The Regulation and Quality Improvement Authority

Where Does the Blood Go In Northern Ireland?

A Regional Audit by The Northern Ireland Transfusion Committee

July 2018

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Assurance, Challenge and Improvement in Health and Social Care

Contents

Overview

Red cell transfusion accounts for over 75% of all blood component use in Northern Ireland (NI)[1] and is therefore the fraction that poses the greatest risk to patients and the highest financial cost for Health and Social Care Trusts (HSCTs)[2]. Multiple initiatives[3-9] from the Northern Ireland Transfusion Committee (NITC) have resulted in a 34% reduction in the red cell transfusion index (expressed as units issued per 1000 of the population) in the years 2004 to 2016, making NI one of the more restrictive red cell transfusion regions in Europe[1,10]. Despite this improvement in transfusion practice, on-going regional pilot work has suggested there is potential for additional safety and financial gains. A comprehensive baseline analysis of areas of consumption was required to understand where red cells are currently transfused, so that new initiatives can be concentrated on appropriate patient groups, to gain maximum benefit with limited resources.

This audit examined all red cell transfusions in NI during a two-week period in February and March 2017. Data collectors determined the demographics and underlying clinical conditions of patients that were transfused a total of 1,462 units of red cells. The audit demonstrated clusters of clinical conditions where there is scope to improve on the use of red cells, by undertaking new projects.

Areas for practice improvement including haemoglobin checks between two-unit transfusions and better treatment of underlying haematinic deficiencies to avoid transfusion were identified. The audit also highlighted that 34% of red cell transfusions were commenced outside daytime hours, many for seemingly non-urgent indications.

Introduction

Red cell transfusion accounts for over 75% of blood component use in NI[1]. In the 2015/16 financial year, 46,618 units of red cells were issued to NI Health and Social Care Trusts at a cost of £6 million[1,2]. Transfusion of stored allogeneic red cells should be considered the last measure in the pathway for the treatment of anaemia, because of the associated risks of major morbidity and mortality as evidenced by the Serious Hazards of Transfusion (SHOT) report data[11]. These include transfusion of incorrect blood components, immediate and delayed transfusion reactions, transfusion associated circulatory overload, transfusion associated acute lung injury and production of atypical antibodies[11]. The latter complication can delay provision of future red cell transfusions for affected patients. Inappropriate and unnecessary transfusions contribute to red cell shortages, which can impact on waiting times for major elective surgery and management of massive blood loss. Recent NICE guidance[12] indicates that reduction in red blood cell transfusions is a key priority for action across the United Kingdom (UK).

The main remit of the NITC is to promote safe and cost effective transfusion practice by focusing on unnecessary and avoidable use of blood components[13], with annual work plans being steered and sanctioned by the Department of Health[14]. Previous regional NITC initiatives[3-9] have resulted in a 34% reduction in demand for red cells per 1,000 head of the NI population, as demonstrated in Figure 1.

Figure 1: Red Cell Issues in Northern Ireland *(moving average data – averaged over previous 12 months)*

This represents a significant advance in patient safety, with recurring financial savings for Health and Social Care Trusts of approximately £2.4 million per year; the cumulative benefit being a greatly reduced blood component purchase *(with a product value of £17.5 million*[*]*)* during the 12-year period of NITC initiatives.

Preliminary work carried out by NITC members in pilot projects during 2015-2016 demonstrated that further reduction in red cell use was possible[15-18], which could be achieved by undertaking a multi-directional integrated improvement project.

The NITC has applied for regional funding to undertake such a project from 2017 onwards; namely "TRUST" (Transfusion Reduction Using Systematic Transformation**)**[19]**.** The main aim of the proposed "TRUST" project is to achieve a further 8% reduction (from the 2015/16 figure) in unnecessary red cell transfusions in NI over a 5-year period. If achieved, this outcome would result in significant improvement in patient safety, by further reduction in avoidable patient exposure to donated blood with its associated hazards and additional financial saving of more than £1 million worth of component use.

The significant reduction in red cell transfusion in the last 12 years has almost certainly changed the demographics of where this blood component is being transfused in NI. Data concerning the annual purchase of red cell units by each NI Trust are available[1] but little is known about the medical and surgical conditions for which red cells are being transfused. The aim of this audit ("Where Does the Blood Go in Northern Ireland?) was to examine the current use of red cells in the different medical and surgical hospital specialties. It would then be possible to focus resources in the ensuing "TRUST" project on the hospital specialties and clinical conditions with the greatest potential to further reduce inappropriate or avoidable use of red cells.

An application was made on behalf of the NITC to the Guidelines and Audit Implementation Network (GAIN) (now the Audit Team at the Regulation and Quality Improvement Authority), to fund this regional audit project to assess the current destination of transfused red cells. Funding was granted in October 2016.

[*] *Based on NIBTS red cell unit charge to hospitals and annual reduction of red cells used since 2003*

Project Methodology

The NITC formed an Audit Steering Group and invited the Chairs of the five HSCT Transfusion Committees to participate and nominate additional Trust representatives, thus ensuring full regional participation. The final composition was a multi-professional group including healthcare professionals from different clinical specialities and senior blood bank personnel.

The audit was primarily concerned with identifying

1. **Patients' underlying clinical conditions for which red cells were transfused.**
2. **The hospital or community locations where the transfusions were administered.**

The Audit Group identified a number of key transfusion standards that were relevant to clinical practice:

3. **Non-urgent transfusions should not be commenced outside daytime hours whenever possible.**
    - Handbook of Transfusion Medicine[20].
4. **Single-unit red cell transfusions should be considered for adults who do not have active bleeding.**
    - National Institute for Health and Care Excellence. NICE Guideline 24:Blood Transfusion[12]
    - NHS Blood and Transplant: Single Unit Transfusions[21]
    - GAIN: Management of the Anaemic Adult Patient Prior to Scheduled Major Surgery[5].

5. **When a two-unit non-urgent red cell transfusion is being considered there should be a patient re-assessment and haemoglobin check between the units in most situations.**
    - National Institute for Health and Care Excellence. NICE Guideline 24:Blood Transfusion[12]
    - National Institute for Health and Care Excellence: Quality Standard 138: Quality Statement 3: Reassessment after red blood cell transfusions[22]**.**

Audit Design

Exclusions

There were no exclusions – all units of red cells transfused during a designated 2-week period were to be followed up.

Sample Size

The Audit Steering Group agreed on a 14-day period from 00:00 on 20th February 2017 to 23:59 on 5th March 2017, during which the destination of every transfused red cell unit in NI was to be examined. It was anticipated that there would be approximately 1744 red cell units transfused across the five NI HSCTs during this two-week period, based on the previous year's figures.

Data Retrieval Process

Details of red cell transfusions from the previous 24 hours were to be identified daily (or as early as possible) from data available in each hospital's blood bank. This information would then be passed on to the data collectors to enable them to examine the corresponding patients' case notes, to determine the indication for transfusion. If the latter information was not evident or unclear within the patients' case notes, the data collector could liaise with clinical staff to determine the reason for transfusion.

Proforma

Indication coding categories were closely aligned to the NHS Blood and Transplant Red Cell Survey[23]. The proforma and data coding sheet were intensively consulted on, piloted and reviewed several times for clarity and ease of completion before the final version was accepted, (Appendix 1 and 2).

