clinical staff (e.g., risks of transfusion, alternatives to transfusion, specific requirements) and patients (e.g., patient information leaflets, SHOT website, NHS information), including accessible and translated documents
- Where chronically transfused patients – consent should be frequently (e.g., annually) renewed in accordance with SaBTO guidelines
- System could alert the user if the patient has previously refused blood components and products
- System can retain and update information relating to refusal of blood components and products

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10. ADMINISTRATION, MONITORING FOR ANY REACTIONS AND DOCUMENTATION

Electronic Blood Management System (EBMS) support:

- Interoperability with other clinical systems that include information relevant to transfusion, with associated data flow

Reduce risk of delays in transfusion:

- Remote issue of red cells in accordance with local requirements
- Rapid access to emergency group O red cells with full audit trail from collection to administration to the patient
- Rapid access to other emergency products such as PCC and fibrinogen concentrates. Including audit trails for reconciliation to patient record for traceability.

Laboratory Information Management System (LIMS) include:

- Interoperability with other clinical systems that include information relevant to transfusion, with associated data flow

Reduce inappropriate transfusions:

- Functionality that enables best practice alerts for inappropriate orders linked to relevant laboratory parameters (e.g., Hb, platelet count, coagulation results, point of care testing results, clinical diagnosis)

Reduce risk of delays in transfusion:

- Electronic issue rules for red cells in accordance with local requirements, supporting rapid release of red cells from the laboratory and remote issue blood fridges
- Functionality supporting appropriate release of anti-D Ig and PCC
- Functionality supporting issue of emergency group O red cells and other emergency products as determined by local requirements
- Should record that patient information leaflet has been provided, with hyperlinks to relevant local document
- Should be recorded as part of consent process that consent for transfusion has been confirmed, including risks of transfusion

STEP TWO ▶

Electronic Patient Record (EPR), Order Comms (OC) systems or stand-alone/equivalent systems specific for transfusion:

Reduce risk of manual transcription errors:

- System can electronically transmit orders for blood components, products (e.g., anti-D Ig) and laboratory tests to the LIMS, including any specific requirements for components
- System can receive data from the LIMS relating to the progress of the order (e.g., order received, order being processed, order completed)
- Ability to generate a printed order form including all data requirements in accordance with BSH guidelines for use where samples are being taken in remote setting and where the electronic sample taking system cannot be used. Order forms include a barcode of the patient medical record number and/or NHS number for safe scanning in the LIMS
- Can send test/order cancellation messages, with reason for cancellation, to other clinical systems (EPR, Order Comms)

Reduce delays in transfusion:

- Orders have a priority level, date/time (optional), and transfusion location at the point of order (e.g., emergency, urgent, routine, referral) that is transmitted to the LIMS
- Remote issue – system has ability to order to remote issue, with ability to distinguish between remote issue and laboratory issue

Reduce inappropriate transfusions:

- Are configurable to restrict access to ordering tests/components to staff groups/individuals in accordance with local requirements
- Must not allow an order for red cells for transfusion at a future date to proceed where there will be no valid sample for laboratory release. Red cell orders must be linked to a sample that will be valid to the date/time of transfusion

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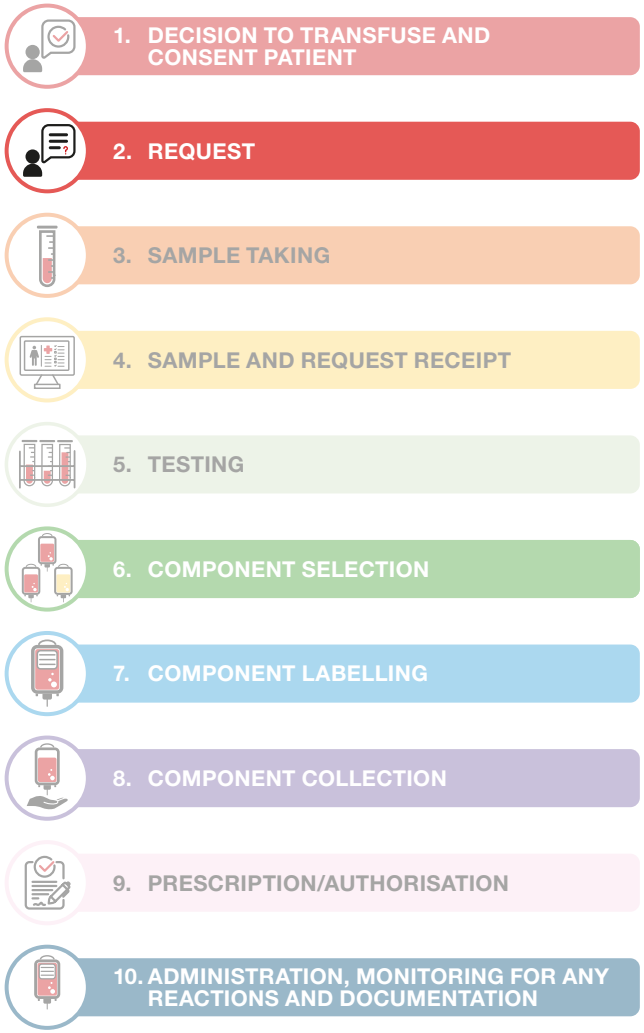

Laboratory Information Management System (LIMS) include:

