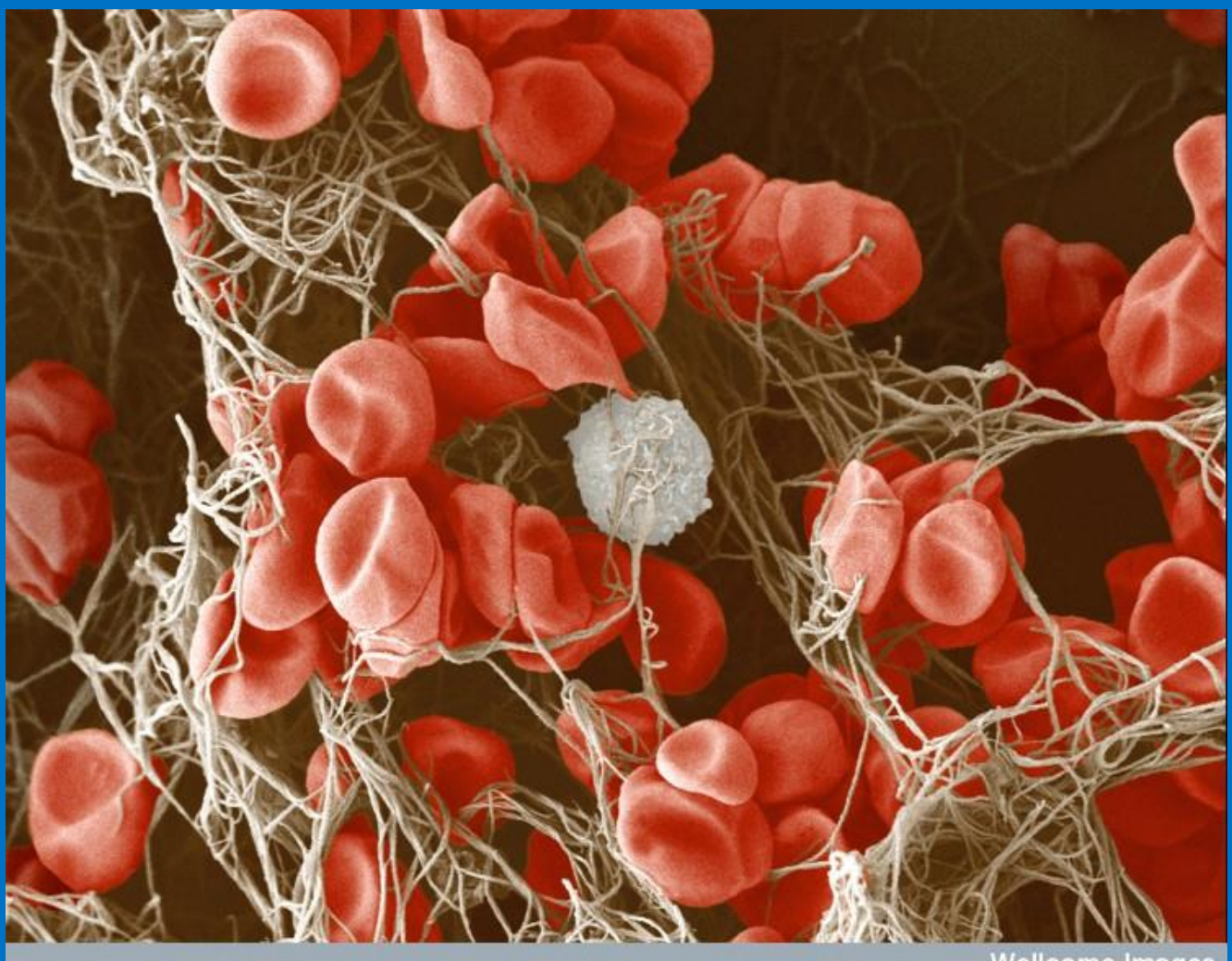
National Comparative Audit
of Blood Transfusion

