
RIGHT PATIENT RIGHT BLOOD PILOT

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Executive summary

The Croydon University Hospital (formerly Mayday Hospital) pilot for the Right Patient, Right Blood pilot was initiated and funded by NHS Connecting for Health (NHS CFH). The pilot had three main aims as clearly set out in the tender documentation and in the presentation made to the selection panel.

Firstly our objective was to establish if, within a district general hospital setting an electronic blood transfusion system could be implemented and integrated with the patient administration system (PAS), electronic requesting system and pathology information systems to improve the safety of the system by incorporating, electronic fail safes and reducing human error.

Secondly we wished to explore the use of Radiofrequency Identification (RFID) technology as well as a wireless and mobile infrastructure to further enhance the process, bring the critical identification steps to "the bedside" thus involving the patient and open up the possibility of real time tracking of blood products thus minimising waste.

Lastly, in the clear awareness that the necessary technological investment could not be justified by the blood transfusion process alone, we wished to make a hard headed assessment of how deploying and integrating these technologies could be leveraged to deliver other clinical IT systems such that the quality, innovation and productivity benefits of such systems would help justify the cost of the improvements in blood transfusion safety.

We believe that the pilot has generated a huge amount of invaluable learning, both positive and negative, for the original vision of the pilot.

Whilst the first objective was achieved we were unable to fully incorporate the RFID component into the system largely because of **critical** dependencies on third party providers, particularly the Pathology LIMS supplier.

The second aim was richly addressed but some of the more useful learning was of the "how not to do it" variety. This included some of the hardware platforms trialled and the way in which RFID scanning devices were connected. There were also issues with the specification and design of the wireless networks with asset tracking and wireless data capabilities variably reconciled. However the introduction throughout the Trust of patient wristbands with embedded high frequency RFID chips was successful.

The third aim was also fulfilled though we were struck by the transience of some of the proposed applications. A proposal to track mattresses as part of the management of Clostridium difficile infection was obviated before it could be trialled by the success of the Trust in practically eliminating C.diff though other measures.

A significant development is that The Learning Clinic's VitalPac clinical system is being rolled out through the Trust with huge expected benefit for patient safety and length of stay. It is unlikely that this would have been done without the pre-existing wireless technology and RFID identification; the Trust is working with VitalPac to use the RFID patient ID bracelets to facilitate and enrich the use of their system. However the success of the Trust in bringing in other clinical systems using these technologies

has also raised the challenge of integrating them as much as possible to avoid a proliferation of software systems and bedside devices. These challenges continue to be addressed and the Trust will be delighted to continue to share its experience and learning

Dr T Newman-Sanders, Clinical Director, Emergency Care; RPRB Project SRO.

1 Background

Croydon University Hospital (CUH) was selected by NHS CFH to pilot an electronic blood tracking system which complies with the Electronic Clinical Transfusion Management System (ECTMS) specification. The ECTMS was jointly developed by the National Patient Safety Agency (NPSA), National Blood Transfusion Committee (NBTC) and Serious Hazards of Transfusion (SHOT). The specification is endorsed by NHS Connecting for Health (NHS CFH) who was responsible for delivering the National Programme for Information Technology (NPfIT).

The ECTMS provides guidance on how to ensure that patients receive blood which is issued specifically for them (Right Patient - Right Blood). It aims to reduce the risk of patient identification errors and focuses on improving safety of blood transfusion from sampling through to administration. The implementation is to be consolidated by ensuring the competency of all staff involved in the blood transfusion pathway.

This report describes the implementation process, changes in clinical practice and lessons learnt.

The system performance evaluation includes:

- Compliance with the ECTMS IT specification
- Effectiveness for managing blood
- Reduction of likelihood of errors in blood transfusions
- Potential applicability to other areas of healthcare delivery

Areas for the pilot were chosen on the basis of the number of blood transfusions undertaken, the nature of the requirement i.e. non urgent, emergency and outpatient and the availability of a wireless network.

The pilot areas were:

- intensive therapy unit and high dependency unit
- two surgical wards
- main theatres 5 and 9
- life blood suite

The pilot was funded by NHS CFH. Lessons learnt from the pilot are to be used by NHS CFH to inform the NHS, Local Service Providers and suppliers how ECTMS can be delivered in any acute hospital setting.

2 System description

To achieve end to end blood tracking various clinical IT functions needed to be integrated. At CUH the following systems were used in the pilot. Please refer to **Appendix 1** for top level system architecture and table of software used in the pilot.

- iSOFT Clinicom
- CliniSys Winpath
- Neoteric BloodTrack

2.1 iSOFT Clinicom

Clinicom, an iSOFT Plc application, is used by the Trust for patient administration, issuing of wristbands, issuing of blood collection requests and ordering of all diagnostic tests including requests for blood products and components.

2.2 CliniSys Winpath

Winpath, a Clin iSys application, is used by the Trust for processing pathology requests. This includes recording all sample requests, test results, stock control, issue and fating of blood products and components.

The system is used for the following:

- Recording sample requests
- Recording results of tests
- Stock control
- Issue and recording of blood products and components

For end to end tracking of blood units it was necessary for the Trust's pathology system to communicate in real time with the BloodTrack system.

2.3 Neoteric BloodTrack

The Trust had to purchase an electronic blood tracking solution. An Invitation to Tender was issued in July 2007 for the acquisition of a system. A detailed evaluation of the responses was undertaken and two suppliers shortlisted. Both were invited to the Trust to present their system.

Based on the initial tender response and outcome of the presentation, Neoteric Technology Ltd was chosen to provide their BloodTrack system. The system consists of a main database server, a management application and various optional modules.

Neoteric provided CUH a technical specification which detailed the system architecture, server specification and network configuration requirements. A pre-installation survey was conducted to determine the required hardware, number of network points and power sockets, and physical location suitability for installation.

2.3.1 BloodTrack server

The Trust sourced the BloodTrack server hardware which hosts the live database and business services including reporting. A server specification was provided by the blood tracking supplier.

2.3.2 BloodTrack manager

A desktop PC was installed in the Blood Transfusion Laboratory to host the BloodTrack management application designed for system administrators and users in the laboratory. This facility enables blood bank staff to electronically oversee and monitor the state and use of blood units. It also controls who has access to BloodTrack. Only trained users will be granted access, the levels of which are determined by roles e.g. porter, phlebotomist, and nurse. Roles are configurable by the BloodTrack system administrator; this role is fulfilled at the Trust by the Trust Transfusion Practitioner and senior Blood Transfusion Laboratory staff.

2.3.3 BloodTrack Courier

The BloodTrack Courier module is used to control blood fridge access. The system is used for delivery of blood throughout the hospital; it is not restricted to the pilot areas. The main issue fridge is located in the blood transfusion department, and three satellite fridges are in Maternity, Main Theatres and Life Blood Suite.

A self-contained unit (kiosk) with touchscreen PC and scanner was wall-mounted by each of four blood fridges in the Trust; a main issue fridge in the blood issue room within the Blood Transfusion department and three satellite fridges. A single power outlet and one network point were required for each installation. Backboards were fitted where required.

A blood stock fridge, a platelet agitator and a fridge for batched products are located in the Blood Transfusion Laboratory and it is intended in the future to link these with BloodTrack Courier.

BloodTrack has a number of features which help ensure that users remove the “correct” Blood from the fridge.

There are three methods of deployment described below with a varying degree of complexity. The Trust has implemented the third option which is the more advanced patient safety solution.

Option 1

In its simplest configuration, when a user scans the blood out of the fridge the patient’s details are displayed on the screen. The user will then acknowledge if the information is correct by selecting “OK”.

Option 2

The user must type in the patient’s hospital number on the kiosk PC before collecting blood. If there is blood for that patient in the fridge BloodTrack will release the fridge door lock. The user must then scan the unit of blood removed from the fridge and BloodTrack will confirm the appropriate unit has been collected. If there is no blood in the fridge for that patient then BloodTrack will not release the lock.

Option 3

At the next level, blood collection slips with a barcoded patient ID can be used. This option has been deployed at CUH using the Trust Order Comms system, which enables the user to check blood availability for collection before raising a request.

The system is configured to print the completed blood collection slip in the porter's office. A request is always followed by a phone call to the porter's office confirming the request. Increased efficiency is achieved as the porter can now go directly to the issue fridge for collection, instead of going to the requesting ward first to pick up the slip. The blood collection process itself is quicker and the risk of collecting the wrong blood is reduced.

2.3.4 BloodTrack Tx

BloodTrack Tx module is a software application and is used at the ward locations for phlebotomy, recording of blood arrival and blood administration. BloodTrack Tx has been installed on mobile devices, Computers on Wheels (COWs) and tablet PCs, which can be used at the patient's bedside.

The BloodTrack Tx desktop enables users to positively identify patients, correctly label sample tubes at the bedside, record transfusion details including begin and end times, reactions and vital signs.