Reduce risk of manual transcription errors:

- Functionality to accept all information relating to transfusion, including patient demographics, clinical details, orders for tests, components and products.
- Ability to prioritise the urgency of orders in worklists that are clear to the users and based on order requirement information from EPR/OC.
- Functionality to accept order cancellations from EPR/OC and remove tests/components with audit trail.
- Functionality that prevents a current valid sample accession number being applied to an order for red cells that will be outside of the current sample validity

STEP THREE ▶

Electronic Patient Record (EPR), Order Comms (OC) systems, EBMS or stand-alone/ equivalent systems specific for transfusion:

Reduce risk of wrong blood in tube:

- Enforce sample labelling at the patient side and positive patient identification (e.g., include enforced scanning of patient ID band, time-out function for re-scanning ID band if process takes too long, checklist or confirmation of initial positive patient identification)
- Include all BSH requirements for sample labelling on the label. Provide a configurable label for local requirements where these differ from BSH
- Do not allow printing of multiple sample labels without an auditable override
- Do not allow labels to print from a device that is not part of the phlebotomy event equipment (e.g., to a remote or centralised printer)
- Support safe sample collection (e.g., providing information on the dangers of wrong blood in tube events)
- Inform the user of the sample expiry date/time
- Support the group-check policy, if appropriate (e.g., by guiding the user on sample requirements, preventing collection of 2 samples at the same time by the same person)
- System does not display a copy of patient ID band on the screen which could be used as a form of identification

Laboratory Information Management System (LIMS) include:

- Functionality to generate a laboratory accession number that is transmitted to the EPR/OC/EBMS/equivalent and is printed on the sample label at source
- Sample number/accession number must not be duplicated for reuse

STEP FOUR ▶

Laboratory Information Management System (LIMS) include:

Reduce risk of manual transcription errors:

- Ability to accept electronically labelled samples by scanning the accession number on the label where orders are electronic.
- Ability to identify correct patient from a scan of the barcode on a paper generated order form
- Ability to accept patient demographics (and associated updates) from a centralised patient administration system (e.g., EPR/OC).

Reduce delays in transfusion:

- Ability to manage sample validity in accordance with BSH guidelines
- Ability to transmit messages to the EPR/OC/EBMS/equivalent relating to sample progress that are clear to the user (e.g., sample received, sample being processed)
- Ability to transmit message to user (via EPR/OC/EBMS) where the sample has been rejected due to mislabelling or other deficiency, where message includes reason for rejection

Reduce risk of failure to meet transfusion specific requirements:

- Ability to alert the user where there is a potentially duplicate record (e.g., another patient record with the same NHS number, name and DOB)
- Clear display of any transfusion specific requirements

Electronic Patient Record (EPR), Order Comms (OC) systems, EBMS or stand-alone/ equivalent systems specific for transfusion:

- Include ability to accept all messages from the LIMS relating to sample management (e.g., progress in the laboratory, rejection, validity date and time)

STEP FIVE ▶

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10. ADMINISTRATION, MONITORING FOR ANY REACTIONS AND DOCUMENTATION

Laboratory Information Management System (LIMS) include:

Reduce risk of laboratory errors:

- Full interfacing of all results and tests performed on an automated analyser
- Ability to interpret raw results from the analytical system into a derived ABO/D blood group result
- Ability to alert where current result is discrepant from historical result
- Ability to report where ABO/D grouping result is indeterminate. Until indeterminate results are confirmed/clarified this should not be viewable by the clinical area
- Include a verification process for confirmation of correct ABO/D type where tests have been performed manually (e.g., check of individual reactions against selected ABO/D type
- Provide ability for reflex testing in accordance with local requirements and best practice (e.g., antibody identification from a positive antibody screen)
- Rules that support compliance with electronic issue (and remote issue) of red cells in accordance with BSH and MHRA recommendations. Including where patient records are flagged as HSCT or solid organ transplant
- Rules that support calculation of fetomaternal haemorrhage from Kleihauer (or alternative) testing
- Interoperability with external referral laboratories for electronic transfer of test order and results
- Automated addition of relevant coded comments based on test results (e.g., requirement for anti-D Ig based on cffDNA result)
- cffDNA should be clearly linked with current pregnancy
- Process to identify where manual testing has occurred on a sample and prevent the use of electronic issue using this sample
- Hyperlinks, or easy access, to standard operating procedures for laboratory staff
- Support use across multiple laboratory sites. Where different LIMS are used across sites they should include interoperability to ensure visibility of critical information relating to transfusion
- When LIMS are replaced, there is ability to migrate all critical information relating to transfusion in such a way that safe practice in maintained in the new system

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Transfusion analyser platforms include:

- Electronic transfer of all results to the LIMS, including flags where results have been recorded manually or edited
- Process for electronic read and transfer of results from manual testing where the relevant technology has been used
- Electronic printing of antibody identification results for manual interpretation
- Decision support for exclusion and inclusion of antibody specificities for antibody identification
- Flagging of potentially spurious/weak results (e.g. in red cell phenotyping) and requirement for manual review of these results

STEP SIX ▶

Laboratory Information Management System (LIMS) include:

- Algorithms for safe and appropriate selection of all blood components based on compatibility (ABO, D and other specified antigens), age, sex, specific requirements, sample validity, unresolved blood group anomaly, exchange transfusions, intrauterine transfusion (IUT), neonatal, and specific clinical reasons (e.g., haemopoietic stem cell transplant (HSCT), solid organ transplant (SOT), sickle cell anaemia and thalassaemia)
- Block to assigning, and releasing, ABO incompatible red cells from patient record
- Algorithms for safe release of anti-D Ig (see anti-D Ig document)
- Rules that support safe release of red cells for neonates where eligible for ‘electronic’ issue and where serological testing is required
- Ability to alert the user where tests on the patient sample are incomplete
- Flags/alerts that are meaningful and required justification, with full audit trail
- Ability to release safe red cells (and other component/products) for emergency use (e.g., must prevent release of ABO incompatible blood components where there is no blood group/no named patient)
- Ability to release group specific or equivalent red cells using rapid release techniques. Where tests are not complete (e.g., antibody screening) this should not impede rapid release of ABO/D compatible red cells
- Rules that support the use of the 2-sample rule if appropriate, e.g., only allow group O red cells for release on a single sample
- Rules that support antigen matching in the presence and absence of red cell alloantibodies
- Interoperability with Blood Services electronic system for transfer of component attributes (e.g., electronic dispatch notice (EDN), vendor managed inventory (VMI))

STEP SEVEN ▶

1. DECISION TO TRANSFUSE AND CONSENT PATIENT

2. REQUEST

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10. ADMINISTRATION, MONITORING FOR ANY REACTIONS AND DOCUMENTATION

Laboratory Information Management System (LIMS)/EBMS include:

- Printing of compatibility labels that include the relevant information in accordance with BSH guidelines
- Compatibility labels that include the level of compatibility (e.g., compatible for, suitable for, emergency)
- Compatibility labels that include a barcode that can be used with the EPR/EBMS or equivalent for safe scanning at the point of administration
- A process for verification that the correct compatibility label has been applied to the correct component before the component is released for collection
- Where remote issue is used with labels printed at the point of collection the process must include confirmation that the label has been applied to the pack. Where the process has not been completed correctly an alert must be generated that is audible and visual to the user and in the laboratory

STEP EIGHT ▶

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Laboratory Information Management System (LIMS)/EBMS/EPR or equivalent include:

Reduce delays in transfusion:

- A process for identification and display of the storage location of the component for collection
- A process for generating a 'pick-up' slip that contains relevant patient and component information and can be used in the collection process

Regulatory requirements:

- A process for verification of the collector's training and competency to complete the task

Support patient safety:

- A process for confirmation that the correct component has been collected for the patient identified in the pick-up slip. Including an alert to the user and the laboratory where there are failures in this process
- Confirmation that the correct component has been collected, as detailed in the pick-up slip
- Confirmation that component matches any specific requirements

Reduce handling and storage errors:

- Management of de-reservation of blood components and the production of a list of units which are beyond their reservation period.
- e.g., The dereservation date/time should default to (whichever is the shortest):
  - Date/time specified by the Blood Service on the product/component label
  - The date/time that the sample validity ends
  - 24 hours from the time that the blood component is required
- Units which are no longer suitable for use (e.g., past their expiry date, out of temperature control) must be blocked from being returned to stock for re-issue

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- Support remote quarantining of blood components in satellite blood fridges (e.g., transfusion reactions, recall of units)
- Where smart fridges are not used the system must alert the user if a component is removed that is not suitable for use

Temperature monitoring systems:

- Include an escalation process that ensures relevant personnel are alerted immediately where there are temperature excursions in component storage devices
- Include decision support and audit trail for actions taken following temperature excursions
- Overview by management

STEP NINE ▶

1. DECISION TO TRANSFUSE AND CONSENT PATIENT

2. REQUEST

3. SAMPLE TAKING

4. SAMPLE AND REQUEST RECEIPT

5. TESTING

6. COMPONENT SELECTION

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8. COMPONENT COLLECTION

9. PRESCRIPTION/AUTHORISATION

10. ADMINISTRATION, MONITORING FOR ANY REACTIONS AND DOCUMENTATION

Electronic Patient Record (EPR), Order Comms (OC) systems or stand-alone/equivalent systems specific for transfusion:

- Includes confirmation that the correct component is to be administered in accordance with the prescription
- Includes confirmation of all specific requirements for the component/patient (e.g., irradiated, washed, CMV negative, HLA/HPA matched, blood warmer, pre-medications etc.) as ordered by the clinician
- Includes instructions of the time-period for administration, volume of component and pump settings where appropriate
- Process for ensuring that blood component prescriptions are completed or cancelled, as appropriate within the prescription time frame
- Includes confirmation of consent and TACO considerations

STEP TEN ▶

Electronic Patient Record (EPR), Order Comms (OC) systems, EBMS or stand-alone/ equivalent systems specific for transfusion:

Patient safety:

- Enforces safety scan of patient ID band against component and compatibility label information, with safety features (e.g., include enforced scanning of patient ID band, time-out function for re-scanning ID band if process takes too long, checklist or confirmation of initial positive patient identification)
- Enforces confirmation that positive patient identification has been performed
- Visual and audible alerts to user and laboratory where there are errors in the process including, discrepancy between patient ID and component label ID, component out of storage for too long
- Ability to scan administration set and alert user if incorrect type used for component
- Alerts the user in cases where the component has been administered over the recommended transfusion time
- Includes confirmation that the prescription has been reviewed before transfusion can be started
- Enforces recording of observations during and post transfusion
- Where consent has not been obtained prior to transfusion there is a process to ensure this is recorded post transfusion
- Alerts the user where the component is due to expire before the transfusion is due to complete.
- Access controls based on staff training and competency assessment, with time bound reminders when re-training required
- System should prompt clinicians about clinically significant red cell antibodies at point of discharge to be included in discharge letters and for patient education
- System should provide discharge leaflet which includes sufficient information regarding signs and symptoms of reactions post transfusion and contact details for advice