NHS
Blood and Transplant

National Comparative Audit of Blood Transfusion

2016 Audit of Red Cell & Platelet Transfusion in Adult Haematology Patients

National Results



Acknowledgements

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HOSPITALS THAT AGREED TO PILOT THE AUDIT

Aintree University Hospital; The Christie Hospital; Conquest Hospital; Darlington Memorial Hospital; Doncaster & Bassetlaw Hospitals NHS Foundation Trust; Eastbourne District General Hospital; The Hillingdon Hospital; The Ipswich Hospital; James Paget University Hospital; King's College Hospital; Manchester Royal Infirmary; The Newcastle upon Tyne Hospitals NHS Foundation Trust; Queen Elizabeth Hospital, Woolwich; Royal Berkshire Hospital; Royal Oldham Hospital; Salford Royal Hospital; Sandwell & West Birmingham Hospitals NHS Trust; Tameside Hospital; University Hospital of North Durham; Wexham Park Hospital; and Ysbyty Gwynedd.

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Contents

Abbreviations

BCSH	British Committee for Standards in Haematology
BMF	Bone marrow failure
Hb	Haemoglobin
IHD	Ischaemic heart disease
IQR	Interquartile range
IT	Information Technology
NBTC	National Blood Transfusion Committee
WHO	World Health Organization

Executive Summary

This audit was conducted in January 2016 in hospitals throughout the United Kingdom and Ireland. 136/141 (96%) eligible NHS English Trusts contributed data.

Organisational audit

151 hospitals participated in the organisational audit.

13% (19/148) of hospitals reported that written transfusion guidelines were not available (**Organisational standard 1**). When available there was variable agreement with national guidelines. In red cell transfusion indications for "anaemia without additional risk factors" and "anaemia with cardiovascular disease" non-compliance was around 30% in each. The main reason for non-compliance was because a higher haemoglobin (Hb) threshold was stated. Only 16% of platelet transfusion guidelines stated that prophylactic transfusions were not required in chronic bone marrow failure (BMF). In only 37% of platelet transfusion guidelines were grades of bleeding specified.

51% (64/125) of hospitals stated that local audit had been performed within the last 12 months (**Organisational standard 2**). This was an improvement compared to the previous national audit in haematology patients in 2010 when compliance was 43%. A significant rise in routine regular audit is unlikely to be achieved without an information technology solution.

Clinical audit

170 hospitals participated in the clinical audit. Patients audited were adults with a haematological malignancy or a myeloid failure syndrome who had received a red blood cell or platelet transfusion.

We analysed a total of 4649 patient records with information on 6109 transfusion episodes. There were 4328 red cell transfusions and 1781 platelet transfusions. 31% of patients received both red cell and platelet transfusions.

When additional units received by audited patients during the study period were included this accounted for around 15% (17020/115217) of all red cell and 45% (8920/19687) of all platelet components requested by participating hospitals.

The majority of patients included in this audit were over sixty years of age (median 72 years). Myelodysplasia, largely a disease of older people, was the commonest haematological diagnosis (28.5%). 70% of all patients were managed without curative intent with either transfusion alone or with the addition of low dose chemotherapy. 7% (219/3305) of all patients whose weight was known weighed less than 50 kg

Compliance with national guidelines was no better in hospitals that manage complex patients that may require prolonged inpatient care (BCSH level 2b or level 3 care) compared to hospitals that manage more straight forward patients who required less intensive management or only outpatient care (BCSH level 1 or 2a care).