3 Measure of compliance with ECTMS specification

3.1 ECTMS Trust compliance report

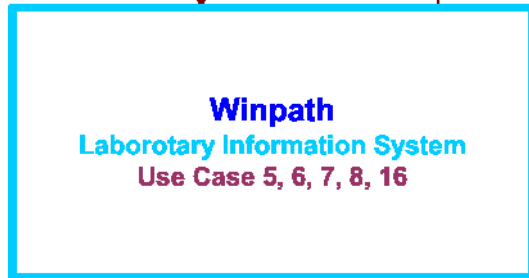
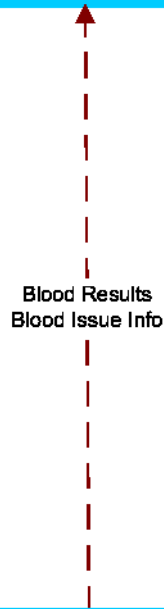
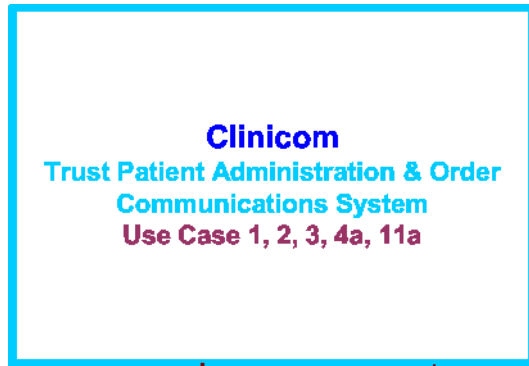
One of the key outcomes of the pilot was a review of the electronic blood tracking system implemented and its compliance with the ECTMS specification and Use Cases. Diagram 1 shows the IT systems, Clinicom, Winpath and BloodTrack available to the Trust to investigate potential compliance with the ECTMS specification and a summary table of the level of compliance with each Use Case. The e-Prescribing system is a future requirement. No single application could meet all of the requirements stated; an integration of systems is required.

An in-depth analysis of the Use Cases against the system implemented was undertaken. Compliance measure was grouped as follows:

- Full compliance
- Partial compliance
- Planned for future implementation
- Requiring additional resources to achieve compliance
- Compliance is achievable but cannot be physically tested at the Trust

A detailed report has been produced which expands on the above criteria and the level of compliance achievable for each Use Case.

Please refer to **Appendix 2** for ECTMS Compliance report.



Use Case	Description	ce
Use Case 1+2	Patient is uniquely identified by an appropriate member of staff	F
Use Case 3	Transfusion history is obtained prior to completion of the request for transfusion	F
Use Case 4	Request form is completed, blood sample is collected, sample tube is labelled and sent to the laboratory	Partial
Use Case 4a	Request form is completed	Partial
Use Case 4b	Blood sample is collected and labelled	Full
Use Case 5	Request and sample processed by blood transfusion lab	Partial
Use Case 6	Request for blood unit made to Supplier	Future
Use Case 7	Blood unit received by blood transfusion laboratory	Future
Use Case 8	Laboratory matches blood to patient	Partial
Use Case 9	Blood unit transferred to issue fridge	Cannot test
Use Case 10	Blood unit is prescribed by authorised clinician	Future
Use Case 11a	Collection of blood product is arranged	Partial
Use Case 11b	Blood unit collected for use	Partial
Use Case 12a	Blood unit recorded as arrived in clinical area	Full
Use Case 12b	Blood unit administered to patient	Full



3.2 ECTMS - autologous blood

The ECTMS does not reference processes related to autologous blood – where a patient’s own blood is used, provided in advance, for a transfusion. This was raised with the Blood Safety IT Steering Group to consider whether autologous blood needs to be addressed in a future, revised version of the ECTMS.

Autologous blood

There are 4 types of autologous transfusion to be considered for inclusion in the ECTMS:

1. Pre deposit autologous. This is not offered at CUH and is generally losing favour.
2. Intra operative cell salvage. CUH do use this; the blood and apparatus do not leave the patient.
3. Acute normovolaemic haemodilution. This is where approximately 1 to 2 units of blood is taken from a patient immediately pre op then given back to them during the operation. This is not in use at CUH.
4. Post operative cell salvage. This is where blood is collected via a drain inserted into the wound and later given back to the patient. CUH have a policy and the unit is currently labelled by hand. This is mainly used in orthopaedic surgery.

3.3 ECTMS use case 10 - e-Prescribing

ECTMS Use Case 10 is concerned with blood being prescribed by an authorised clinician.

The Project Initiation Document stated there is not currently an “E” prescription system in place and suggests a possible workaround consisting of the generation of a prescription request after which a prescription form will be printed out and placed in the patient’s healthcare records.

A workaround was produced using the Trust Order Communications system; this was subject to a risk assessment. Appendix 3 describes how the Trust Order Communications system is used for electronic ordering of blood tests and also shows example of the e-prescription request form in section 5.3.

A review of the processes highlighted areas of concern. Current prescription charts have a section for intravenous fluids which includes all fluids, blood components and products. The prescription form would be a sheet of paper separate to the existing prescription chart; which introduces risks to the patient. These risks are set out in the extract of the risk assessment below, Diagram 2.

Concerns are:

- single sheets of paper are easy to mislay, discard in error or file inappropriately.
- nurses/midwives could “miss” the requirement of a patient’s transfusion if the prescription sheet is not with the prescription chart.
- during major haemorrhage and care of very unwell patients, fluid balance will be more difficult to calculate as fluids and blood components/products are in different places.

Other workarounds were discussed such as producing labels with the prescription information printed on them; these would be placed onto the existing prescription chart. Another option could be the information being printed directly onto the drug chart. Both of these options would require development and additional costs.

The safest and most appropriate avenue would be a Trust wide “e” prescription system for all inpatient medicines and fluids. This system would need to be based on a functional specification and would be a major IT undertaking and would require separate funding and project management and is therefore not viable within the constraints of the Right Patient – Right Blood Pilot.

Diagram 2 - E-Prescribing: Extract of Risk Assessment

Re f.	Summary description of activity/ event that give rise to risk	Foreseeable adverse factors contributing to the risk	What is the Risk?		Current Controls				Potential Further Controls to Reduce Risks	Costs of further Controls			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	ECTMS suggests prescription of blood components should be an "Electronic order". Trust currently has no "E" prescribing system. There fore a work around was formalised in PID- to generate a prescription request via Order Comms this would then be printed and placed in notes.	Introduces dual system with medication and IV therapy on prescription card and transfusion prescription on printed sheets of paper.	Impact on Service	4	All drug prescriptions for intra hospital medications on one prescription card.	3	12	HIGH	Trust wide "E" prescribing system to negate dual prescribing.	Unknown.	1	4	LOW

	Transfusion prescriptions on single sheets separate from prescription chart.	Single sheet of transfusion prescription may be lost- clinical staff may then not be aware of transfusion requirement and transfusion may not be administered.	Impact on Person	4	All drug prescriptions for intra hospital medications are on one prescription card.	3	12	HIGH	Single system for all drug prescriptions.	None as is current system.		0	LOW
	Transfusion prescriptions on single sheets separate from prescription chart.	In massive transfusion would be difficult to see patients total infused volumes as IV therapy and transfused components are not together.	Impact on Person	4	All drug prescriptions for internal hospital medications are on one prescription card.	5	20	EXTREME	Single prescription system- as in use currently or Trust wide E prescribing for all drugs.	E system- cost unknown. Current system none.	1	4	LOW
	Element of decision support specified in ECTMS for prescribing of blood components and products.	Limited scope for decision support on SAM.	Impact on Service	2	Manually prescribed on prescription chart.	2	4	LOW	Trust wide "E" prescribing system to negate dual prescribing.	E system- cost unknown. Current system none.	2	4	LOW

RISK SCORE = IMPACT x LIKELIHOOD

Likelihood	Impact				
	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

RISK RATING

Low (1-4)	Moderate (5-9)	High (10-12)	Extreme (15-25)
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4 Resources

The project was funded by NHS CFH who closely monitored the pilot and played a major part in communication of the learning to the wider NHS. A blood pilot steering group was established to review implementation and evaluation of the pilot.

A formal project board was set up at the Trust to oversee and manage the project. Project tasks were driven and completed by project team members. The main resource groups are listed below.

INTERNAL
Project board & project manager
Project team
Trust transfusion practitioner
Blood transfusion laboratory staff
IT support
ICT training
Portering supervisors
Ward sisters
Estate and facilities . installation of data and power points
EXTERNAL
NHS CFH funding and communication of learning
Neoteric project management , technical & development
CliniSys project management , technical & development
E.Novation interface development

The project was led by Clinical Director Dr Tony Newman-Sanders and Lead Consultant Haematologist Dr Hilary Lumley.

Numerous system pathology upgrades and interfacing requirements placed a large demand on Blood Transfusion Laboratory resources to undertake testing and validation to satisfy the Medicines and Healthcare products Regulatory Agency (MHRA) requirements in line with the Blood Safety and Quality Regulations 2005 (BSQR).

The Regulations set the standards of quality and safety for the collection, testing, processing, storage and distribution of human blood and blood components. It is the legislation which requires and provide for the MHRA to have powers to monitor compliance. Inspections of hospital blood banks may be carried out by the MHRA and they have the authority to close down a blood bank. Extensive validation and evidence reporting is therefore crucial when implementing new methods/ processes within the Blood Transfusion Laboratory.

The project would have benefited from having a dedicated Biomedical Scientist (BMS) and Trust Transfusion Practitioner (TTP) as well as some additional sessions for the lead consultant in blood transfusion during the implementation phase. Funding was allocated for a third of the TTP's post at the outset of the project; this was

intended to backfill the post while the TTP concentrated on project work but proved impractical to fill due to unavailability of a suitable person for a temporary period.

The necessity for the blood transfusion staff to undertake project work alongside routine laboratory and ongoing work to meet national directives impacted heavily on project delivery timescales.

Significant input was also required from the Trust IT department to deliver the wireless network and new client platforms used in the pilot.

Implementing BloodTrack using tablet PCs, mobile carts, Bluetooth and passive RFID technology constituted new developments for the blood tracking system supplier and involved a considerable amount of work. They were however “expected” challenges which were met in a timely fashion.

The requirement to incorporate a unique identifier component and integrate BloodTrack with Winpath resulted in a large body of work for the Trust LIMS provider. The LIMS supplier deliverables were impacted upon by the need to complete unforeseen developments to comply with guidelines driven by the MHRA and DH, and the preference to minimize the number of software versions delivered to the Trust, each of which are subject to extensive validation by blood pathology laboratory staff.