Data Collectors and Training

In order to comply with Governance and Data Access Agreements, data collectors for each hospital were recruited locally on the advice of each Transfusion Committee Chair and were either Haemovigilance Practitioners or Biomedical Scientists with a transfusion laboratory background.

A comprehensive manual with visual completion examples was provided so that the data collectors could fully understand how to complete the proforma. Each hospital undertook a pilot of 20 red cell unit transfusions before the main study was undertaken.

Data Governance

The NITC and RQIA have data access agreements with the five HSCTs. The data collectors collected and returned anonymised data to the Audit Facilitation Team in the South Eastern Trust for collation and analysis.

Data Return

Completed proformas were scanned and submitted to the Audit Facilitation Team on a daily basis. The proformas were checked for completeness and overall quality of data collection prior to data collation and analysis.

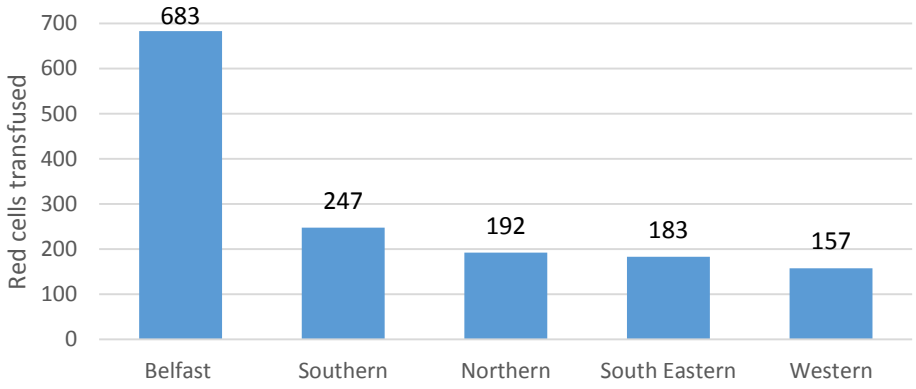
Results and Recommendations

Transfusion Demographics

All five HSCTs participating in the audit returned data on all red cell units transfused in the 14-day period. There were 1528 red cell units transfused in total during the 14 days, which was 87.6% of the predicted quantity (1744) for this period. Of these, 95.7% (1462 of 1528) were followed up by the data collectors to determine the transfusion indication. The remaining 4.3% (66 of 1528) units were not followed up due to the absence of a data collector in one hospital and were excluded from subsequent analysis.

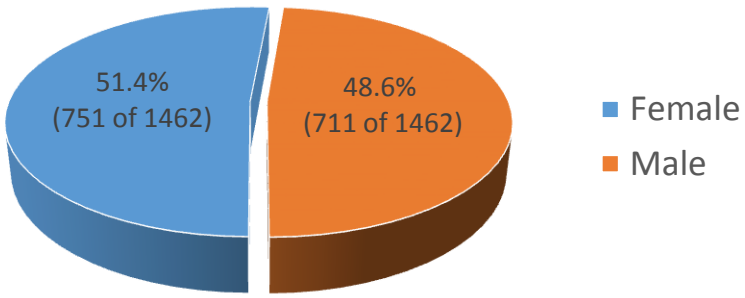
The returns by each Trust are illustrated in Figure 2 below:

Figure 2: Red cells transfused by Trust in 14-day period



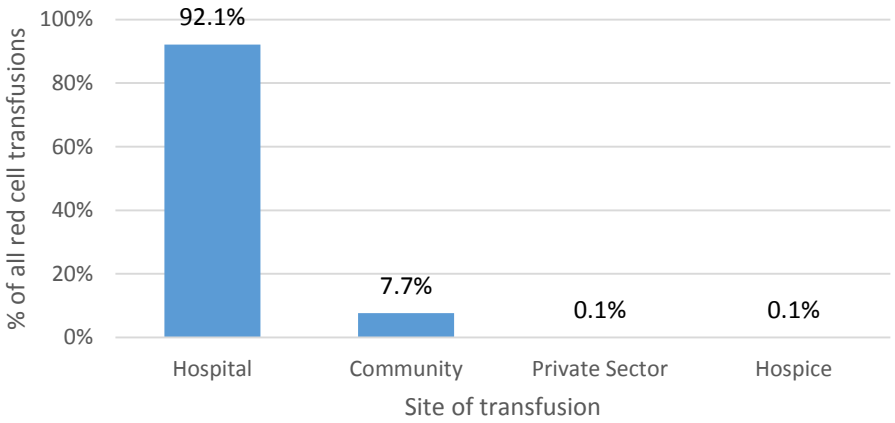
There were slightly more red cells transfused to females than males (Figure 3):

Figure 3: Gender division of transfusions



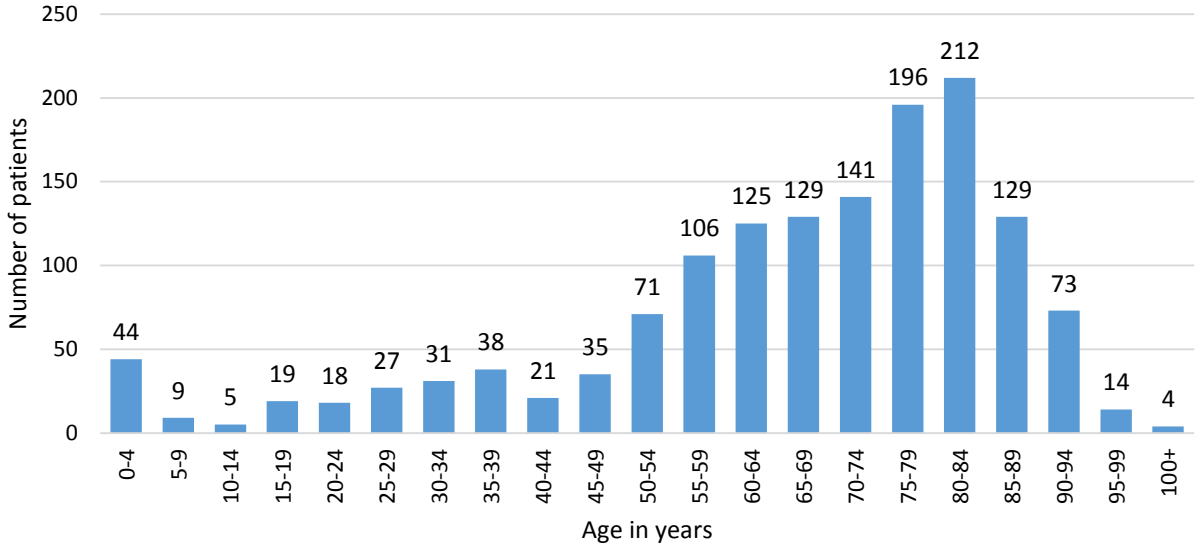
The majority of red cells 92.1% (1347 of 1462) were transfused in Trust hospitals, with a further 7.7% (112 of 1462) being transfused in a community setting (Figure 4). There were only two units transfused in the private sector and one unit transfused in a hospice during the audit period.