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Management of transfusion reactions:

- Confirms that all observations have been performed in accordance with BSH guidelines and alerts the user when they are due/overdue
- Enforces specific aspects of the transfusion process in the clinical documentation process such as, scan of donation number, volume transfused, transfusion start/end, benefit, and outcome
- Provides a process for alerting the user to a potential transfusion reaction, e.g., using early warning scores, patient symptoms, changes in observations
- Provides clinical decision support for management of transfusion reactions and follow up testing based on reaction type

Safe blood donation post transfusion:

- Includes transfusion of blood components on discharge summaries for the patient and GP or care other providers

Electronic administration pump systems:

- Ability to scan administration set and alert user if incorrect type selected for component
- Ability to input component volume and transfusion duration to calculate rate of administration

LIMS, Electronic Patient Record (EPR), Order Comms (OC) systems, EBMS or stand-alone/equivalent systems specific for transfusion:

- Provide a platform that supports traceability of components from vein to vein, or final disposal. Including chain of custody, cold chain compliance and all other activities relating to traceability

IT SYSTEMS ▶

ELECTRONIC PATIENT RECORDS SYSTEMS

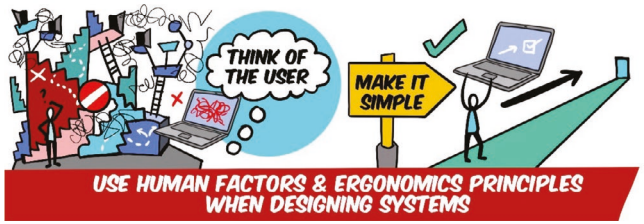
ELECTRONIC BLOOD MANAGEMENT SYSTEMS

LABORATORY INFORMATION MANAGEMENT SYSTEMS

TRANSFUSION ANALYSER PLATFORMS

TEMPERATURE MONITORING SYSTEMS

ELECTRONIC ADMINISTRATION PUMP SYSTEMS



Transfusion IT system

Please use this part of the document to assess how individual transfusion IT systems can be utilised to improve patient safety. Each step of the transfusion process is considered within each system. It may be useful for those evaluating the functionality of their existing systems or considering the implementation of further transfusion IT. Please note, the transfusion IT systems discussed may not apply to each step in the transfusion pathway.

Please click on the icon for the relevant system on the left to access the corresponding system in the document.

SYSTEM ONE ▶

ELECTRONIC PATIENT RECORDS SYSTEMS
ELECTRONIC BLOOD MANAGEMENT SYSTEMS
LABORATORY INFORMATION MANAGEMENT SYSTEMS
TRANSFUSION ANALYSER PLATFORMS
TEMPERATURE MONITORING SYSTEMS
ELECTRONIC ADMINISTRATION PUMP SYSTEMS

This section covers clinical decision support for appropriate transfusion of blood components in accordance with BSH guidelines in Electronic Patient Record (EPR), Order Comms (OC) systems or stand-alone/equivalent systems specific for transfusion:

STEP 1: DECISION TO TRANSFUSE AND CONSENT PATIENT

Reduce inappropriate transfusions:

- Functionality within systems enables best practice alerts for inappropriate blood component orders linked to relevant laboratory parameters (e.g., haemoglobin (Hb), platelet count, coagulation results, point of care testing results, clinical diagnosis)
- Supports interoperability with other clinical systems and devices that include information relevant to transfusion, with associated data flow (e.g., pharmacy/cell salvage/chemocare/EPR/blood tracking – stand-alone decision support)
- Functionality within systems to provide best practice alerts for consideration of alternatives to transfusion based on mean cell volume (MCV) and Hb levels
- System provides functionality to support individualised care pathways for chronically transfused patients based on Hb or other parameters for that patient
- System supports single red cell transfusion policy for haemodynamically stable adult patients
- System supports an alert where requests are out with local policy (e.g., excessive number of units (e.g., request for 10 units/pools of cryoprecipitate)
- System supports single unit platelet transfusion policy for defined conditions
- System displays clear transfusion history including component type, specific requirement, previous reactions, date/time of transfusion, volume transfused
- System displays and highlights transfusion specific patient history including red cell or platelet antibodies, known clinical conditions and specific requirements
- System provides functionality for hyperlinking to local or external sources of information supporting safe and appropriate decision-making practice

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ELECTRONIC PATIENT RECORDS SYSTEMS
ELECTRONIC BLOOD MANAGEMENT SYSTEMS
LABORATORY INFORMATION MANAGEMENT SYSTEMS
TRANSFUSION ANALYSER PLATFORMS
TEMPERATURE MONITORING SYSTEMS
ELECTRONIC ADMINISTRATION PUMP SYSTEMS

- System could alert the user if the patient has previously refused blood components
- System can retain and update information relating to refusal of blood components
- System supports use of cell salvage, including booking devices for use and interoperability with devices for electronic transfer of data