5 Implementation

51 Blood transfusion electronic ordering

At the outset of the pilot, the Blood transfusion electronic ordering was in the process of development as there were outstanding issues. Once resolved and tested it was moved to live operational use.

Throughout the Trust, requests for bloods/ blood products are ordered electronically using PatientCentre which is a front-end of the CliniCom application.

The order screen is displayed below, Diagram 3. A detailed guide is available in **Appendix 3**, Blood Transfusion Electronic Ordering.

The screenshot shows a software window titled "GROUP AND SCREEN". It contains the following fields and controls:

- Request Date/Time:** 30/04/2008 13:55
- Priority:** ROUTINE
- Primary Diagnosis:** Please Select From List
- ? Known High Risk:** Please Select From List
- Bleep/Extension:** [Empty text box]
- Known Blood Transfusion History:**
- Blood Group (If Known):** Blood Group Unknown
- Atypical Antibodies:** No Known Antibodies
- Antibody Details:** [Empty text box]
- For Cross Match Only Fill In The Details Below:**
- Blood Type Required:** Nil
- Unit of Blood:** Nil
- Platelet Pools:** Nil
- FFP:** [Empty text box] mls (12-15 mls per Kg)
- Date Required Transfusion:** [Empty date and time fields]
- Clinical Comments (Including Reasons for Requesting Blood Products):** [Large text area]
- ** Please Enter Date-Time if requiring Blood Products ****
- FOR QUERIES OR ADVICE CONTACT BLOOD TRANSFUSION LABORATORY ON EXT. 3466 / BLP. 141**
- Buttons:** OK, Cancel

Diagram 3

There were a number of benefits:

- Accurate patient demographic information on requests, including NHS number where available
- Electronic audit available of all requests and requestors
 - Mandatory fields to capture required information
 - Structured request information
 - Legible request forms
 - Requests no longer need to be entered manually on receipt in the BT Lab
 - Reduction of requests and samples rejected in the BT Lab
 - Increased efficiency on the wards and in the BT Lab
 -
 -

The Blood Transfusion laboratory has identified the following limitations/restrictions:

The Trust's CliniCom system can contain two or more duplicate records for the same patient. This can occur for example if a patient is registered more than once on the patient administration system. Pre electronic ordering the BT Lab was able to decide against which patient record to book the paper request. With electronic requesting the patient selection is determined at the point of ordering and the LIMS system will not automatically flag up the fact there is a second patient record for the same patient. Therefore an additional patient search step has been added to the BT laboratory procedure prior to requesting any products to ensure antibody history or special requirements

stored with a duplicate patient record are not missed.

The Trust order communications system does not have an adequate rule base to prevent ordering of inappropriate test e.g. Kleihauers on baby sample at delivery. On the LIMS, inappropriate tests cannot be cancelled, a reason must be recorded against the test; this can give rise to inaccurate work load statistics.

- There are restrictions on the LIMS regarding the number of data items which can be received from the Trust Order Comms system, which makes it difficult to capture all the details of product requests electronically in LIMS. Some manual input is still required in the BT Lab.

In 2007 all blood transfusion requests were submitted on written request sheets. Diagram 4 shows uptake of blood transfusion (BT) electronic ordering at the Trust since it was introduced in January 2008. On commencement of electronic ordering in January 2008 there was a big drop in manual requests, which then gradually reduced and remains around 5% of all BT requests.

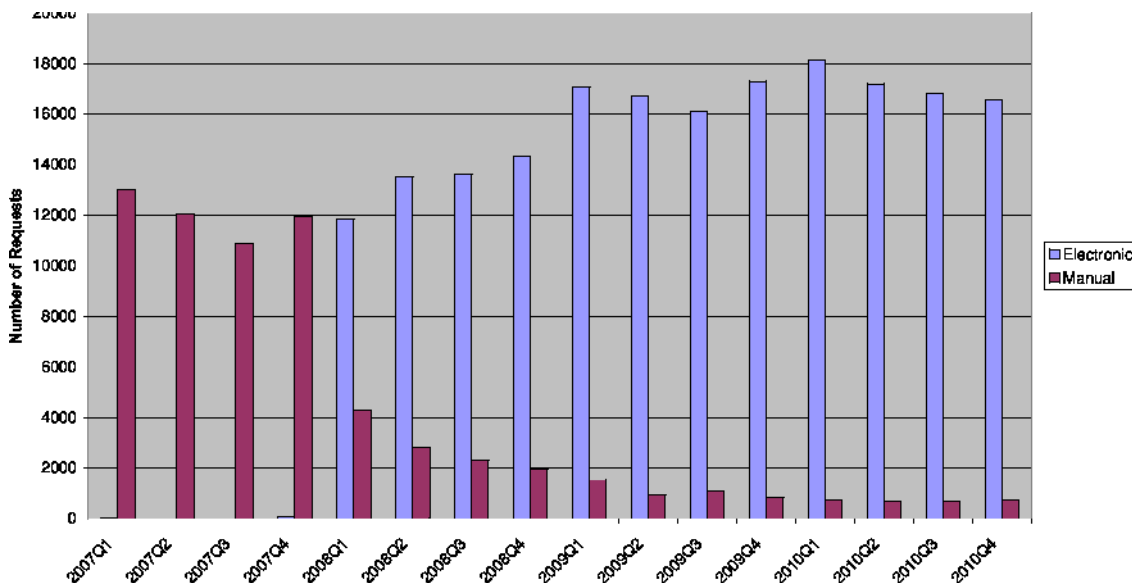


Diagram 4

Diagram 5 below shows the total number of blood transfusion electronic requests and GP/ community manual requests since January 2008. There is a clear increase in electronic requests raised within the Trust. Manual requests have reduced but still constitute approx 1/3 of all BT requests the majority of which are raised in the community, i.e. for antenatal patients. In 2011 the Trust will be deploying “Sunquest ICE”, an electronic ordering and results reporting system which can be used by GP practices to place electronic orders. Use of the system in the community will also be

2000

under consideration.

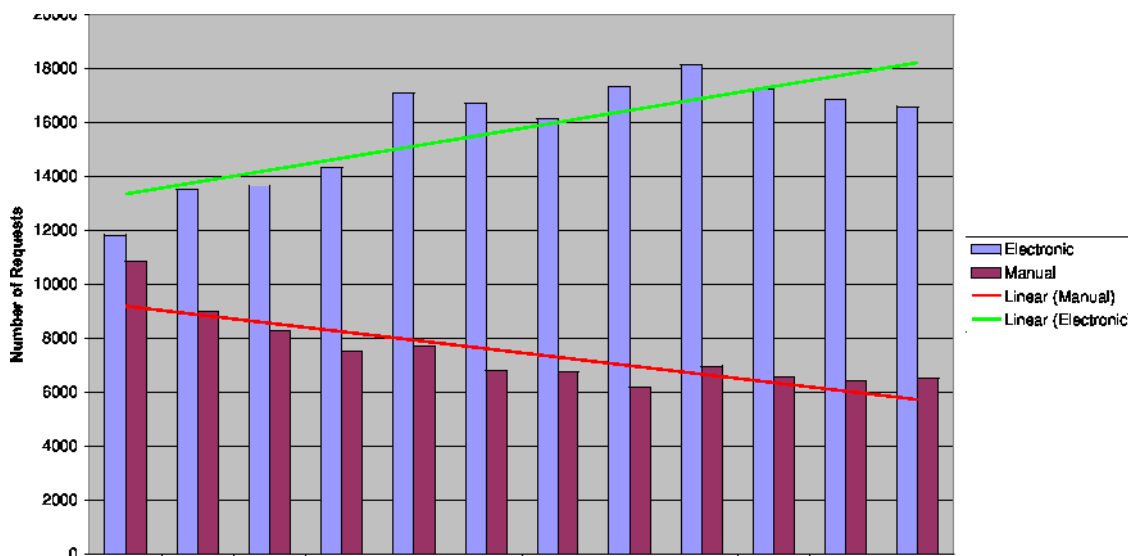


Diagram 5

5.2 Trust wide patient identification policy

Correct identification of the patient is key to safety in blood transfusion; a blood transfusion identification policy existed already within the Trust.

Audits were undertaken to ascertain if existing wrist banding processes were adequate. Results of the audit showed a small number of patients with no wristband and wristbands with incorrect data. At that time the Trust used red wristbands to denote allergies. A few patients with allergies were not wearing a red wristband.

The results of the audit and the blood tracking pilot were drivers to introduce a Trustwide policy. This initiative was driven forward by senior nursing staff in the Trust and supported at Clinical Directorate level. The policy provides guidance on the process of identification of the patient, verification of patient demographics, issuing and changing of patient wristbands. Red wristbands were no longer to be used to denote allergy; the policy advises clinical staff check the patient's notes and details held on the patient administration system prior to prescribing/ administering of medication.

5.3 Introduction of passive RFID wristbands across the Trust

Prior to the pilot the Trust were printing wristbands which had eye-readable patient demographic data and a 2D barcode containing the same data.

The 2D barcode was used by phlebotomists for scanning and printing of sample tube labels for all pathology samples with the exception of blood transfusion. This method is a SATO UK solution; it uses a scanner and printer which communicate via infrared.

Change of the patient identification wristbands used in the Trust was driven by:

- a need to comply with NPSA Safer Practice Notice 24 “Standardising Wristbands Improve Patient Safety”, which provides guidance on patient wristband identifiers and layout
- the results of audits
- the desire to pilot auto identification
- potential/ long term benefit of storing more patient information on the RFID chips on the patient’s wristband e.g. allergy information
- the intention to test the effectiveness of using an RFID chip identifier, unique to that patient’s wristband to help ensure blood is correctly transfused. This would be done by obtaining a unique identifier at the time of sampling and using it as an additional identifier check pre blood administration

This change of wristbands was overseen by the director of nursing who was actively involved in meetings to discuss the information required and layout of data on the wristband. The decision to not use red wristbands to denote allergy was made at directorate level.