Figure 4: Location of transfusion



The median age of the transfused patients was 71 years and the age distribution was seen to peak in the 80-84 year age group (Figure 5):

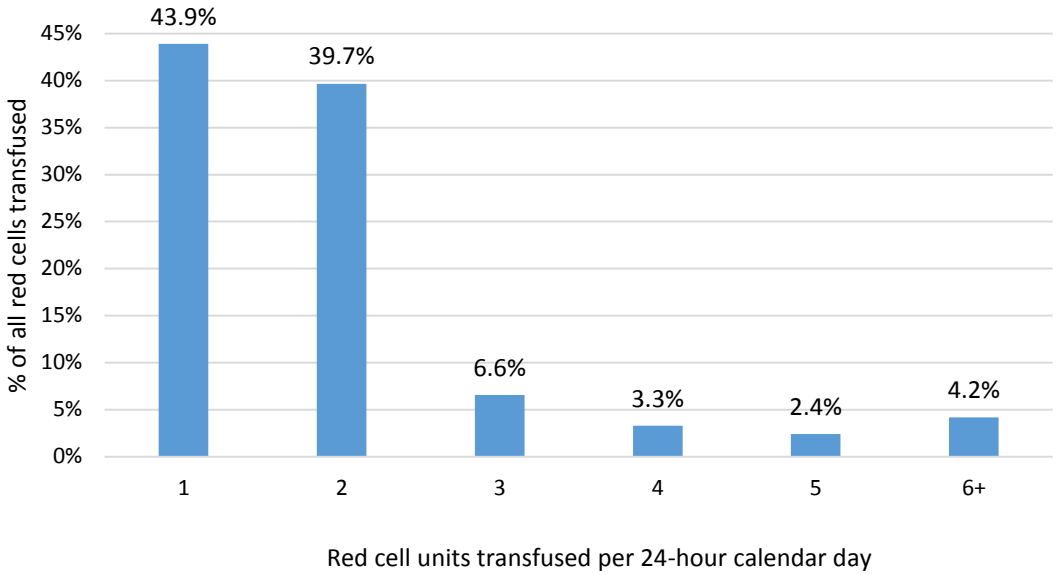
Figure 5: Age distribution of transfused patients



Distribution of red cell unit transfusions

The majority of red cells were administered as a single unit transfusion in 43.9% (642 of 1462) or as a two-unit transfusion - 39.7% (580 of 1462) in each 24-hour calendar day (Figure 6).

Figure 6: Distribution of red cell unit transfusions

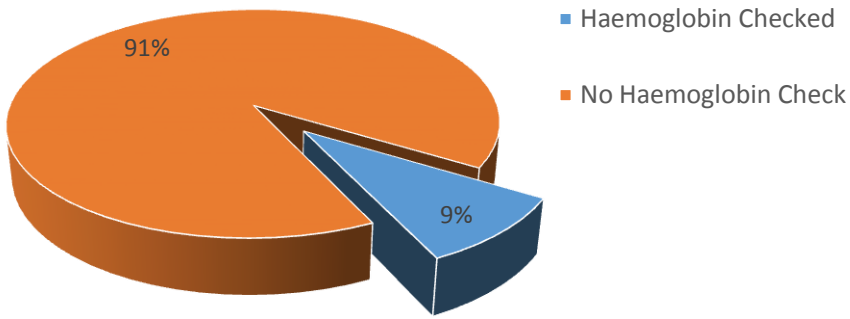


Eight patients had massive transfusions of 6 or more red cell units, which accounted for 4.2% (61 of 1462) of all red cell units administered in the two-week audit period.

Over transfusion occurs when too many units of red cells are administered during a transfusion episode and this problem has been repeatedly highlighted in previous NITC audits. There is considerable variation in the haemoglobin content of a unit of red cells and in the circulating volume of a recipient patient, so over transfusion can result unless adequate haemoglobin checks are undertaken. If a small patient is administered a red cell unit with a large volume, the haemoglobin may rise by more than 30g/litre. In a non-emergency, with a stable patient, over transfusion can be avoided by checking the patient's haemoglobin level after each red cell unit has been transfused.

Data on whether or not a haemoglobin check was performed between the first and second unit were available for 96.5% (280 out of 290) of the two unit transfusions. This haemoglobin check was undertaken in only 9% (26 of 280) of cases (Figure 7).

Figure 7: Checking haemoglobin between units in a two-unit transfusion



In the 254 cases where the Haemoglobin was not checked between units in a two unit transfusion, 65% (165) were judged likely to be non-emergency indications from the audit indication coding. It is probable that there is potential for improvement in this aspect of transfusion practice as every unit of red cells transfused is not without risk, so restrictive practice should be adhered to in patients who are not bleeding.

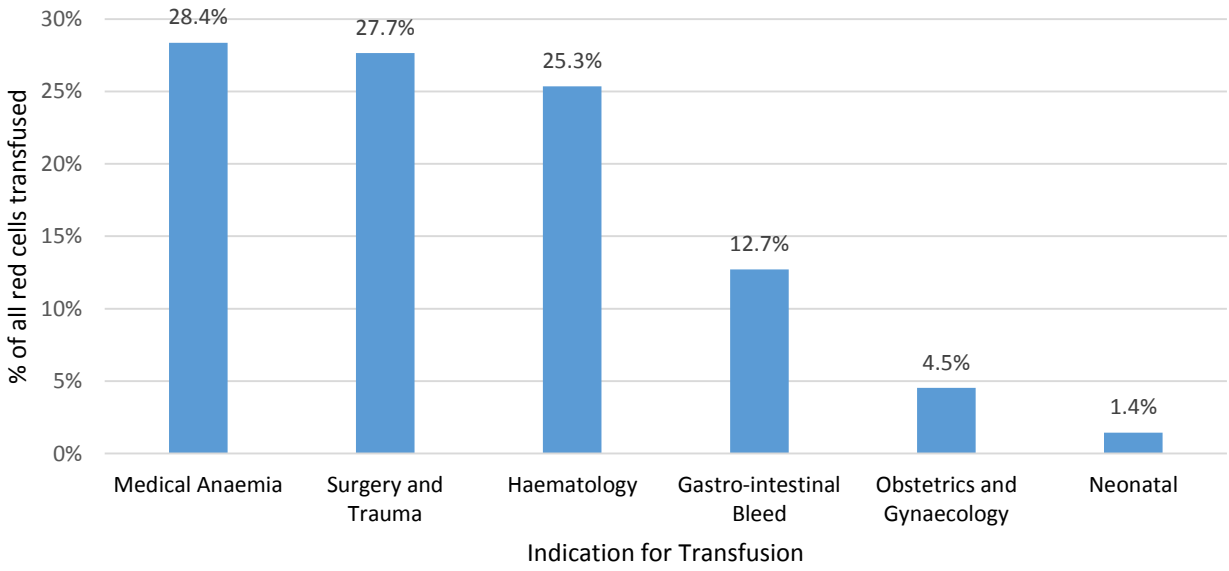
Recommendation 1

In non-emergency transfusions, the patient's haemoglobin level should be checked after every unit transfused and additional red cells should only be transfused if the required threshold has not yet been achieved.

Clinical indications for transfusion

Clinical indications for red cell transfusion were categorised into six broad groups (Figure 8).