Reduce risk of delays in transfusion:

- Functionality within systems provides best practice alerts to avoid delay in transfusion where multiple red cell antibodies (e.g., patient has autoimmune haemolytic anaemia (AIHA)) and Hb <60g/L
- Functionality in systems to support appropriate use are configured for non-urgent transfusion and do not impede provision of blood components in major haemorrhage scenarios
- Systems support local requirements for triggering the major haemorrhage, or trauma, pathways for rapid access and ordering of component 'packs' and specifies trigger phrases
- System supports appropriate and rapid access to, and prescription of, prothrombin complex concentrate (PCC)
- Clear notification to users indicating that the patient has specific requirements that may cause delay in transfusion. For example, presence of (or historic presence) red cells antibodies, irradiated components needed, washed components, human leukocyte antigen (HLA)/ human platelet antigen (HPA) matched platelets

Reduce risk of failure to meet specific requirements:

- System provides ability to indicate any special requirements for transfusion (e.g., irradiated, cytomegalovirus (CMV) negative, HbS negative, washed components, HLA/HPA matched, blood warmer) that are electronically transferred to the prescription/authorisation record and to the laboratory information management system (LIMS)
- System has the ability to accept information from other electronic systems (e.g., pharmacy, chemotherapy, LIMS) that relates to transfusion (e.g., requirement for irradiated components, laboratory results)
- System supports hyperlinking to local and external guidance for best practice
- System provides the ability to indicate where certain patient groups may require specialist testing (e.g., phenotyping in chronically transfused groups including sickle cell disease and thalassaemia)

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Reduce risk of pulmonary complications, over and under transfusion:

- System supports use of transfusion associated circulatory overload (TACO) risk assessment for at risk patients (e.g., paediatric, low weight adults, heart failure, pulmonary oedema, significant positive fluid balance)
- System support calculation of red cell transfusion requirements based on patient weight and target Hb (weight adjusted red cell dosing)
- System support calculation of platelet or plasma component transfusion requirements based on internationally recognised formula
- Provision of integrated red cell calculator, this might be an integrated option, or as a separate pop-up bo

Supports appropriate management of anti-D Ig in pregnancy:

- System has functionality to support management of anti-D Ig in pregnancy (see anti-D Ig document)

Support for consent for transfusion of blood components in accordance with SaBTO in Electronic Patient Record (EPR), Order Comms (OC) systems or stand-alone/equivalent systems specific for transfusion:

- Systems include a prompt/field for confirmation of patient consent for transfusion
- Systems provide access/prompt to information about transfusion suitable for medical staff (e.g., risks of transfusion, alternatives to transfusion, specific requirements) and patients (e.g., patient information leaflets, SHOT website, NHS information), including accessible and translated documents
- Where chronically transfused patients –consent should be frequently (e.g., annually) renewed in accordance with SaBTO guidelines
- System could alert the user if the patient has previously refused blood components and products
- System can retain and update information relating to refusal of blood components and products

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STEP 2: REQUEST

Reduce risk of manual transcription errors:

- System can electronically transmit orders for blood components, products (e.g., anti-D Ig) and laboratory tests to the LIMS, including any specific requirements for components
- System can receive data from the LIMS relating to the progress of the order (e.g., order received, order being processed, order completed)
- Ability to generate a printed order form including all data requirements in accordance with BSH guidelines for use where samples are being taken in remote setting and where the electronic sample taking system cannot be used. Order forms include a barcode of the patient medical record number and/or NHS number for safe scanning in the LIMS
- Can send test/order cancellation messages, with reason for cancellation, to other clinical systems (EPR, Order Comms)

Reduce delays in transfusion:

- Orders have a priority level, date/time (optional), and transfusion location at the point of order (e.g., emergency, urgent, routine, referral) that is transmitted to the LIMS
- Remote issue – system has ability to order to remote issue, with ability to distinguish between remote issue and laboratory issue

Reduce inappropriate transfusions:

- Are configurable to restrict access to ordering tests/components to staff groups/individuals in accordance with local requirements
- Must not allow an order for red cells for transfusion at a future date to proceed where there will be no valid sample for laboratory release. Red cell orders must be linked to a sample that will be valid to the date/time of transfusion

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STEP 3: SAMPLE TAKING

Reduce risk of wrong blood in tube:

- Enforce sample labelling at the patient side and positive patient identification (e.g., include enforced scanning of patient ID band, time-out function for re-scanning ID band if process takes too long, checklist or confirmation of initial positive patient identification)
- Include all BSH requirements for sample labelling on the label. Provide a configurable label for local requirements where these differ from BSH
- Do not allow printing of multiple sample labels without an auditable override
- Do not allow labels to print from a device that is not part of the phlebotomy event equipment (e.g., to a remote or centralised printer)
- Support safe sample collection (e.g., providing information on the dangers of wrong blood in tube events)
- Inform the user of the sample expiry date/time
- Support the 2-sample policy, if appropriate (e.g., by guiding the user on sample requirements, preventing collection of 2 samples at the same time by the same person)
- System does not display a copy of patient ID band on the screen which could be used as a form of identification

STEP 4: SAMPLE AND REQUEST RECEIPT

- Include ability to accept all messages from the LIMS relating to sample management (e.g., progress in the laboratory, rejection, validity date and time)