Before any hardware or new wristbands were sourced the format of information on the wristbands was agreed and signed off.

Refer to **Appendix 4:**
Patient Identification Policy
Patient Wristband Fact sheet

Sourcing of hardware & consumables

An invitation to tender was issued to several companies for the hardware and consumables required. These included:

- patient wristbands with embedded high frequency RFID chips.
- RFID Direct Thermal Label Printer to print the patient identification wristband. The data received by the wristband printer will come from the Patient Administration System (PAS).
- label printers - Bluetooth mobile direct thermal printers for sample tube labelling at the patient’s bedside, and thermal printer with internal Ethernet (for use on the network) for printing of compatibility labels.
- STAB (Stick to a Body) Labels – Labels specially made to be put on a person. For example in Theatres, the patient’s wristband may be covered up during a procedure. To avoid removing the wristband, the wristband can be scanned to

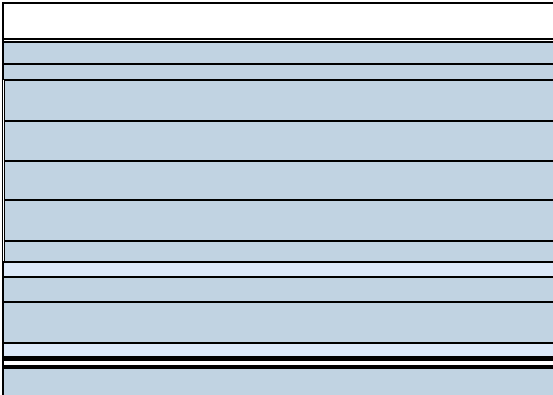
print a STAB label with the patient demographic data and placed on a suitable, visible part of the patient.

STAB labels were initially used when a patient had an MRI scan (Magnetic Resonance Imaging). Following testing RFID wristbands are no longer removed for MRI scans. Batch testing of RFID chips proved information on the chip is not corrupted and can still be read, even after multiple scans. There is no deterioration of the images produced by the scanner. Testing showed there to be no issue with the RFID chip being put in the scanner; the chip itself is passive (i.e. does not send out any signal) and is no bigger than; for example a dental filling which many patients have. There is no impact on the chip itself, on the images, or on the scanner.

- scanners – With scanning capability of linear, 2D barcode and RFID capability.
- tablet PC – Infection control mobile device to be used by phlebotomists, doctors and nurses to access clinical information by the patient's bedside. They are used for scanning of barcodes and the RFID chipped wristband for producing sample tube labels and pre transfusion checks.

5.4 Overview of BloodTrack

The BloodTrack suite of modules is a comprehensive blood unit inventory, tracking, and transfusion management system. The system maintains an audit trail of all activities.

BLOODTRACK MODULE	DESCRIPTION
<p>BloodTrack Manager</p>	<p>Installed on a PC in the Blood Transfusion (BT) lab, used by BT lab staff.</p> <p>Main functions: monitors movement of blood generates alerts produces audit information.</p>
<p>BloodTrack Courier</p>	<p>A BloodTrack Courier kiosk is installed by each blood fridge:</p> <p>BT issue room life blood suite maternity main theatres used by BT Lab staff, porters, theatre staff, maternity staff, life blood suite staff and staff on wards Duppas 1 & 2.</p> <p>Main functions: controls access to the blood fridge all blood units are scanned in and out using barcodes all transactions are recorded in BT Lab.</p>
<p>BloodTrack Tx</p> 	<p>Installed on mobile carts/ COWs (computers on wheels) and tablet PCs. Works on wireless network and must be charged when not in use. Used by phlebotomists and nursing staff.</p> <p>Main functions in use: bedside labelling of samples record blood arrival record begin & end transfusion record emergency transfusion</p>

5.5 BloodTrack manager

BloodTrack Manager is an essential component of the BloodTrack application and has many benefits. The application is utilised by the Trust Transfusion Practitioner and Laboratory staff. It is recommended as a redundancy measure that there are at least two PCs set up to run BloodTrack Manager.

What went well

- Real-time tracking of products which is helpful when monitoring major bleeds or assessing if product requests are duplicated or not.
- Allows remote monitoring of satellite fridge contents – as above.
- Will not allow units to be collected that are past the de-reservation period or expired.
- Monitors all BloodTrack users enabling identification of re-training requirements.
- Alerts BT staff to problems experienced by users, e.g. cold chain expiry.
- Alerts if the unit taken from the fridge has not been issued for the patient identified to the kiosk; reducing the risk of incorrect blood collected and transfused.

Challenges

- Batched products, e.g. albumin, anti-D, coagulation factors, cannot be handled by BloodTrack as they do not have a barcode. The laboratory has devised a work around in that all batched products once issued will be stored in the laboratory until an individual comes to collect them. The products will then be handed to this person. Winpath does have the functionality to produce barcodes and the intention in the long term is to produce barcode labels for batched products; they can then be tracked in and out of blood fridges
- Platelets cannot be tracked via BloodTrack without falsifying the unit audit log by indicating they have been issued to and stored in a fridge, this would not occur in reality and concerns were raised with regards to MHRA compliance and unit audit trail. A workaround was devised in that a "platelet agitator" location was set up on Blood track Manager; this allowed the platelets, once issued, to be moved into this location. When the platelets are collected they are signed out of this location on BloodTrack Manager by the BMS staff, thereby ensuring the audit trail was correct.
- A new location INTRANSIT had to be created in LIMS to enable the LIMS to show when units had been collected and were en route to a ward or satellite fridge. This was necessary because the existing configuration in LIMS did not accommodate the relevant messages sent from BloodTrack. BloodTrack needed to be provided the appropriate status list codes used by Winpath. Remote "end transfusion" location of units also had to be added to Winpath.

- The “End Transfusion” functionality is used on BloodTrack in the BT Lab to manually fate units. Fating of products on BloodTrack Manager had to be implemented because fate of unit information does not go across the interface from LIMS to BloodTrack; therefore unit status was not comparable on both systems. An upgrade of the LIMS system is required to enable this transfer of information, however the LIMS is still the primary record of fate. The current BloodTrack system has no function for entering time of transfusion when manual fating – all units are fated as transfused at 23:59 – which has had implications when investigating transfusion histories and outcomes.
- Fating problems were encountered with some units not being linked to patient in LIMS because patient details were not being sent with unit details from BloodTrack. After investigation it was identified as a problem due to how users navigated around the BloodTrack system; “Tab” or “Enter” gave correct information, navigation by mouse did not. The Standard Operating Procedure (SOP) has been updated to give specific instructions on key strokes.
- A further fating problem was encountered with units that had been issued being fated on BloodTrack with fates other than patient based fates e.g. “Out of Temperature”. These fates were transferred to the LIMS into the unit record but did not update the patient record. The units still showed as issued to the patient in the patient history. This has been solved by performing a return to stock function for these units first to dissociate them from the patient, and then they have the final fate updated on the LIMS directly.
- BloodTrack Manager does not alert in the event of LIMS/BloodTrack interface failure. This functionality requires redevelopment of the interface and will only be able to alert problems at the BloodTrack end of the interface.

5.6 BloodTrack Courier

In order to use BloodTrack Courier it was necessary to interface between the LIMS system and BloodTrack. The LIMS basically sends a message across the interface informing BloodTrack which blood unit has been issued to which patient. BloodTrack informs LIMS of any recorded blood unit movement/ activity from the point of being in the issue fridge.

What went well

- BloodTrack Courier has a training environment which can be used for training and observational competences.
- Practical training material was localised
- Staff found the system easier to use than the manual system; there was little objection from portering staff to use an electronic system; uptake was very good.
- Improved cold-chain management; blood units out of temperature are recorded.
- Will not allow units back into the cold chain that are no longer viable.

- Stricter control of staff access to blood fridge(s). Enables controlled access to blood fridges. Only authorised and trained staff can access the fridge.

Challenges

- The current version of Winpath in Blood Transfusion did not support the generic Blood Track interface which was available from CliniSys, LIMS supplier. This necessitated an upgrade of the LIMS system for Blood Transfusion. Extensive validation and reporting required for MHRA audit purposes took several months to complete.
- Implementation was delayed due to the failure of the Trust issue fridge and a satellite fridge. In order to accurately record auditable information BloodTrack needs to work as a “closed system”; i.e. all blood fridges in the system need to be monitored online. Porter refresher training was undertaken before go-live.

- There were a couple of incidents where a trained member of staff gave their staff ID badge to an untrained colleague to collect blood. This was addressed immediately by high level management.

- Initial problems occurred where users only scanned the first unit out and not the others collected for the same patient; this was addressed by retraining

- Users can still forget to scan the blood unit out after removing it from the fridge – this will however alert in the BT Lab.

- A porter can mistakenly select the emergency blood function and scan out a cross-matched unit. If this occurs, all patient details available with that unit are removed and are no longer available on BloodTrack. This is notified by an alert on the kiosk and in the laboratory if the units are not O RhD negative and is currently addressed by retraining.

- There is no interface test environment readily available between LIMS and BloodTrack.

Impact of new system

1. Decrease in blood wastage, due to improved cold chain management.
2. Increased availability of report/ audit information.
3. The blood collection process was made more efficient. Barcoded collection slips are used by porters and all audit data recorded electronically.
4. Perceived increased workload in the Blood Transfusion Laboratory. BT staff are required to acknowledge all alerts and troubleshoot accordingly.