Figure 8: Clinical indication for transfusion



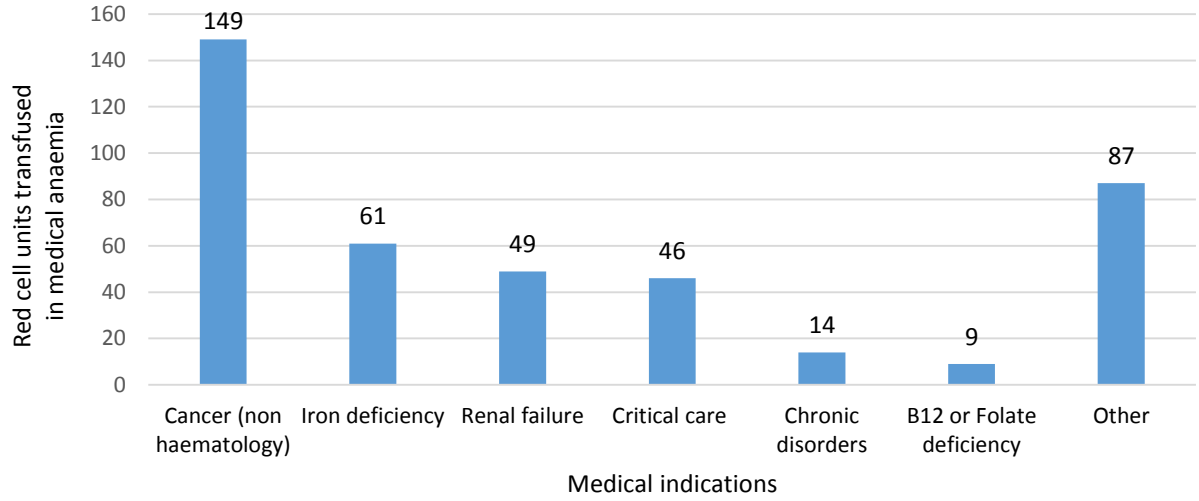
Neonatal transfusion accounted for 1.4% (21 of 1462) of all units transfused; the majority (18 out of 21) of which were administered as “top up” red cell transfusions to meet the minimum haemoglobin threshold.

The other five patient groups most commonly transfused were examined in greater detail to identify where improvements in practice might be possible.

Medical indications *(28.4% (415 of 1462) of all red cells transfused)*

The most common indication for red cell transfusion was medical anaemia, with non-haematological cancer being the largest subgroup in this category (Figure 9).

Figure 9: Transfusion indications within medical anaemia



The indication for transfusion in almost 21% (87 of 415) of this group fell into "Other" as the source of the anaemia was either under investigation, unknown or outside the designated options.

It is notable that at least 4.8% (70 of 1462) of all red cell units were transfused to patients who were anaemic due to a simple haematinic deficiency of iron, vitamin B_{12} or folate. Previous Trust and Regional audits[5,16] have demonstrated that transfusion for anaemia because of haematinic deficiency is often avoidable.

Recommendation 2

The cause of anaemia should be promptly investigated whenever possible.

Any underlying haematinic deficiencies should be corrected without delay to reduce requirement for transfusion.

Surgical and Trauma indications *(27.7% (404 of 1462) of all red cells transfused)*

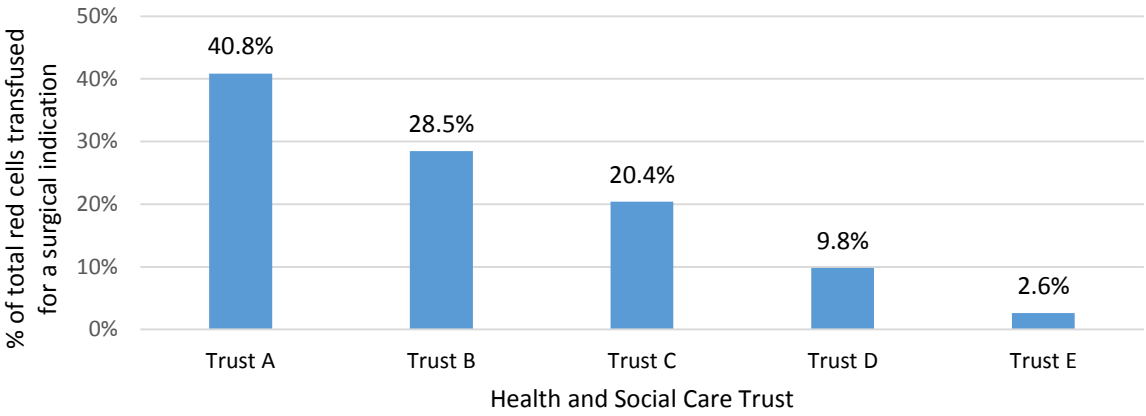
Surgery and trauma was the second largest patient group for whom red cells were transfused; it was subdivided into eight categories (Table 1).

Table 1: Red cell use within surgical and trauma specialities

Indication	Units Transfused		Total
	n	%	%
Trauma			**7.0**
Blunt	3	0.2	
Penetrating	4	0.3	
Fractured femur	39	2.7	
Fractured pelvis	2	0.1	
Other fracture	5	0.3	
Other (specify)	49	3.4	
Cardiothoracic			**5.9**
CABG (first)	34	2.3	
CABG (redo)	0	0.0	
Valve replace +/- CABG	36	2.5	
Other (specify)	16	1.1	
Gastrointestinal			**4.8**
Oesophageal	4	0.3	
Gastric	13	0.9	
Pancreatic	5	0.3	
Colorectal	26	1.8	
Liver	6	0.4	
Other (specify)	16	1.1	
Orthopaedics			**4.5**
THR (first)	14	1.0	
THR (redo)	11	0.8	
TKR (first)	5	0.3	
TKR (redo)	0	0.0	
Other (specify)	36	2.5	
Vascular Surgery			**2.3**
Emergency AAA repair	7	0.5	
Elective AAA repair	2	0.1	
Other (specify)	25	1.7	
Urology	27	1.8	**1.8**
Ear, Nose and Throat (ENT)	7	0.5	**0.5**
Other	12	0.8	**0.8**

There was marked variation by Trust in the percentage of total red cells transfused for a surgical indication (figure 10).

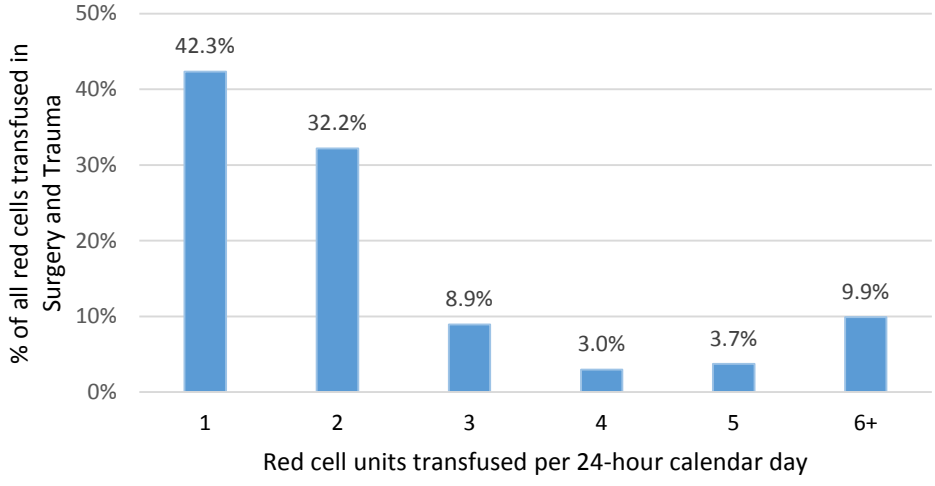
Figure 10: Percentage of red cells transfused to surgical patients by Trusts



Location of regional specialities and variance in the quantity of emergency and trauma cases and overall surgical volume are all likely to account for the different percentages in surgical transfusion between Trusts. The graph above identifies that some Trusts transfuse little blood to surgical patients. In other Trusts where a high proportion of red cells are transfused in surgical patients, more proactive patient blood management may be beneficial.