Red cell transfusion

In 59% (2551/4325) of transfusion episodes the reason for transfusion was chronic anaemia. 94% (4055/4322) of patients had an Hb measured within 24 hours if they were an inpatient or within 72 hours if they were an outpatient (**Red cell standard 1**). Single unit transfusions were uncommon [27% (390/1447) inpatients compared to outpatients 13% (383/2859)]. When more than one unit of red cells was transfused only 11% (116/1050) of inpatients and 0.5% (12/2452) of outpatients had an Hb measured in between units. Results were similar in patients weighing less than 50 kg. Seven patients weighing less than 50 kg received 3 unit red cell transfusions as outpatients. This practice is unsafe because it puts patients at risk of Transfusion Associated Circulatory Overload (TACO).

Patients with chronic anaemia were excluded from red cell transfusion standards which used a haemoglobin threshold alone as this group may require an individualised transfusion threshold.

Only 17% (163/955 of patients who were anaemic and had no additional risk factors were transfused when their Hb was 70g/L or lower (**Red cell standard 2**).
Only 30% (8/60) of patients who were anaemic and had cardiovascular disease were transfused when their Hb was 80g/L or lower (**Red cell standard 3**).

Compliance with standards associated with sepsis and radiotherapy which used higher Hb thresholds was much better.

An algorithm was used to assess appropriateness which included all red cell transfusion episodes (an Hb threshold of 100g/L with review of symptoms was used for patients with chronic anaemia). At best 75% were considered appropriate (see Executive Summary Table 1).

Platelet transfusion

77% (1379/1781) of platelet transfusion episodes were given as prophylaxis, and within this group 53% were given to patients with chronic BMF. 9% (160/1781) were used pre-procedure and 10% (182/1781) were used to treat bleeding. For 3% (60/1781) of patients the reason for transfusion was either unclear or not stated.

Prophylactic platelet transfusion

95% (1681/1776) of patients had a platelet count measured within 24 hours if they were an inpatient or within 48 hours if they were an outpatient. In patients with reversible BMF and no other risk factors, 62% (289/474) of patients had a platelet count less than or equal to 10 x 10^9/L (**Platelet standard 1**). This was an improvement compared to the last audit in 2010 when only 54% of these patients had a platelet count less than or equal to 10 x 10^9/L.

93% (1277/1379) of prophylactic platelet transfusions were single units; 90% of inpatients and 96% of day patients (**Platelet standard 2**). In the previous audit in 2010 90% (2057⁄2277) of prophylactic transfusions were single unit transfusions; 89% of inpatients and 93% of day patients). Only 42% of inpatients, who received more than one prophylactic unit, had a platelet count measured in between units, which is likely to represent unnecessary use.
Using an appropriate use algorithm 72% of prophylactic transfusion episodes associated with reversible BMF were considered appropriate but only 43% of

episodes associated with chronic BMF, not receiving intensive therapy, were considered appropriate (**Platelet standard 3**) (see Executive Summary Table 1).

Pre-procedure

84% (42/50) of patients who had a platelet transfusion prior to a procedure (liver biopsy, transbronchial biopsy, indwelling line insertion, laparotomy, etc.) had a platelet count of less than or equal to 50 x 10^9/L (**Platelet standard 4**). In the previous audit in 2010 compliance with this standard was 81% (64/326).

In 9% (14/160) of patients who had a platelet transfusion prior to a procedure the only procedure being performed was a bone marrow biopsy or trephine (**Platelet standard 6**). This is likely to have been unnecessary and demonstrates no change in practice compared to the last audit in 2010 (9%; 45/497).

Therapeutic

Within this category 63% (115/182) of Adult Therapeutic Doses were used to treat WHO grade 2 non severe bleeding and 37% (67/182) to treat severe WHO grade 3 or above bleeding.

Conclusion

Haematological patients are high blood users and those with chronic BMF receive more blood than those with reversible BMF.

Single unit red cell transfusions are uncommon and prophylactic single unit platelet transfusions would almost certainly be increased if counts were performed prior to transfusion of further units.

Local hospital guidelines are frequently discrepant with national guidelines and contribute to inappropriate transfusion practice. Compliance is similar across all levels of care.