5.7 BloodTrack Tx

The BloodTrack Tx module is used by the Trust for the following functions:

- Inpatient blood sample collection
- Recording blood arrival on the ward
- Recording the start of a transfusion
- Recording the end of a transfusion

What went well

- The BloodTrack software normally runs on a PDA device and was developed to run on a Windows platform for the pilot. This was an enabler for the testing of tablet PCs.
- The trialling of mobile devices by clinicians for treating patients at the bedside.
- Patient demographic details recorded on the RFID chip on the patient wristband are scanned at the bedside to produce sample tube labels, pre transfusion verification before commencing a transfusion The BloodTrack software was configurable to include reminders of checks to be performed e.g. patient identification checks.
- The BloodTrack Tx software was developed to ensure data scanned from the wristband was exactly produced on the sample tube label. Last name and first name are truncated to 24 and 20 characters maximum respectively in the Patient Administration System. These field lengths are accommodated on the patient wristband and must therefore be recorded accurately on the sample tube label, and subsequently on the blood bag compatibility label. The change on BloodTrack required a hard coded change to but was essential to ensure validity of patient identification data.
- The sample tube label was changed to accommodate surname, forename, staff badge identification field length, date of birth, local patient identification number and NHS Number. The signing of the label is not a legal requirement when using the BloodTrack system in the UK, the badge identification record takes the place of the signature The revised label meets the NPSA specifications as a minimum.
- The BloodTrack Tx software was tailored to display the patient details at the top of every screen displayed through the blood collection process.
- Blood Transfusion sample labels pre-pilot were all handwritten. The primary reason for this is because it was considered to be a risk that an extra label could be printed in error and put on the wrong tube. A risk assessment was conducted which assessed the manual and electronic process. The conclusion was that there were no greater risks associated with printing of blood transfusion sample labels at the patient's bedside.
- BloodTrack Tx can run using data from an RFID chip or the barcode interchangeably. This functionality was not required in practice as the RFID

chips in the patient's wristband were easy to read. However for the purpose of the pilot it was built in for redundancy.

Challenges

- Finding a suitable mobile device which is fit for purpose. The device had to be practical for use on the wards, easy to use by phlebotomists, nurses and doctors.
- Extensive validation of all process changes had to be actioned and documented.
- At the time of implementation Winpath could not produce a 2D barcode on the blood compatibility label. In order to avoid further delay to the project it was decided BloodTrack would be used to produce a compatibility label for red cells, FFP and platelets. Winpath would continue to produce compatibility labels for batched products. A dual system is not ideal and it is intended, following successful upgrade of the Winpath System, to print all compatibility labels from Winpath.
- Some nursing staff were resistant to the new technology which required them to logon to *another* electronic system. Nursing staff were requested to log when the electronic system was not used and to give the reasons why. This information was collated by the TTP. This highlighted problems with logging onto the Trust network and difficulties scanning. This was addressed by configuring the tablet PC to automatically connect to the Trust network on start-up and reprogramming of the RFID and barcoding functionalities on the device. The TTP provided on the ward support for staff until use was established.
- Reliability of the wireless technology. There were incidents where the device lost its wireless connectivity. This was either due to the wireless network being unavailable or network card failure in the device. This resulted in a lack of confidence in the system and for some nurses a reluctance to use a system which they felt was slower. The Trust has since invested in a wireless network specialist to carry out a passive survey of the hospital's wireless network, a review of network controller configurations and has acted upon recommendations to improve wireless connectivity and location accuracy. The result is a much improved performance of mobile computing devices within the Trust.
- For the information recorded to be useful all transfusion steps must be recorded. Clinical staff frequently forgot to use the electronic system to end the transfusion. This happened particularly when a transfusion started on one shift and ended on another shift. This was addressed by the TTP by using the BloodTrack audit trail to identify those staff for retraining. ITU and HDU are now actively using the system for recording of blood arrival, begin and end transfusion. Furthermore, the next version of BloodTrack sends a fate of unit message at the beginning of a transfusion.
- Change requests with regards to the software impacted on delivery timescales.

- On BloodTrack fate of blood unit occurs when a transfusion is ended. It is preferred at CUH that fate of unit is recorded at beginning of transfusion. If start of transfusion is recorded electronically, the end transfusion must be recorded electronically to ensure the unit is fated. The latter does not always happen and then necessitates a time consuming investigation to determine the fate of that unit. The TTP addressed the issue through retraining and nurses are now ensuring the end of transfusion is recorded electronically.

Impact of new system

Pre-BloodTrack phlebotomists used handheld scanners and mobile printers operating using infrared to produce all pathology sample labels (except for blood transfusion) at the patient's bedside. They would be required to scan the wristband and print the label within 30 seconds. If a label was not printed in this time a rescan of the wristband would be required. This infrared system is still in use in the hospital where there is no wireless network. Phlebotomists recognise the safety aspects of BloodTrack, but generally feel that BloodTrack is a much slower system than the system previously used as it introduced extra steps in their workflow. From a phlebotomist perspective the additional process steps are listed below. Those in blue are not standard to BloodTrack.

1. Starting up and logging on to a PC (COW or tablet), once at the beginning of their phlebotomy round. This extra step is particular to CUH as it was chosen to use a mobile PC device which connects to the wireless network. This has since been addressed by the Trust to automatically connect to the wireless network and launch the BloodTrack application once the mobile device is turned on.
2. Scanning of ID badge to logon to BloodTrack
3. Scanning of ID badge for each sample collection required
4. Scanning of the patient identification wristband twice; first to identify the patient, second to generate a printed sample label at the bedside. CUH Hospital Transfusion Team (HTT) requested the second scan to ensure the clinician is still at the patient's bedside when the sample tube label is printed.
5. Scanning the barcode on the mobile Bluetooth printer. This requirement was necessitated by the use of Bluetooth technology and considered by the system supplier a safety step to verify an association, i.e. ensure the label did not print off at another Bluetooth printer.

Phlebotomists found it frustrating to have to identify themselves to BloodTrack for each patient. The scan to identify them before each bleed is a compulsory feature of BloodTrack essential to maintain an audit trail. Also the BloodTrack system timed out after a period of inactivity. The latter is a security feature of most clinical systems but was configurable to allow sufficient time for difficult bleeds. Phlebotomists felt two scans of the wristband to be surplus. The Trust has since met with the BloodTrack supplier to discuss how the process can be simplified yet maintain effectiveness. A new version of BloodTrack TX is expected in the near future for testing.

Use of BloodTrack Tx by phlebotomists has prompted an assessment of existing phlebotomy processes throughout the Trust. As bleeds take place at all times of day consideration is being given to revising ward phlebotomy hours and training all nurses in phlebotomy. It has been agreed to work towards training all Health Care Assistants in phlebotomy.

Nursing staff acknowledged the benefits of using BloodTrack Tx but generally felt it was of more benefit to the BT Laboratory than on the ward. Feedback from nursing staff is summarised below:

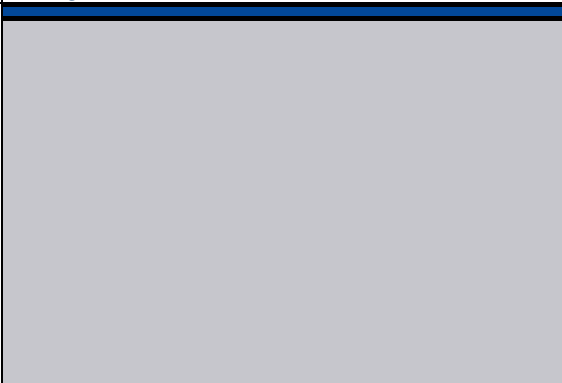
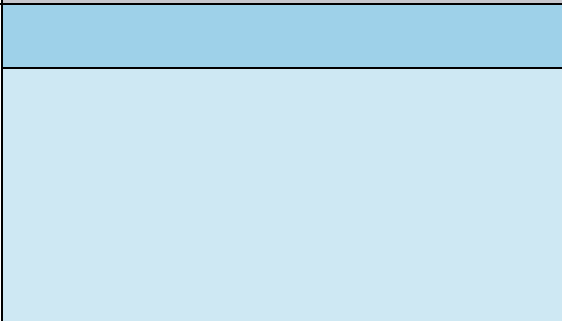
- Some nurses perceive the new system to be slower; however this is outweighed by the benefit of only requiring one nurse for the pre-transfusion check which results in an overall saving of nursing resource.
- On wards where transfusions are not frequent staff feel less confident to use the system, however through continued use of the system confidence has grown.
- The move to “one nurse check” was well received by some nursing staff. In ITU/ HDU the “one nurse check” is in full use.
- A change in process was introduced. Nurses previously completed the manual fating slip when the blood unit was put up; now fating is recorded electronically when a transfusion is ended. The TTP highlighted that the system needs to fate the unit at the beginning of the transfusion. This functionality is now available in a later release of BloodTrack Tx. It is an added benefit that the system records the time the blood left the issue fridge, the arrival of blood on the ward, and the exact start and end times of the transfusion. This provides accurate cold chain information.
- The key benefit on the ward is patient safety.
- It was useful that the tablet PCs could be wiped clean.
- The tablet PC was considered by some users to be too heavy to hold comfortably.



As initial problems were addressed and use of the devices improved there has been a growing acceptance of the technology. Nursing staff on ITU and HDU wards, where there is a larger number of transfusions, particularly recognise the benefit of moving to a “one-nurse” check.

There is increased confidence and understanding of the objectives of the system amongst nursing staff. The TTP has requested more resource to establish use of the system on other wards.

6 Technology used in the pilot

A wireless network was installed at the Trust to enable the use of mobile technology in the pilot areas. Specifications of the equipment used in the pilot can be found in **Appendix 5**.