Treatment of major haemorrhage with six or more red cell units accounted for 9.9% (40 of 404) of all red cell units transfused in the surgery and trauma patient group. Another 42.3% (171 of 404) of red cells transfused to surgical or trauma patients in each 24-hour calendar period were administered as single unit transfusions (Figure 11).

Figure 11: Distribution of red cell transfusion in Surgery and Trauma



Some Trusts already demonstrate a very restrictive approach to transfusion in surgery. It is evident from the data in Table 1 that some red cell transfusions were administered to patients undergoing entirely elective surgery e.g Total Hip Replacement (THR) where transfusion might not be expected and 90% (18 out of 20) of these transfused THR patients required a single unit transfusion. The high proportion of single-unit transfusions suggests that it may be possible to avoid transfusion completely in some cases by greater adherence to patient blood management initiatives[12,24,25,26].

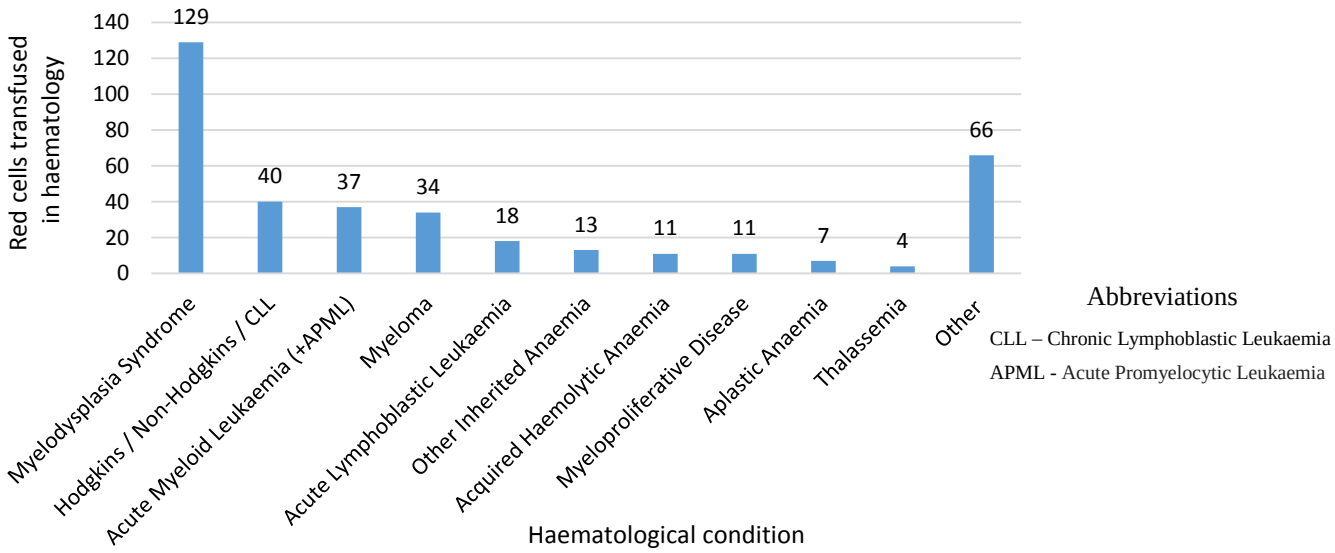
Recommendation 3

Patient blood management should be fully implemented so that the requirement for red cell transfusion can be avoided in many patients undergoing elective surgery.

Haematological indications *(25.3% (370 of 1462) of all red cells transfused)*

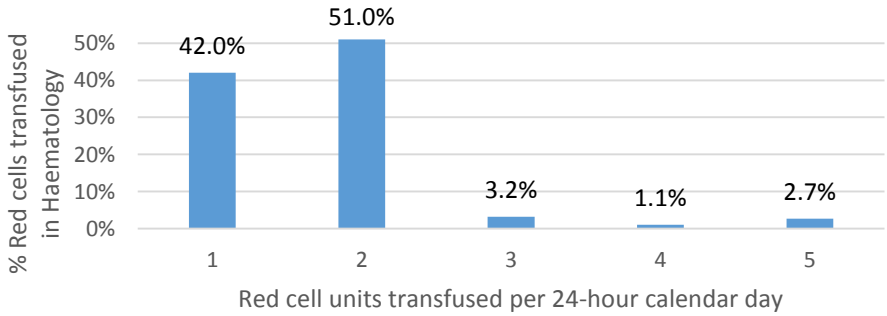
The third largest cohort of conditions treated with red cell transfusion was grouped under Haematology, of which patients with Myelodysplasia Syndrome (MDS) were the largest sub-group requiring over one third of all red cell units in this group (Figure 12).

Figure 12: Red cell transfusion by condition within Haematology



50.8% (188 of 370 units) of blood in the Haematology group were administered as a two-unit transfusion during each 24-hour audit calendar day (Figure 13). This most likely reflects the requirement for “top up” transfusions in the management plan of this group of transfusion dependent patients with impaired red cell production.

Figure 13: Distribution of red cell transfusion in Haematology

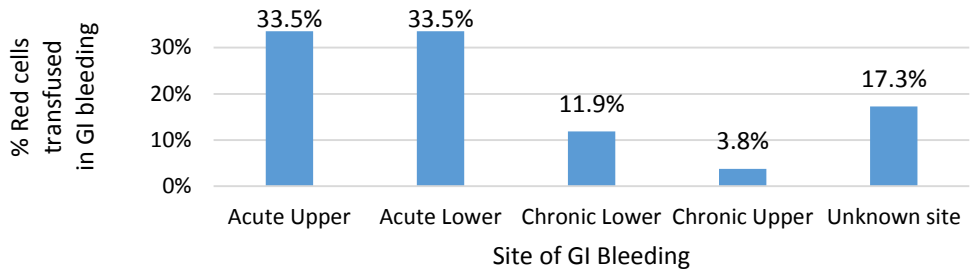


Transfusion is not without risk for all patients and only 3.2% (3 of 94) Haematology patients had a haemoglobin check between the first and second units. NICE (NG24) does not currently propose a restrictive approach for the management of transfusion dependent chronic anaemia, but this may be an area worthy of investigation in the future.

Gastrointestinal Bleeding *(12.7% (186 of 1462) of all red cell transfusions)*

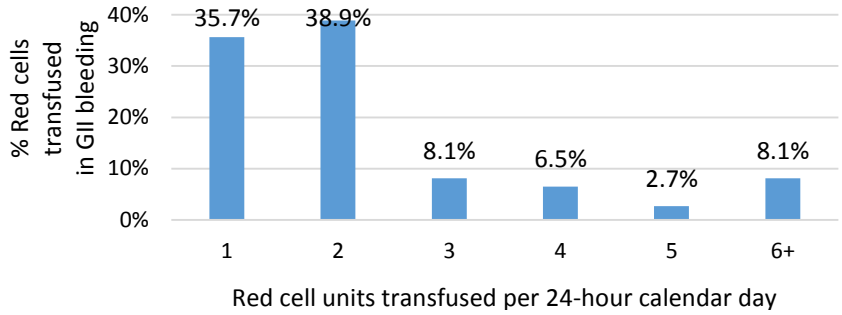
The site of bleeding in the gastrointestinal (GI) tract could be differentiated between upper and lower in 82.2% (153 of 186) of cases and 81% (124 of 153) of red cells transfused in this circumstance were for acute rather than chronic gastrointestinal bleeding. A slightly greater number of red cells were transfused for lower GI bleeding 54.9% (84 of 153) than upper GI bleeding 45.1% (69 of 153). The site of bleeding was unknown at the time of transfusion in 17.7% (33 of 186) of cases (Figure 14).