Executive Summary Table 1: Reason for the transfusion and compliance with national guidelines

Reason for transfusion	Total number transfusions	Appropriate	Outside of guidance	Unable to assess
RED BLOOD CELL	**4328**	**75% 3232**	**15% 649**	**10% 447**
PLATELET				
Prophylactic	**1379**	**55% 756**	**37% 512**	**8% 111**
Reversible BMF	638	72% 459	22% 142	6% 37
Chronic BMF (non-intensive therapy)	639	43% 273	56% 359	1% 7
Chronic BMF (intensive therapy)	31	77% 24	23% 7	-
Unable to categorise	71*	-	6% 4	94% 67
Pre-procedure	**160**	**61% 97**	**19% 31**	**20% 32**
Therapeutic	**182**	**87% 159**	**6% 11**	**7% 12**
Unable to determine	**31**	**-**	**-**	**100% 31**
Not stated	**29**	**-**	**-**	**100% 29**

* 67 of these cases were known to have chronic BMF but not known whether patients had intensive or non-intensive treatment

Summary of Recommendations

Key recommendations for improving local guidelines

1. Local hospital guidelines must be easily available and reflect national guidelines for blood transfusion.
2. Local hospital guidelines should state that prophylactic platelet transfusions are not required:
    a. Prior to bone marrow aspirates and trephine
    b. In stable patients with chronic bone marrow failure.
3. Local hospital guidelines should state how to manage transfusions in patients at high risk of Transfusion Associated Circulatory Overload (TACO).

Key recommendation for local audit

1. Information technology solutions are required to allow regular non-labour intensive audit of transfusion practice.

Key recommendations for improving clinical practice

1. The reason for transfusion should be clearly documented in the patient's record including any individual threshold agreed for that patient.
2. In the absence of active bleeding, use the minimum number of red cell units required to achieve target haemoglobin and consider a single unit transfusion.
3. One adult therapeutic dose of platelets is required for prophylaxis. Pre-procedure consider the size of the patient, previous platelet count increments and the target platelet count.
4. Risk assess the patient for transfusion-associated circulatory overload (TACO), which is the transfusion reaction most commonly associated with death.

Aims of the audit

This audit aimed to:

- examine the use of red cells and platelets in a sample of patients who had a known haematological condition
- collect information on the context in which care was delivered through the use of an organisational questionnaire
- identify variation in practice and compare practice against guidelines
- discuss reasons for variation and identify opportunities to reduce variation while not compromising treatment

Audit standards

Organisational

1. Local written guidelines are available for the management of blood component transfusions in haematology patients.
2. Regular local audits are performed to assess compliance with local blood transfusion guidelines.

Red Cell Transfusion

1. Hb is measured within 24 hours prior to the transfusion of red cells if the patient is an inpatient or within 72 hours if the patient is a day patient;
2. In normovolaemic patients without additional risk factors (defined as cardiovascular disease or signs or symptoms of cardiovascular compromise, severe sepsis or acute cerebral ischaemia) the transfusion threshold is an Hb of 70g/L;
3. In patients with cardiovascular disease or signs or symptoms of cardiovascular compromise the threshold is raised to an Hb of 80g/L;
4. In patients with severe sepsis or acute cerebral ischaemia the threshold is raised to an Hb of 90g/L;
5. In patients receiving radiotherapy the threshold is raised to an Hb of 100g/L;

Platelet Transfusion - Prophylactic

1. In patients with a reversible cause for bone marrow failure and no other risk factors for bleeding the threshold for prophylaxis is a platelet count of 10 x 10^9/L;
2. When platelets are prescribed for prophylactic use, this should not be more than one adult therapeutic dose;
3. Patients with chronic bone marrow failure are not routinely given prophylactic platelet transfusions.