Device	Image	Usage
Zebra RFID printer Zebra R2844-Z		<p>A direct thermal RFID label printer is used to produce wristbands requested on the Trust Patient Administration System (PAS).</p> <p>A thermal direct version of this is used for paediatric wristbands which are made from softer material.</p>
High Frequency RFID Patient Wristband		<p>High Frequency RFID chips are used to ensure singularity when identifying a patient.</p> <p>The format of data printed on the wristband is compliant with NPSA Safer Practice Notice 24.</p> <p>Wristbands are manufactured from a combination of allergenic properties. Both wristbands and snap closures are latex free and have been subject to durability testing including solvents, water, soap and abrasion.</p>

<p>Computer on wheels</p>		<p>Two types of computer on wheels are in use as a result of the pilot. Mobile casenote PCs are in use by doctors undertaking ward rounds. The doctor is able to scan the patient's wristbands to bring up the correct patient details and raise electronic tests requests against this record. These work well on medical wards where doctors visit each patient on the ward in an ordered ward round.</p> <p>These are practical because they use the wireless network, can be taken to the bedside, on board scanner and mobile printer.</p>
<p>Handheld scanner</p>		<p><u>Storage area available for phlebotomist's equipment.</u></p> <p>Handheld Bluetooth scanner designed to operate within the accepted standard to read high frequency RFID chips. They are used in the pilot to read RFID chips, linear and 2D barcodes.</p>

Tablet PC		<p>The Panasonic CF-H1 are used on the wards to record blood arrival, begin and end transfusion.</p> <p>The device is infection control compliant, can be easily wiped clean, is touchscreen, has built in RFID and barcode scanning capability and can operate with a Bluetooth mobile printer.</p> <p>The BloodTrack software is touchscreen driven and runs well on this device.</p>
Mobile label printer		<p>The Zebra QL220 Plus label printer is used to produce sample tube labels at the patient's bedside. Direct thermal printing is used.</p>

7 Expectations of the system

The system was expected to deliver primarily qualitative benefits. Although improved efficiency can lead to cost savings we have not looked to quantify these savings. The new technology used in the pilot is costly; other areas of application have been either implemented or are planned to leverage the benefits. Current applications include:

- VitalPac. (The Learning Clinic) This system for electronically recording patient observations and other clinical assessments has been rolled out across the hospital using the wireless technology and has been adapted to use the RFID patient identifier to further streamline the process.
- Inflex - updating patient status
- Bedside ordering of diagnostic tests

Key expectations of the system can be grouped into two main areas

Improved patient safety

1. Positive patient identification.
2. Bedside checks and printing of sample tube labels.
3. An improvement in the phlebotomy process which would lead to a reduction in the number of samples rejected in the BT Lab, in particular less wrong blood in tube incidents. Enhanced bedside checking process to ensure the patient is given blood which is specifically for them (Right Patient, Right Blood)
4. The electronic system would use the RFID identifier to perform a similar function to the red label system, which is a manual paper based system designed to track/ link the patients wristband (at the time of sampling), the sample and the cross-matched blood.
5. A reduction in the number of adverse events
6. Less re-bleeds of the patient required due to a reduction of rejected samples in the BT Lab.

Improved efficiency

1. Electronic requesting of bloods.
2. Improved traceability of bloods.
3. Decrease in labour intensive tasks in the Lab.
4. Better cold-chain management.
5. More efficient use of the limited resource of blood products.
6. A reduction of illegible group & save/ cross-match requests in the BT laboratory
7. A reduction in sample rejections in the BT laboratory.
8. Improved audit trail and reporting

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8 Key changes in working practices

81 Doctors and specialist nurses

This staff group have previously used the Trust order communications for electronic ordering of all pathology requests and there was little change to their working practice.

Doctors are using mobile PCs to order requests at the patient's bedside. Different models of tablet PCs have been trialled. Dual functionality of touchscreen and keyboard are preferred.

82 Blood transfusion lab staff

The changes in processes e.g. sample reception, test requesting, product issue and storage, return of unused products necessitated validation and updates to existing standard operating procedures (SOPs) and subsequent retraining of staff. The latter has been a particular pressure and strain on the laboratory senior staff.

There is additional workload in dealing with blood track system alerts – especially out of hours – as all alerts are potentially hazards they cannot wait until the day staff take over but must be dealt with immediately they are noted. This proves demanding during “out of hours” operation as there is a single Biomedical Scientist, often covering both blood transfusion and haematology areas. This has been addressed by providing ongoing training for dealing with alerts. Lab staff are more familiar and efficient at responding to alerts. Alert actions are communicated at shift handover.

8.3 Phlebotomy staff

Phlebotomists have been resistant to using BloodTrack. Overall they feel their job takes them much longer when using BloodTrack for all Pathology bleeds. Inpatient phlebotomists at CUH have been using infrared technology since 2003 to print sample tube labels at the bedside. The new system has introduced additional steps. The phlebotomy BloodTrack Tx process is under review.

8.4 Portering staff

Portering staff adapted well to the BloodTrack system for collection/ returning of blood components. They felt it made their job quicker and felt assured there was a check being done automatically.

The common complaint from porters is that ward staff are not always checking blood availability before requesting collection. Ward staff have the facility to do this; this is therefore a failure to follow procedure on the wards. There is a prompt on the blood collection request screen to remind staff to check the blood has been issued and is ready for collection.

9 Functionalities undergoing development

The pilot required integration of different systems and utilised some pioneering techniques. As such there were high risks to achieving the capabilities required to deliver end to end blood tracking using RFID, wireless and tablet PC technology.

Areas undergoing development at the time of writing this report are:

- Integration of the Trust order communications system and the BloodTrack system
- Collection of a unique passive RFID number at the point of bleeding, to be used as a unique identifier check pre transfusion.

Both areas are new developments, previously untried and untested, requiring integration of systems, detailed specifications to be agreed, significant development and testing.

The overall objective is to introduce a system whereby the unique RFID identifier on the patient wristband at the point of sample collection is used as an additional check before blood products are given to help ensure that the blood is given to the patient from whom the original sample was taken. If the RFID identifier does not match then the BloodTrack system will alert.

The following was initially proposed:

1. The assumptions are:

All electronic requests have a unique identifier. All

- wristbands have a unique identifier
 -
2. When electronic orders for blood tests are raised on Clinicom, an electronic request is sent to the Pathology system.
 3. BloodTrack should also receive these electronic requests for all pathology samples including blood transfusion. The extended scope was to enable phlebotomists in the pilot area to use the one system - BloodTrack.
 4. At the point of sampling BloodTrack would
 - Know the session number of the electronic request and associated patient demographic information
 - Verify the details on the patient wristband with the details on the electronic request
 - Capture the RFID identifier, and send to the LIMS the electronic request session number, associated patient demographic information and RFID identifier.
 5. On receipt of the above message, the LIMS system would link the RFID identifier to its electronic request by matching electronic order session number, associated patient demographic information.

6. If a compatibility label is printed for blood crossmatched against that particular sample, it will have patient demographic details and RFID identifier.

The original solution offered by Neoteric was to use their PathCollect module to help achieve the above. This would have provided a blood collection list for the Phlebotomist on each ward. The initial collation of the tests and their sample requirements was undertaken by the Trust and submitted to Neoteric in April 2008.

Potential issues with the solution were identified within BloodTrack:

- BloodTrack would need to hold an electronic list of all Pathology tests which would require regular updating due to ongoing changes in the test tables. The process to update this into PathCollect was complicated
- Inability to change tests (since the electronic order had already been sent to LIMS)
- Inability to group orders (since electronic orders had already been sent to LIMS)
- Inability to cancel orders, resulting in duplicity of test requests

Development work was undertaken between Neoteric and CliniSys to send the RFID and link this to the electronic request, and include the RFID in the 2D barcode at blood product issue. A full risk assessment was undertaken to ensure that the proposed solution was robust and safe. This functionality was put in the test environment in November 2010.

In December 2010 Neoteric concluded the above solution would require significant work on BloodTrack to maintain integrity of test code tables. Additionally the existing interface with LIMS could not be used - a new interface would be required.

Subsequently discussions have taken place to simplify the process and integrate it with the current sample collection module BloodTrack Tx. This involves an additional step with the order number on the printed electronic request form being scanned for blood transfusion requests only. The BloodTrack Tx module, developed for the pilot, is being reviewed to reduce steps where possible without compromising safety.

10 Lessons learnt

Undertaking the pilot at CUH heightened the awareness of clinical staff of the issues around patient safety and the blood transfusion process.

10.1 Patient identification

From the outset, audits of patient wristbands highlighted issues with existing processes. Patient safety and the objective to trial RFID wristbands were drivers for the Trust to review current practice. Reference to the NPSA Safer Practice Notice 24 provided valuable guidance during this process.

If present and verified in the Patient Administration System, the NHS Number is printed on the new wristband, and used as a key identifier.

Some third party systems and processes within the Trust have not been developed to cater for input or search of NHS Number. In these cases, development is underway to enable the use of NHS Number as a key identifier. The NHS Number eye readable

and barcode format is now present on casenotes and casualty cards. The Trust's LIMS supplier has developed their system to accept input and print the NHS number if available.

To maintain business continuity during the above development the local patient identifier has been retained on the wristband. The presence of this identifier on the wristband was subject to formal risk assessment; i.e. did the presence of this identifier give rise to any risk?

Gender was recorded on the wristband, subject to formal risk assessment.

Removal of the ward name field from the wristband meant the wristband did not need to be changed each time a patient moved to another ward – this reduces the risk of putting an incorrect wristband on a patient.

Measures were implemented to ensure wristbands were only removed if essential, e.g. if illegible, damaged, or in the way of administering treatment. Stick to a body (STAB) labels were introduced for use in Theatres and MRI Unit.