Figure 14: Red cell transfusion for gastrointestinal bleeding



The breakdown of units transfused in Figure 15 shows that the majority of red cells were administered as single or two-unit transfusions in each 24-hour calendar day.

Figure 15: Distribution of red cell transfusion for gastrointestinal bleeding

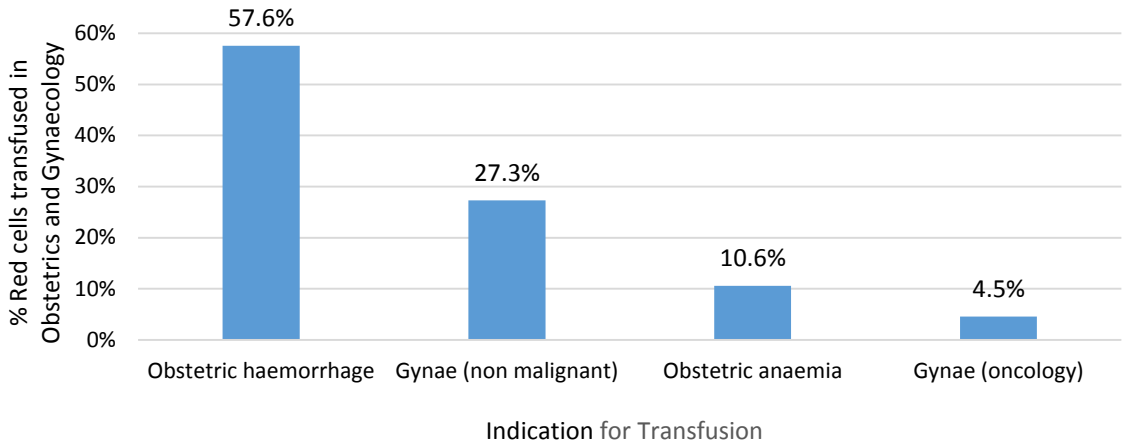


There is increasing evidence that a restrictive transfusion strategy is beneficial in GI bleeding[27], but a haemoglobin check after the first unit was only performed in 8.3% (3 of 36) of the two-unit transfusions. Better adherence to checking haemoglobin level after the first unit may be applicable to an increasing number of patients with GI bleeding see Recommendation 1.

Obstetrics and Gynaecology *(4.5% (66 of 1462) of all red cell transfusions)*

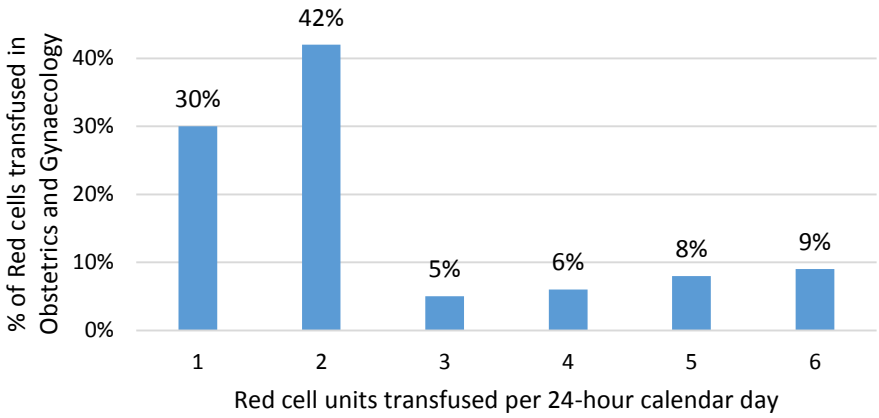
68.2% (45 of 66) of red cells transfused in this group were administered to obstetric patients, most of which were transfused for obstetric haemorrhage (Figure 16).

Figure 16: Red cell transfusions in Obstetrics and Gynaecology



72.7% (48 of 66) of red cells were administered as a single or two-unit transfusion in each 24-hour period (Figure 17).

Figure 17: Administration pattern in Obstetrics and Gynaecology



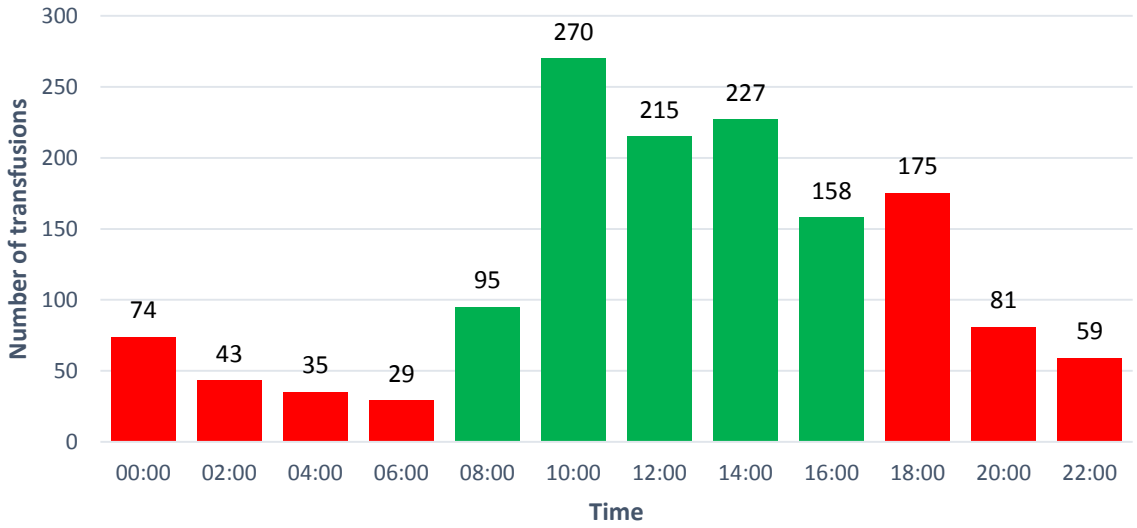
It may have been possible to reduce or avoid transfusion requirement in some of these cases, by more prompt detection and treatment of antenatal anaemia and implementation of patient blood management.

Time of transfusion

The time of removal from a blood fridge or the actual time of commencement of transfusion was recorded for all but one of the red cell units audited and these times were considered to be the start time of the transfusion.

In 66% (965 of 1462) of cases transfusion commenced between 08.00 hour and 18.00 hour; 34% (497 of 1462) occurred between 18.00 hour and 08.00 hour (Figure 18).

Figure 18: Start time of transfusion



For this audit, daytime working hours were defined as the period between 08.00 and 18.00 hours, the core working hours for nursing staff in most clinical areas, who usually are tasked with administering red cells and monitoring the patient's observations during a transfusion. Analysis of the out of hours' transfusions showed that they occurred in all hospital specialties for a wide range of indications. It is accepted that "out of hours" transfusions are unavoidable in the management of emergency or urgent situations but 41% (204 of 497) of these transfusions appear to have been administered for anaemia or haematology indications, many of which could have taken place in daytime hours.