Platelet Transfusion - Pre-procedure

4. Prior to invasive procedures (liver biopsy, transbronchial biopsy, indwelling line insertion, laparotomy, etc.), if no other risk factors for bleeding are present, the threshold platelet count is 50 x 10^9/L;
5. Prior to operations in critical sites such as the eye or brain the threshold platelet count is 100 x 10^9/L or lower;
6. Patients do not require platelet transfusion prior to a bone marrow biopsy.

Methodology

Any hospital in England that treated adult patients, aged 16 years or over, with a malignant haematological diagnosis / myeloid failure syndrome was eligible to enrol. The audit was also offered to hospitals in Northern Ireland, Scotland & Wales and the Republic of Ireland.

Cases could be inpatients or outpatients.

Sites were asked to audit patients seen in January 2016, with the possibility of including patients seen in the first 2 weeks of February if this would allow them to contribute a better sample of patients. They were asked to include up to 40 patients receiving a red cell transfusion (up to 20 inpatients and 20 outpatients).

The same number of patients receiving platelets were also eligible for audit. Sites were asked to collect consecutive cases, and while a patient could only be audited once for each component, that patient could be audited for both red cells and platelets, so one patient could fulfil 2 of the suggested quota.

The Analysis Algorithms are available in Appendix B, the Patient Audit Tool is shown in Appendix C, and the Organisational Questionnaire is shown in Appendix D.

RESULTS: STANDARDS

Organisational

1. Local written guidelines are available for the management of blood component transfusions in haematology patients.

87% of hospitals (129/148) stated that written guidelines were available and 13% (19) stated that they were not.

2. Regular local audits are performed to assess compliance with local blood transfusion guidelines.

51% of hospitals (64/125) stated that local audit had been performed within 12 months and a further 18% (22) indicated that audit had been performed within 24 months. See organisational audit results for further details.

Red Cell Transfusion

Cases associated with chronic anaemia due to bone marrow failure (BMF) were excluded from all red cell transfusion standards which relied on a threshold Hb as this is not an appropriate assessment for this population.

1. Hb is measured within 24 hours prior to the transfusion of red cells if the patient is an inpatient or within 72 hours if the patient is a day patient;

94% (4055/4322) of all patients had a pre-transfusion Hb measured within the specified time frame. For inpatients this was 99% (1425/1444) and for day patients this was 91% (2609/2856)

2. In normovolaemic patients without additional risk factors (defined as cardiovascular disease or signs or symptoms of cardiovascular compromise, severe sepsis or acute cerebral ischaemia) the transfusion threshold is an Hb of 70g/L;

There were 955 cases where the Hb was reported and no other standards with higher thresholds applied. 163 (17%) had an Hb less than or equal to 70g/L and 792 (83%) had an Hb greater than 70g/L.

3. In patients with cardiovascular disease or signs or symptoms of cardiovascular compromise the threshold is raised to an Hb of 80g/L;

There were 60 cases where the Hb was reported and no other standards with higher thresholds applied. 18 (30%) had an Hb less than or equal to 80g/L and 42 (70%) had an Hb greater than 80g/L.

4. In patients with severe sepsis or acute cerebral ischaemia the threshold is raised to an Hb of 90g/L;

There were 191 cases where the Hb was reported. None of these were associated with standards allowing a higher threshold. 188 (98%) had an Hb less than or equal to 90g/L and 3 (2%) had an Hb greater than 90g/L.

5. In patients receiving radiotherapy the threshold is raised to an Hb of 100g/L;

There were 14 cases, all of which had a documented Hb and all had an Hb of less than or equal to 100g/L.

Platelet transfusion - Prophylactic

1. In patients with a reversible cause for bone marrow failure and no other risk factors for bleeding the threshold for prophylaxis is a platelet count of 10 x 10^9/L;

62% (289/474) of patients received a prophylactic platelet transfusion for reversible bone marrow failure without additional risk factors, when the count was less than or equal to 10 x 10^9/L.