A STAB label is produced by scanning the patient's wristband to replicate the patient demographic details on the label. The label can be placed appropriately on the patient; thereby reducing the need to remove and apply a new wristband.

In the MRI Unit, batch testing was conducted to determine if information on the RFID chip embedded in the wristband was corrupted. The results showed no loss or deterioration of electronic data and no impact on clarity of scan. Following the outcome of these tests the MRI Unit no longer remove the patient's wristband before a scan.

The decision not to continue to use coloured wristbands was based primarily on the following:

- There was a perceived reliance on the red wristband on a patient to denote allergies
- Clinical policy states that presence of allergies must be checked in the patient's notes prior to administration of medication
- The outcome of audits showed a small number of patients with allergies who were not wearing a red wristband: a significant patient safety risk

From a practical viewpoint it would have necessitated two printers in each area; one loaded with regular wristband media and one with coloured media. Wristband printers at the Trust are networked; additional network and power points would be essential.

A Trustwide Patient Identification Policy was drawn up and provides guidance to staff regarding wristbanding procedures. The Policy was made available on the Trust intranet and communicated at ward level throughout the Trust.

There were several suppliers in the UK of patient identification wristbands embedded with high frequency RFID chips. Choice of wristband was based on the combined cost of wristband and fastener, the material, size and quality of the chip. There was limited availability regarding size of chip available. Most suppliers at the time could only offer a 1 K or 2K chip. A 2K was sufficient for patient demographic details and a unique identifier. Longer term the Trust expects to trial larger chips with more capacity to hold additional patient information.

Sourcing of a suitable RFID printer was more limited for choice and the Trust decided on the most capable model on the UK market at that time. The printer needed to be programmable to:

- Accept an input string from the Patient Administration System
- Produce a specified format of eye readable data on the wristband
- Produce a specified format of data in a linear barcode
- Produce a specified format of data in a 2D barcode
- Produce a specified format of data on an RFID chip by writing to the chip and then checking the data can be read. If the chip cannot be written to or the data read, the wristband will be “voided”. The printer automatically attempts to produce the requested wristband.

The printer needs to be fit for purpose and should be tested with wristband media taking into account the following:

- Ability to cope with the throughput of media
- Compatibility with media (thermal or direct thermal required)
- Printing of barcode densities
- Printer encoder firmware compatibility with the RFID chip
- Location of the sensor on the printer and location of sensor markings on the wristband
- Printer reliability – is the void rate high/low?.

Once the new wristbands and printers had undergone testing and validation training was provided on the wards.

10.2 Mobile technology

An effective wireless network was vital to the project implementation. The Trust did encounter problems with the wireless network which hampered uptake of the BloodTrack system on the wards.

Due to the fact that new elements were introduced at the same time it was sometimes difficult to pinpoint where the problem lay; i.e. The tablet PC, intermittent signal loss, and RFID/ barcode scanning ability of the devices. There were particular problems in side rooms or when the ward lighting was dimmer than the norm. The wireless network issues were resolved by repositioning of some aerials and a review and change to some of the wireless controller configuration settings.

In retrospect, it would have been beneficial to have sought, from the outset of the pilot, comprehensive specialist scoping of the RFID/ asset tracking component.

The Trust has utilised wireless network and RFID chip technology for its VitalPac project. VitalPac is used to record and display electronically patients’ vital signs. The VitalPac rollout is ongoing and is currently established in 19 wards.

VitalPac and BloodTrack run on different mobile devices. The challenge for the Trust and suppliers is to develop and provide a solution which enables multiple applications to run on the one device.

The wireless and mobile capabilities delivered by the pilot are anticipated to be key enablers to maximise the transformational effects of the impending Trustwide rollout of the Cerner Millennium product.

10.3 Blood tracking software options

It was important to understand the functionalities offered by the blood tracking system. It was equally important to know the limitations of the system. The blood tracking system in use is designed primarily to record and time stamp transactions. It is a most useful tool for reporting and traceability. Decision support can be limited.

Ease of configurability of the system was less understood by the Trust. Some changes to format of data on the sample tube label were not easily configurable and required hard coded changes within the software.

The interfacing requirement between the blood tracking system and LIMS necessitated significant validation to be undertaken by the Trust BT Lab staff.

Validation of the software and interface did highlight impracticalities and bugs in functionality described in Sections 5.5/ 5.6/ 5.7.

10.4 Workload in the blood transfusion laboratory

MHRA validation requirements require extensive testing and validation of all blood transfusion processes. The Blood Transfusion process itself is still heavily reliant on training. The absence of a BloodTrack Tx test/ training environment impacted heavily on BT staffs' time. Without a test/ training environment it was difficult to complete validation according to project timescales.

Please see below a quote from the Trust's BT Lab Manager:

"It was initially very difficult to get other people involved in the project to understand the extent of testing and validation that was required for each small change made. Involving some of them in writing validation plans and reports has helped with this as they are now more aware of what is involved and the additional work load placed on the BT staff."

In BT Lab it was difficult to keep up with the updating of SOPs and training of staff. This was noted in a CPA assessment. A review of the training process and competency assessment process was required.

It would have been better to secure funding for a full time locum BMS to help with the additional workload by either involving them in the project or covering the routine workload of other staff required to be diverted to the project.

Initially the project was expected to be for one year only. It was thought that the additional work load could be absorbed by the BT department for this period. However it quickly became apparent that the project would be on-going for a much longer period and the BT staff were under pressure to achieve project deliverables alongside the other demands on them now from MHRA.

Good communication was essential between IT and project manager with BT staff when arranging site visits, testing, training etc in order that key personnel could be

certain to be available to attend and be made available to deal with any issues arising.

10.5 Use of bloodtrack on the wards

The uptake of BloodTrack at ward level has been slower than hoped. Adoption of new technology tends to be maximised when the necessary new behaviours are used across the whole organisation and across as much of individual staff member's working practice as possible. Contrary-wise, new technologies which are used relatively infrequently and inconsistently across an organisation seem likely to have much slower and less robust acceptance. A vivid comparison was noted with the VitalPac rollout which entailed the use of a new system as part of every nurse's core practice and which was replicated across all areas of the organisation.

Uptake of BloodTrack Tx was hindered in part by the changing of two key roles during the project; the negative impact of which may have outweighed the advantages of continuity.

- The Trust Transfusion Practitioner (TTP) left the Trust and a new TTP was recruited. It took time to get up to speed with the project and establish a presence on the wards.
- The Project SRO had a significant change in job description which impacted on his sphere of influence midway through the project.

On the wards, Phlebotomists find the new process slower than the previous process whereby a simpler routine was used to print labels but still had a safety feature inbuilt to ensure labels are printed at the bedside.

Some nurses have not been receptive to the tablet PCs and many forget to record the end transfusion (which results in the unit not being automatically fated by the system). Proactive workshops and assessments are being undertaken by the Trust to assist nursing staff and enhance their IT skills.

A new version of the blood tracking software is being developed to fate units at the beginning of transfusion; the time the transfusion is ended is still to be recorded.

A large training and on-going support resource is essential to establish the use of BloodTrack on the wards.

11 Benefits and measures

The undertaking of a full evaluation and measure of benefits/ disbenef its (an expected negative outcome) requires extensive resourcing. The Trust project team can however report on some of the benefits.

Improving patient safety

Auto identification functionality has been implemented to assist in identifying the right patient during bedside checks in the blood transfusion process.

Better monitoring of blood movement helps ensure the patient receives the right blood and reduces the risk of a patient being administered blood which is out of temperature.

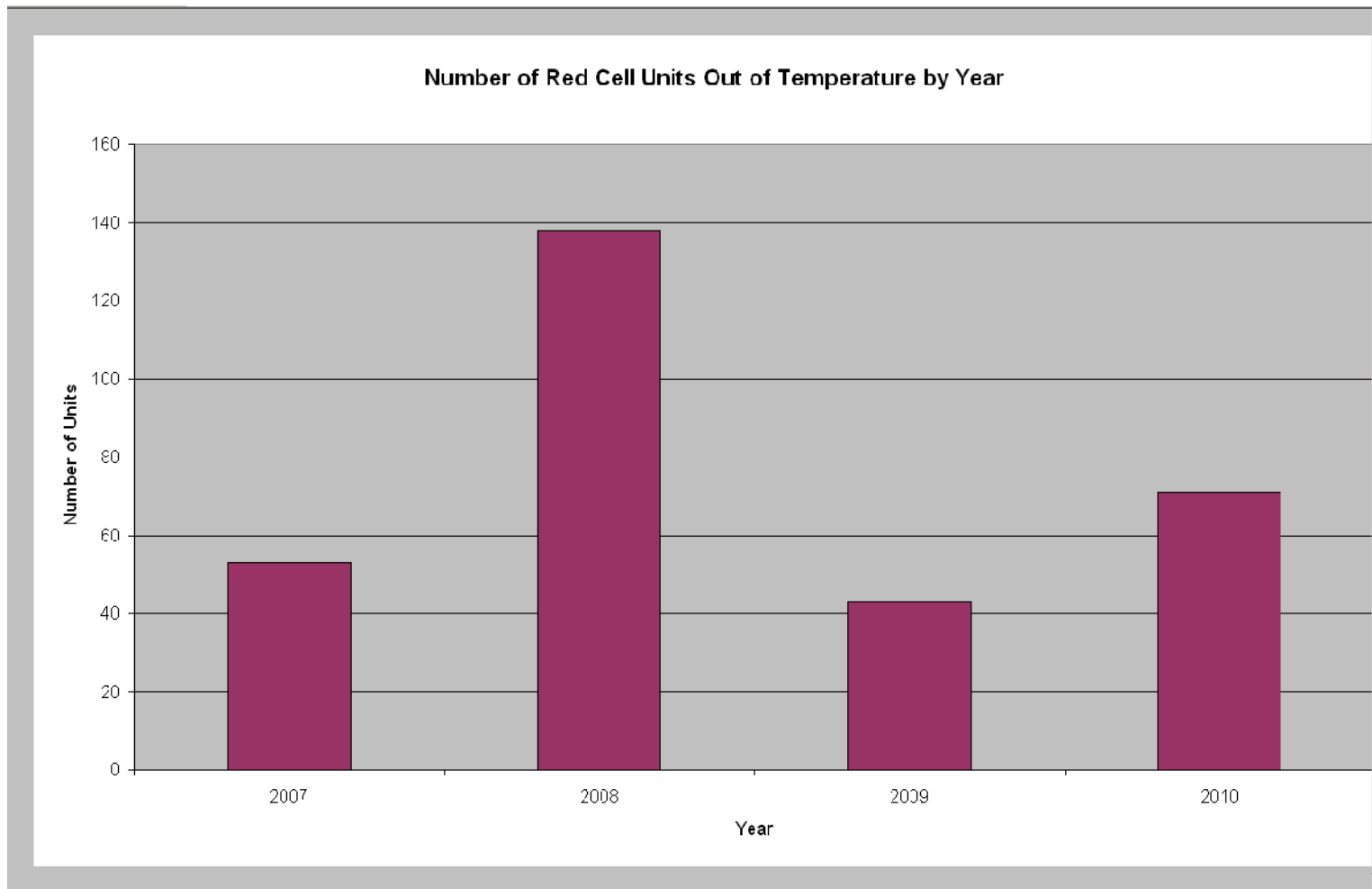
The BT Laboratory and Trust Transfusion Practitioner (TTP) have the ability to monitor blood transfusion activity on the pilot wards.