Recommendation 4

Non-urgent transfusions should be transfused within daytime working hours whenever possible.

Discussion

Limitations of this audit

- Health and Social Care Trusts reported and confirmed that they had included every unit of red cells transfused within the two-week audit period, although the data returns were only 87.6% of the number predicted; hence the audit may not be totally representative of the annual red cell usage in NI.
- In order to manage the workload for the data collectors, more than one unit of red cells had to be transfused in the same calendar day to be counted as a "multiple unit" transfusion. There was no matching up of transfusions between sequential days, so many "single unit" transfusions may have been multiple unit transfusions episodes, spread out across the midnight hour or over a period of days.
- The audit may have underestimated the number of red cells transfused outside of daytime hours, given that transfusion could have continued beyond 18.00 hour and in many cases the start time of transfusion was estimated from when the red cells were taken out of controlled temperature storage.

Putting this audit in perspective

Previous successful NITC coordinated regional audits of the appropriateness of transfusion and of the management of anaemia to avoid transfusion, were not designed to produce an accurate picture of where and how all red cells were transfused. In order to produce useful information for individual hospitals in addition to an assessment of regional transfusion practice, these audits had built-in sampling bias in terms of the specific inclusion criteria and the minimum sample size. Despite the limitations of the current audit, the sample is sufficiently large and inclusive of all clinical activity to be highly informative about where red cells are being transfused in NI (appendix 3).

This audit provides a solid evidence base of the demographics of the transfused population, all the underlying clinical conditions and the extent to which this blood component is transfused within each specialty. The audit also highlights multiple potential areas of improvement within the patient blood management agenda[24,25,26], which are recommended by the National Institute of Clinical Excellence (NG24)[12]. These include better detection and treatment of iron deficiency, greater

implementation of blood management around surgery[24], better adoption use of single unit transfusion policy[21] with haemoglobin checking between units for the non-bleeding patient[22].

As a consequence of undertaking this audit, it will be possible to concentrate time and resources where the greatest improvements can be made to further reduce unnecessary and avoidable red cell transfusion, which will in turn improve patient safety and provide significant financial savings over and above that already achieved in NI.

Recommendations

Recommendation 1

In non-emergency transfusions, the patient's haemoglobin level should be checked after every unit transfused and additional red cells should only be transfused if the required threshold has not yet been achieved.

Recommendation 2

The cause of anaemia should be promptly investigated whenever possible.
Any underlying haematinic deficiencies should be corrected without delay to reduce requirement for transfusion.

Recommendation 3

Patient blood management should be fully implemented so that the requirement for red cell transfusion can be avoided in many patients undergoing elective surgery.

Recommendation 4

Non-urgent transfusions should be transfused within daytime working hours whenever possible.

Action Plan

- Regional and Trust based future Quality Improvement Initiatives should be designed and funded to promote implementation of the above recommendations. Projects should include
  - Promotion of patient assessment including haemoglobin checking between transfused units,
  - Development of a regional patient blood management programme,
  - Change management training to empower Blood Bank and Haemovigilance staff to challenge inappropriate clinical requests for red cell units without haemoglobin checks.

  Action: NI Transfusion Committee and NITC Audit and Implementation Lead

- The results of this audit are to be widely distributed to all Healthcare Trusts and Healthcare Professionals.
  Action: RQIA Audit, NI Transfusion Committee and NITC Audit and Implementation Lead

- Individual Trust data are to be reported back to Trusts to highlight areas for improvement and future audit.
  Action: NITC Audit and Implementation Lead

- An educational presentation of this audit is to be made available to all Trust Transfusion Committees and Haemovigilance Practitioners for presentation to relevant personnel in Trusts.
  Action: NITC Audit and Implementation Lead, Hospital Transfusion Committees and Haemovigilance Practitioners

- Multiprofessional education study days and events are to be organised to highlight potential performance improvements identified in this audit.
  Action: NI Transfusion Committee

- The implementation of improvement will bring real benefits in terms of patient safety and financial savings for all Healthcare Trusts in NI. There should be a clear implementation strategy to ensure this will occur.
  Action: NI Transfusion Committee

- The implementation strategy should be adequately resourced to ensure that improvements in patient safety and financial savings are realised quickly and effectively.
  Action: Regional funding bodies

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Acknowledgements

Project Group

Name	Designation	Organisation
Monique Abela	Haematologist	NIBTS
Susan Atkinson	Consultant Anaesthetist	BHSCT (NITC Chair)
Ni Ni Aung	Consultant Haematologist	NIBTS
Louann Birch	Haemovigilance Practitioner	SEHSCT
Damien Carson	Consultant Anaesthetist	SEHSCT (NITC Audit & Implementation Lead)
Sinead Carty	Transfusion Laboratory Manager	SEHSCT
Adrian Crawford	Transfusion Laboratory Manager	WHSCT
Siobhan Crilly	Clinical Audit Facilitator	RQIA
Matt Gillespie	Transfusion Laboratory Manager	NHSCT
Jeremy Hamilton	Consultant Haematologist	SEHSCT
Don Hull	Consultant Haematologist	SHSCT
Stephen Kane	Transfusion Laboratory Manager	BHSCT
Zona Kelly	Haemovigilance Practitioner	BHSCT
Kathryn Maguire	Consultant Haematologist	NITBTS
Patrick McAteer	Anaesthetic Registrar	BHSCT
Aine McCartney	Regional Haemovigilance Practitioner Coordinator	BHSCT
Mary P.McNicholl	Haemovigilance Practitioner	WHSCT
Kieran Morris	Consultant Haematologist	NIBTS
Graham Scott	Transfusion Laboratory Manager	SHSCT
Patricia Watt	Haemovigilance Practitioner	SHSCT
Trust Coordination		
Sinead Carty	Transfusion Laboratory Manager	SEHSCT
Matt Gillespie	Transfusion Laboratory Manager	NHSCT
Stephen Kane	Transfusion Laboratory Manager	BHSCT
Zona Kelly	Haemovigilance Practitioner	BHSCT
Aine McCartney	Regional Haemovigilance Practitioner Coordinator	BHSCT
Adrian Crawford	Transfusion Laboratory Manager	WHSCT
Mary P. McNicholl	Haemovigilance Practitioner	WHSCT
Don Hull	Consultant Haematologist	SHSCT
Graham Scott	Transfusion Laboratory Manager	SHSCT
Patricia Watt	Haemovigilance Practitioner	SHSCT
Data Collectors		
Louann Birch	Haemovigilance Practitioner	SEHSCT
Sonia Blair	Haemovigilance Practitioner	BHSCT
Brendan Donnelly	Haemovigilance Practitioner	BHSCT
Matt Gillespie	Transfusion Laboratory Manager	NHSCT
Zona Kelly	Haemovigilance Practitioner	BHSCT
Aine McCartney	Regional Haemovigilance Practitioner Coordinator	BHSCT