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STEP 9: PRESCRIPTION/AUTHORISATION

- Includes confirmation that the correct component is to be administered in accordance with the prescription
- Includes confirmation of all specific requirements for the component/patient (e.g., irradiated, washed, CMV negative, HLA/HPA matched, blood warmer, pre-medications etc.) as ordered by the clinician
- Includes instructions of the time-period for administration, volume of component and pump settings where appropriate
- Process for ensuring that blood component prescriptions are completed or cancelled, as appropriate within the prescription time frame
- Includes confirmation of consent and TACO considerations

STEP 10: ADMINISTRATION, MONITORING FOR ANY REACTIONS AND DOCUMENTATION

Patient safety:

- Enforces safety scan of patient ID band against component and compatibility label information, with safety features (e.g., include enforced scanning of patient ID band, time-out function for re-scanning ID band if process takes too long, checklist or confirmation of initial positive patient identification)
- Enforces confirmation that positive patient identification has been performed
- Visual and audible alerts to user and laboratory where there are errors in the process including, discrepancy between patient ID and component label ID, component out of storage for too long
- Ability to scan administration set and alert user if incorrect type used for component
- Alerts the user in cases where the component has been administered over the recommended transfusion time
- Includes confirmation that the prescription has been reviewed before transfusion can be started
- Enforces recording of observations during and post transfusion
- Where consent has not been obtained prior to transfusion there is a process to ensure this is recorded post transfusion

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- Alerts the user where the component is due to expire before the transfusion is due to complete.
- Access controls based on staff training and competency assessment, with time bound reminders when re-training required
- System should prompt clinicians about clinically significant red cell antibodies at point of discharge to be included in discharge letters and for patient education
- System should provide discharge leaflet which includes sufficient information regarding signs and symptoms of reactions post transfusion and contact details for advice

Management of transfusion reactions:

- Confirms that all observations have been performed in accordance with BSH guidelines and alerts the user when they are due/overdue
- Enforces specific aspects of the transfusion process in the clinical documentation process such as, scan of donation number, volume transfused, transfusion start/end, benefit, and outcome
- Provides a process for alerting the user to a potential transfusion reaction, e.g., using early warning scores, patient symptoms, changes in observations
- Provides clinical decision support for management of transfusion reactions and follow up testing based on reaction type

Safe blood donation post transfusion:

- Includes transfusion of blood components on discharge summaries for the patient and GP or care other providers
- Be part of a platform that supports traceability of components from vein to vein, or final disposal. Including chain of custody, cold chain compliance and all other activities relating to traceability

SYSTEM TWO ▶

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STEP 1: DECISION TO TRANSFUSE AND CONSENT PATIENT

- Interoperability with other clinical systems that include information relevant to transfusion, with associated data flow

Reduce risk of delays in transfusion:

- Remote issue of red cells in accordance with local requirement
- Rapid access to emergency group O red cells with full audit trail from collection to administration to the patient
- Rapid access to other emergency products such as PCC and fibrinogen concentrates. Including audit trails for reconciliation to patient record for traceability.

STEP 3: SAMPLE TAKING

Reduce risk of wrong blood in tube:

- Enforce sample labelling at the patient side and positive patient identification (e.g., include enforced scanning of patient ID band, time-out function for re-scanning ID band if process takes too long, checklist or confirmation of initial positive patient identification)
- Include all BSH requirements for sample labelling on the label. Provide a configurable label for local requirements where these differ from BSH
- Do not allow printing of multiple sample labels without an auditable override
- Do not allow labels to print from a device that is not part of the phlebotomy event equipment (e.g., to a remote or centralised printer)
- Support safe sample collection (e.g., providing information on the dangers of wrong blood in tube events)
- Inform the user of the sample expiry date/time
- Support the 2-sample policy, if appropriate (e.g., by guiding the user on sample requirements, preventing collection of 2 samples at the same time by the same person)
- System does not display a copy of patient ID band on the screen which could be used as a form of identification

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STEP 4: SAMPLE AND REQUEST RECEIPT

- Include ability to accept all messages from the LIMS relating to sample management (e.g., progress in the laboratory, rejection, validity date and time)

STEP 7: COMPONENT LABELLING

- Where remote issue is used with labels printed at the point of collection the process must include confirmation that the label has been applied to the pack. Where the process has not been completed correctly an alert must be generated that is audible and visual to the user and in the laboratory

STEP 8: COMPONENT COLLECTION

Reduce delays in transfusion:

- A process for identification and display of the storage location of the component for collection
- A process for generating a 'pick-up' slip that contains relevant patient and component information and can be used in the collection process

Regulatory requirements:

- A process for verification of the collector's training and competency to complete the task

Support patient safety:

- A process for confirmation that the correct component has been collected for the patient identified in the pick-up slip. Including an alert to the user and the laboratory where there are failures in this process
- Confirmation that the correct component has been collected, as detailed in the pick-up slip
- Confirmation that component matches any specific requirements

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Reduce handling and storage errors:

- Management of de-reservation of blood components and the production of a list of units which are beyond their eservation period.
- e.g., The de-reservation date/time should default to (whichever is the shortest):
  - Date/time specified by the NHSBT on the product label
  - The date/time that the sample validity ends
  - 24 hours from the time that the blood component is required
- Units which are no longer suitable for use (e.g., past their expiry date, out of temperature control) must be blocked from being returned to stock for re-issue
- Support remote quarantining of blood components in satellite blood fridges (e.g., transfusion reactions, recall of units)
- Where smart fridges are not used the system must alert the user if a component is removed that is not suitable for use