Records of adverse events for blood transfusion are maintained within the Trust. Adverse events are monitored and investigated by the Trust Transfusion Practitioner.

Management of blood/ blood products

Compliance with Blood Safety and Quality Regulations is improved by automatic recording of blood movement which leads to better cold chain monitoring. Please see Graph 1 below which shows statistics on out of temperature blood.

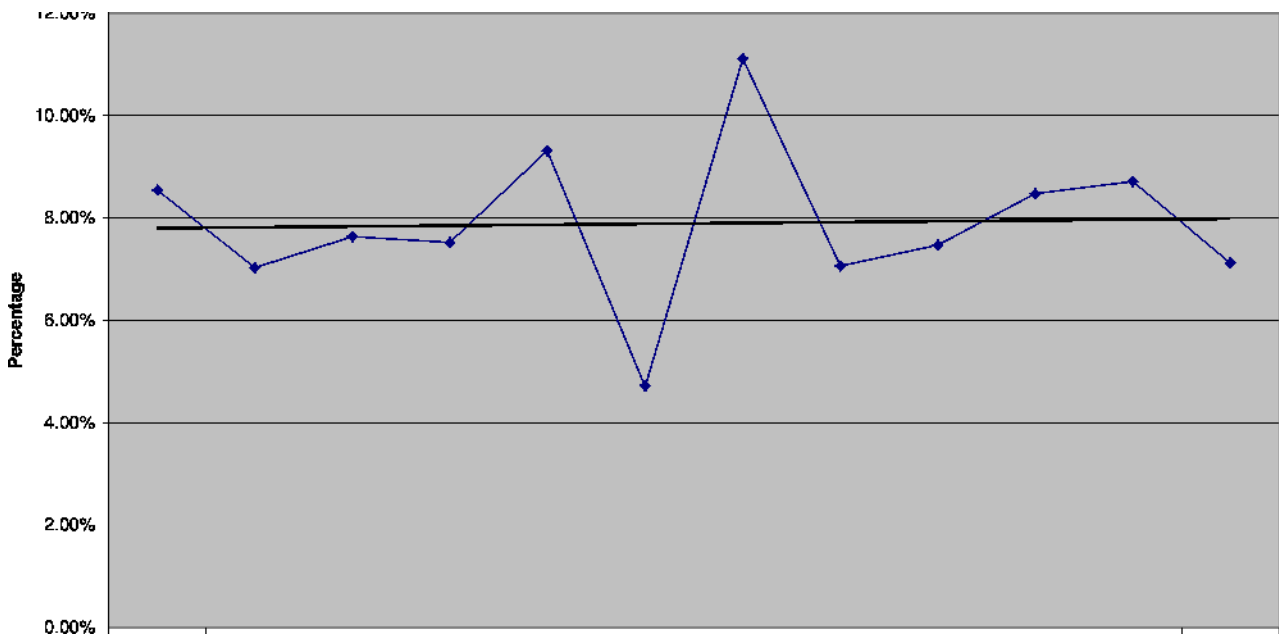
In 2008, to obtain a baseline measurement before implementation of the electronic system, the Blood Transfusion unit undertook an internal audit of the recording of bloods in/ out of satellite fridges. The high level in 2008 on the graph was due mainly to failures in the recording process of units into or out of satellite fridges using the manual, paper based system in place at this time. Therefore units that were possibly still fit for purpose were discarded as the cold chain was not complete. Year 2009, when BloodTrack Courier was established and in full use showed a significant decrease in out of temperature units. It is likely that the increase in year 2010 is due to a better monitoring process.



Graph 1

Sample rejection in blood transfusion

Before the pilot all blood transfusion sample labels were handwritten. It was authorised in November 2008 that Blood Transfusion samples could be printed if the details were scanned from the patient's wristband and printed by the patient's bedside. The graph below shows the percentage sample rejection statistics by quarter for all electronic orders placed within the pilot areas ITU/ HDU and Queens 1,



2 and 3 in 2008 and 2010.

Graph 2.

In 2009 Quarter 1, there were significantly fewer rejected samples in BT, probably due to the move to printing of all BT sample labels in the Trust.

In 2009 Quarter 3 there was a significant increase in rejected samples in BT. Investigation showed there to be much movement of phlebotomy staff during this period.

Training and support for new staff has addressed issues and the figures have lowered.

The table below shows the reasons for sample rejection in BT.

Count of sample rejections in ITU/ HDU and Queens 1, 2, and 3 wards from electronic requests only

Reason	Year		Grand Total
	2008	2010	
Incorrect/no hosp no	23	21	44
Incorrect name	13	22	35
Not signed	10	13	23
Illegible details	10	8	18
Incorrect/no DoB	4	9	13
Two or more reasons	3	7	10
Wrong patient details		2	2
Printed label	2		2
Unlabelled	1	1	2
Wrong blood in tube		1	1
Wrong sample type	1		1
Total	67	84	151

The statistics in the above table detailing reasons for sample rejections in BT indicate that some labels are still being handwritten. An analysis of sampling on the Queens wards was undertaken by the TTP. This showed that phlebotomists on the Queens wards were using the BloodTrack system for all pathology sampling however the majority of BT samples were being taken by a nurse or doctor after the phlebotomy round, due to requests being made later in the day. This prompted a review of current process to encourage the move to raising requests earlier in the day. It also highlighted the need to train nurses, doctors and health care assistants on BloodTrack. The auditable information available has enabled capture and identification of human errors and thus prompted action to rectify them.

Time/ resource

There is a perceived increase in workload in the Blood Transfusion Laboratory. It is perceived as workload measures have not been taken.

Measures of time taken to complete individual processes need to be taken to assess the overall impact on the workload.

Potential time/ resource savings include:

- faster process for booking in samples
- easier to trace blood/ blood products
- easier to investigate adverse events
- better reporting
- automatic fating.

Maximising benefits

With the continued use of a blood tracking system underpinned by mandatory training in blood transfusion processes the benefits can be maximised.

A Blood Transfusion e-learning module is available in the Trust to assist training.

It is recognised that some staff are not very au fait with computer technology. Given the increasing use of IT in healthcare it is essential to help staff develop their skills. The Trust is running the NHS CFH Essential IT Skills (EITS) and all staff are required to complete assessments.

The technology used in the pilot is being used for other projects in the Trust and it is planned to extend the scope of usage.

12 Capturing and sharing the learning from this experience

The body of learning from the pilot is available and communicated via the

NHS CFH website:

<http://www.connectingforhealth.nhs.uk/systemsandservices/bloodpilot>

Reference website:

Reference published papers:

13 The future of blood tracking at Croydon University Hospital

Croydon Health Services NHS Trust will be implementing Cerner Millennium in 2012. It is planned to retain the successful elements of blood tracking functionality within the constraints of the new system.

Management of blood products has significantly increased efficiency in the blood transfusion laboratory. To lose this functionality would be a huge retrograde step and the Trust Blood Transfusion Department is keen to retain it.

The phlebotomy aspect of the project prompted the setting up of a working group to standardise all phlebotomy and sample labelling across the entire organization with the aim of reducing instances of wrong blood in tube. This group will work with Cerner, using the learning obtained from the Right Patient - Right Blood pilot, to ensure patient safety aspects of the blood transfusion process are harnessed and maximized.

The Trust is continuing to use RFID wristbands which are used for other projects including VitalPac (vital signs observations). At the time of writing, the passive RFID interfacing between supplier systems remains in development phase.

The wireless infrastructure and experience of mobile technology driven out by the blood tracking pilot will be fully utilised and extended with the introduction of Cerner Millennium.

Valuable lessons learnt from this pilot will be used within the Cerner Millennium programme.

Appendices

Appendix 1 Top level system architecture and software table

Appendix 2 ECTMS compliance report

Appendix 3 Blood transfusion electronic ordering

Appendix 4 Trust wide patient identification policy patient wristband fact sheet

Appendix 5 Specifications of equipment used in the pilot