Name	Designation	Organisation
Paula McKee	Biomedical Scientist	SEHSCT
Carolyn McLaughlin	Haemovigilance Practitioner	BHSCT
Mary P.McNicholl	Haemovigilance Practitioner	WHSCT
Josephine Monaghan	Haemovigilance Practitioner	WHSCT
Loisel Neil	Haemovigilance Practitioner	BHSCT
Rachael Robinson	Biomedical Scientist	SEHSCT
Patrick Sheridan	Haemovigilance Practitioner	SHSCT
Patricia Watt	Haemovigilance Practitioner	SHSCT
Fionnuala Walker	Haemovigilance Practitioner	BHSCT
Sarah Wallace	Haemovigilance Practitioner	BHSCT
Audit Facilitation Team		
Adele Hyvart	Audit Facilitator	SEHSCT
Linda Kelly	Assistant Director (Safe &Effective Care)	SEHSCT
Carol Lutton	Audit Manager	SEHSCT
Melanie Regan	Audit Facilitator	SEHSCT
Sharon Thompson	Audit Manager	SEHSCT
Regulation and Quality Improvement Authority		
Siobhan Crilly	Regional Clinical Audit Facilitator	RQIA
Robert Mercer	Regional Clinical Audit Facilitator	RQIA
Nicola Porter	Audit Manager	RQIA

Appendix 1

Data collection proforma

Keep This Red Master Record Portion Secure
It is NOT to be seen outside your Trust

Date _____

Return this Green Audit Data Record
Portion to The Facilitation Team

Master Code	Patient Name	H&C / Hospital Number	Ward	Master Code	Gender	Age	Time unit out (24 hr clock)	Unit given to same patient earlier today?				Transfusion			Site transfusion occurred	COMMENTS
								Yes / No	Previous Record no.	This is unit no.	If 2 units today Hb Check? Y/N	Indication/s Indication	Code	Clearly documented in notes? Y/N		
				T 1			:									Relates to Patient Master Code:_____
				T 2			:									
				T 3			:									
				T 4			:									Relates to Patient Master Code:_____
				T 5			:									
				T 6			:									Relates to Patient Master Code:_____
				T 7			:									
				T 8			:									
				T 9			:									Relates to Patient Master Code:_____
				T 10			:									
				T 11			:									
				T 12			:									Relates to Patient Master Code:_____
				T 13			:									
				T 14			:									
				T 15			:									Relates to Patient Master Code:_____
				T 16			:									
				T 17			:									
				T 18			:									Relates to Patient Master Code:_____
				T 19			:									
				T 20			:									
				T 21			:									Relates to Patient Master Code:_____
				T 22			:									
				T 23			:									
				T 24			:									Relates to Patient Master Code:_____
				T 25			:									
				T 26			:									Relates to Patient Master Code:_____
				T 27			:									
				T 28			:									
				T 29			:									
				T 30			:									

Appendix 2
Data Collection Coding Sheet

	Cardiothoracic		**Orthopaedics**		**Anaemia due to**
1	CABG (first)	24	THR (first)	44	Renal Failure
2	CABG (redo)	25	THR (redo)	45	Cancer (non haem)
3	Valve replace +/- CABG	26	TKR (first)	46	Iron deficiency
4	Other (specify)	27	TKR (redo)	47	B12/Folate defic
		28	Other (specify)	48	Chronic disorders eg Rheumatoid Arthritis
5	**Ear, Nose and Throat (ENT)**	29	**Plastic Surgery**	49	Critical care not related to surgery, trauma or GI
	Gastrointestinal	30	**Maxillo-facial Surgery**	50	Other (specify)
6	Oesophageal				
7	Gastric	31	**Other surgery (specify)**		**Haematology**
8	Pancreatic			51	MDS
9	Colorectal		**Obs & Gynae**	52	AML (+APML)
10	Liver	32	Gynae (non-malignant)	53	ALL
11	Other (specify)	33	Gynae (oncology)	54	Myeloma
12	**Neurosurgery**	34	Obstetric anaemia	55	Hodgkins/NHL/CLL
	Trauma	35	Obstetric haemorrhage	56	Acquired Haem Anaemia
13	Blunt			57	Thalassemia
14	Penetrating		**Neonatal/Fetal**	58	Sickle cell disease
15	Fractured femur	36	Neonatal top up	59	Other inherited anaemia
16	Fractured pelvis	37	Neonatal exchange	60	Myeloproliferative disease
17	Other fracture	38	Other (specify)	61	CML
18	Other (specify)			62	Aplastic anaemia
			GI Bleed	63	Other (specify)
19	**Urology**	39	Acute Upper		
20	**Organ Transplant**	40	Acute Lower		
		41	Chronic Upper		
	Vascular Surgery	42	Chronic Lower	**Site Transfusion Occurred**	
21	Emergency AAA repair	43	Unknown site	Hospital Hospice Community Private sector	
22	Elective AAA repair				
23	Other (specify)				

Appendix 3: Full data breakdown of 1462 units followed up

Indications	Number of Units Transfused		Indications	Number of Units Transfused	
	n	%		n	%
Cardiothoracic			**Obs & Gynae**		
CABG (first)	34	2.3	Gynae (non-malignant)	18	1.2
CABG (redo)	0	0.0	Gynae (oncology)	3	0.2
Valve replace +/- CABG	36	2.5	Obstetric anaemia	7	0.5
Other (specify)	16	1.1	Obstetric haemorrhage	38	2.6
Ear, Nose and Throat (ENT)	**7**	**0.5**	**Neonatal/Fetal**		
			Neonatal top up	18	1.2
Gastrointestinal			Neonatal exchange	2	0.1
Oesophageal	4	0.3	Other (specify)	1	0.1
Gastric	13	0.9			
Pancreatic	5	0.3	**GI Bleed**		
Colorectal	26	1.8	Acute upper	62	4.2
Liver	6	0.4	Acute Lower	62	4.2
Other (specify)	16	1.1	Chronic Upper	7	0.5
			Chronic Lower	22	1.5
Neurosurgery	4	0.3	Unknown site	32	2.2
Trauma			**Anaemia due to**		
Blunt	3	0.2	Renal Failure	49	3.4
Penetrating	4	0.3	Cancer (non haem)	149	10.2
Fractured Femur	39	2.7	Iron deficiency	61	4.2
Fractured Pelvis	2	0.1	B12/Folate defic	9	0.6
Other Fracture	5	0.3	Chronic disorders eg Rheumatoid Arthritis	14	1.0
Other (specify)	49	3.4	Critical care not related to surgery, trauma or GI	46	3.1
			Other (specify)	88	6.0
Urology	**27**	**1.8**			
			Haematology		
Organ Transplant	**1**	**0.1**	MDS	129	8.8
			AML (+APML)	37	2.5
Vascular Surgery			ALL	18	1.2
Emergency AAA repair	7	0.5	Myeloma	34	2.3
Elective AAA repair	2	0.1	Hodgkins/NHL/CLL	40	2.7
Other (specify)	25	1.7	Acquired Haem Anaemia	11	0.8
			Thalassemia	4	0.3
Orthopaedics			Sickle cell disease	0	0.0
THR (first)	14	1.0	Other inherited anaemia	13	0.9
THR (redo)	11	0.8	Myeloproliferative disease	11	0.8
TKR (first)	5	0.3	CML	1	0.1
TKR (redo)	0	0.0	Aplastic anaemia	7	0.5
Other (specify)	36	2.5	Other (specify)	65	4.4
Plastic Surgery	**1**	**0.1**			
Maxillo-facial Surgery	**1**	**0.1**			
Other Surgery	**5**	**0.3**	**Total**	**1462**	**100**

The **Regulation** and
Quality Improvement
Authority

The Regulation and Quality Improvement Authority
9th Floor
Riverside Tower
5 Lanyon Place
BELFAST
BT1 3BT

Tel 028 9536 1111
Email info@rqia.org.uk
Web www.rqia.org.uk
@RQIANews