STEP 10: ADMINISTRATION, MONITORING FOR ANY REACTIONS AND DOCUMENTATION

Patient safety:

- Enforces safety scan of patient ID band against component and compatibility label information, with safety features (e.g., include enforced scanning of patient ID band, time-out function for re-scanning ID band if process takes too long, checklist or confirmation of initial positive patient identification)
- Enforces confirmation that positive patient identification has been performed
- Visual and audible alerts to user and laboratory where there are errors in the process including, discrepancy between patient ID and component label ID, component out of storage for too long
- Ability to scan administration set and alert user if incorrect type used for component
- Alerts the user in cases where the component has been administered over the recommended transfusion time
- Includes confirmation that the prescription has been reviewed before transfusion can be started

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- Enforces recording of observations during and post transfusion
- Where consent has not been obtained prior to transfusion there is a process to ensure this is recorded post transfusion
- Alerts the user where the component is due to expire before the transfusion is due to complete.
- Access controls based on staff training and competency assessment, with time bound reminders when re-training required
- System should prompt clinicians about clinically significant red cell antibodies at point of discharge to be included in discharge letters and for patient education

Management of transfusion reactions:

- Confirms that all observations have been performed in accordance with BSH guidelines and alerts the user when they are due/overdue
- Enforces specific aspects of the transfusion process in the clinical documentation process such as, scan of donation number, volume transfused, transfusion start/end, benefit, and outcome
- Provides a process for alerting the user to a potential transfusion reaction, e.g., using early warning scores, patient symptoms, changes in observations
- Provides clinical decision support for management of transfusion reactions and follow up testing based on reaction type

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STEP 1: DECISION TO TRANSFUSE AND CONSENT PATIENT

- Interoperability with other clinical systems that include information relevant to transfusion, with associated data flow

Reduce inappropriate transfusions:

- Functionality that enables best practice alerts for inappropriate orders linked to relevant laboratory parameters (e.g., Hb, platelet count, coagulation results, point of care testing results, clinical diagnosis)

Reduce risk of delays in transfusion:

- Electronic issue rules for red cells in accordance with local requirements, supporting rapid release of red cells from the laboratory and remote issue blood fridges
- Functionality supporting appropriate release of anti-D Ig and PCC
- Functionality supporting issue of emergency group O red cells and other emergency products as determined by local requirements
- Should record that patient information leaflet has been provided, with hyperlinks to relevant local document
- Should be recorded as part of consent process that consent for transfusion has been confirmed, including risks of transfusion

STEP 2: REQUEST

Reduce risk of manual transcription errors:

- Functionality to accept all information relating to transfusion, including patient demographics, clinical details, orders for tests, components and products.
- Ability to prioritise the urgency of orders in worklists that are clear to the users and based on order requirement information from EPR/OC.
- Functionality to accept order cancellations from EPR/OC and remove tests/components with audit trail.
- Functionality that prevents a current valid sample accession number being applied to an order for red cells that will be outside of the current sample validity

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STEP 3: SAMPLE TAKING

- Functionality to generate a laboratory accession number that is transmitted to the EPR/OC/EBMS/equivalent and is printed on the sample label at source
- Sample number/accession number must not be duplicated for reuse

STEP 4: SAMPLE AND REQUEST RECEIPT

Reduce risk of manual transcription errors:

- Ability to accept electronically labelled samples by scanning the accession number on the label where orders are electronic.
- Ability to identify correct patient from a scan of the barcode on a paper generated order form
- Ability to accept patient demographics (and associated updates) from a centralised patient administration system (e.g., EPR/OC).

Reduce delays in transfusion:

- Ability to manage sample validity in accordance with BSH guidelines
- Ability to transmit messages to the EPR/OC/EBMS/equivalent relating to sample progress that are clear to the user (e.g., sample received, sample being processed)
- Ability to transmit message to user (via EPR/OC/EBMS) where the sample has been rejected due to mislabelling or other deficiency, where message includes reason for rejection

Reduce risk of failure to meet transfusion specific requirements:

- Ability to alert the user where there is a potentially duplicate record (e.g., another patient record with the same NHS number, name and DOB)
- Clear display of any transfusion specific requirements

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STEP 5: TESTING

Reduce risk of laboratory errors:

- Full interfacing of all results and tests performed on an automated analyser
- Ability to interpret raw results from the analytical system into a derived ABO/D blood group result
- Ability to alert where current result is discrepant from historical result
- Ability to report where ABO/D grouping result is indeterminate. Until indeterminate results are confirmed/clarified this should not be viewable by the clinical area
- Include a verification process for confirmation of correct ABO/D type where tests have been performed manually (e.g., check of individual reactions against selected ABO/D type
- Provide ability for reflex testing in accordance with local requirements and best practice (e.g., antibody identification from a positive antibody screen)
- Rules that support compliance with electronic issue (and remote issue) of red cells in accordance with BSH and MHRA recommendations. Including where patient records are flagged as HSCT or solid organ transplant
- Rules that support calculation of fetomaternal haemorrhage from Kleihauer (or alternative) testing
- Interoperability with external referral laboratories for electronic transfer of test order and results
- Automated addition of relevant coded comments based on test results (e.g., requirement for anti-D Ig based on cffDNA result)
- cffDNA should be clearly linked with current pregnancy
- Process to identify where manual testing has occurred on a sample and prevent the use of electronic issue using this sample
- Hyperlinks, or easy access, to standard operating procedures for laboratory staff
- Support use across multiple laboratory sites. Where different LIMS are used across sites they should include interoperability to ensure visibility of critical information relating to transfusion
- When LIMS are replaced, there is ability to migrate all critical information relating to transfusion in such a way that safe practice in maintained in the new system

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STEP 6: COMPONENT SELECTION

- Algorithms for safe and appropriate selection of all blood components based on compatibility (ABO, D and other specified antigens), age, sex, specific requirements, sample validity, unresolved blood group anomaly, exchange transfusions, intrauterine transfusion (IUT), neonatal, and specific clinical reasons (e.g., haemopoietic stem cell transplant (HSCT), solid organ transplant (SOT), sickle cell anaemia and thalassaemia)
- Block to assigning, and releasing, ABO incompatible red cells from patient record
- Algorithms for safe release of anti-D Ig (see anti-D Ig document)
- Rules that support safe release of red cells for neonates where eligible for 'electronic' issue and where serological testing is required
- Ability to alert the user where tests on the patient sample are incomplete
- Flags/alerts that are meaningful and required justification, with full audit trail
- Ability to release safe red cells (and other component/products) for emergency use (e.g., must prevent release of ABO incompatible blood components where there is no blood group/no named patient)
- Ability to release group specific or equivalent red cells using rapid release techniques. Where tests are not complete (e.g., antibody screening) this should not impede rapid release of ABO/D compatible red cells
- Rules that support the use of the 2-sample rule if appropriate, e.g., only allow group O red cells for release on a single sample
- Rules that support antigen matching in the presence and absence of red cell alloantibodies
- Interoperability with Blood Services electronic system for transfer of component attributes (e.g., electronic dispatch notice (EDN), vendor managed inventory (VMI))

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STEP 7: COMPONENT LABELLING

- Printing of compatibility labels that include the relevant information in accordance with BSH guidelines
- Compatibility labels that include the level of compatibility (e.g., compatible for, suitable for, emergency)
- Compatibility labels that include a barcode that can be used with the EPR/EBMS or equivalent for safe scanning at the point of administration
- A process for verification that the correct compatibility label has been applied to the correct component before the component is released for collection
- Where remote issue is used with labels printed at the point of collection the process must include confirmation that the label has been applied to the pack. Where the process has not been completed correctly an alert must be generated that is audible and visual to the user and in the laboratory

STEP 8: COMPONENT COLLECTION

Reduce delays in transfusion:

- A process for identification and display of the storage location of the component for collection
- A process for generating a 'pick-up' slip that contains relevant patient and component information and can be used in the collection process

Regulatory requirements:

- A process for verification of the collector's training and competency to complete the task

Support patient safety:

- A process for confirmation that the correct component has been collected for the patient identified in the pick-up slip. Including an alert to the user and the laboratory where there are failures in this process
- Confirmation that the correct component has been collected, as detailed in the pick-up slip
- Confirmation that component matches any specific requirements

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Reduce handling and storage errors:

- Management of de-reservation of blood components and the production of a list of units which are beyond their reservation period.
- e.g., The de-reservation date/time should default to (whichever is the shortest):
  - Date/time specified by the NHSBT on the product label
  - The date/time that the sample validity ends
  - 24 hours from the time that the blood component is required
- Units which are no longer suitable for use (e.g., past their expiry date, out of temperature control) must be blocked from being returned to stock for re-issue
- Support remote quarantining of blood components in satellite blood fridges (e.g., transfusion reactions, recall of units)
- Where smart fridges are not used the system must alert the user if a component is removed that is not suitable for use

Temperature monitoring systems:

- Include an escalation process that ensures relevant personnel are alerted immediately where there are temperature excursions in component storage devices
- Include decision support and audit trail for actions taken following temperature excursions

STEP 10: ADMINISTRATION, MONITORING FOR ANY REACTIONS AND DOCUMENTATION

- Provide a platform that supports traceability of components from vein to vein, or final disposal. Including chain of custody, cold chain compliance and all other activities relating to traceability

SYSTEM FOUR ▶

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STEP 5: TESTING

- Electronic transfer of all results to the LIMS, including flags where results have been recorded manually or edited
- Process for electronic read and transfer of results from manual testing where the relevant technology has been used
- Electronic printing of antibody identification results for manual interpretation
- Decision support for exclusion and inclusion of antibody specificities for antibody identification
- Flagging of potentially spurious/weak results (e.g., in red cell phenotyping) and requirement for manual review of these results

SYSTEM FIVE ▶

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STEP 8: COMPONENT COLLECTION

- Include an escalation process that ensures relevant personnel are alerted immediately where there are temperature excursions in component storage devices
- Include decision support and audit trail for actions taken following temperature excursions
- Overview by management

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STEP 10: ADMINISTRATION, MONITORING FOR ANY REACTIONS AND DOCUMENTATION

- Ability to scan administration set and alert user if incorrect type selected for component
- Ability to input component volume and transfusion duration to calculate rate of administration