2. When platelets are prescribed for prophylactic use, this should not be more than one adult therapeutic dose;

One adult therapeutic dose was transfused in 93% (1277/1379) of all prophylactic transfusions. This was 90% (690/764) of inpatients and 96% (584/611) of day patients.

3. Patients with chronic bone marrow failure are not routinely given prophylactic platelet transfusions.

56% (359/639) of patients with chronic bone marrow failure and not receiving intensive therapy were given platelet transfusions in the absence of any stated risk factors.

Platelet Transfusion - Pre-procedure

4. Prior to invasive procedures (liver biopsy, transbronchial biopsy, indwelling line insertion, laparotomy, etc.), if no other risk factors for bleeding are present, the threshold platelet count is 50 x 10^9/L;

There were 50 patients for whom the platelet count was reported. None of these were associated with standards allowing a higher threshold. 42 (84%) had a platelet count less than or equal to 50 x 10^9/L and 8 (16%) had a platelet count greater than 50 x 10^9/L.

5. Prior to operations in critical sites such as the eye or brain the threshold platelet count is 100 x 10^9/L or lower;

There were 3 cases where the platelet count was reported. 2 (67%) had a platelet count less than or equal to 100 x 10^9/L and 1 (33%) had a platelet count greater than 100 x 10^9/L.

6. Patients do not require platelet transfusion prior to a bone marrow biopsy.

14 patients were transfused platelets when only a bone marrow biopsy was performed.

RESULTS: ORGANISATIONAL AUDIT

A total of 171 sites participated in the combined clinical and organisational audit, 170 in the clinical audit and 151 in the organisational audit. Some of the organisational submissions were at Trust level and these were duplicated within the dataset for each participating site within the Trust. There were 149 NHS sites with organisational data: 133 from England; 10 from Wales; and 3 each from Northern Ireland and Scotland. There were 2 additional sites from the Republic of Ireland. There were no submissions from Independent hospitals.

To see which sites participated in the audit, please see Appendix E.

Section 1. General information

Levels of Haematology care

The level of care was provided by questionnaires from 138 Trusts/hospitals on behalf of 151 hospital sites. Where a Trust audit submission covered more than one hospital, each hospital was allocated the highest level of care accessible within their Trust. The vast majority of care is provided by level 2a, 2b and 3 with around 30% of care in each of these categories. For 3 sites no further information other than level of care was provided.

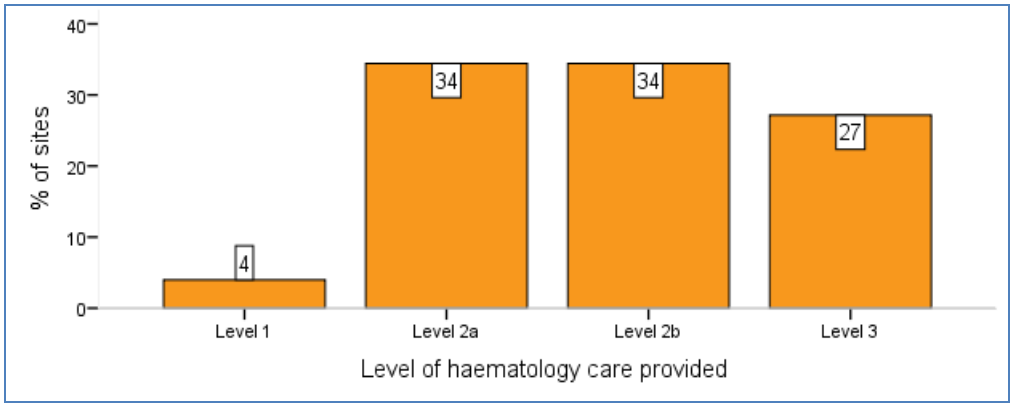


Figure 1: Level of haematology care according to BCSH criteria

Number of in-patient beds designated as haematology beds

(includes all types of haematology patient)

135 replies were received. As the data provided will have included all beds within that organisation, information was not duplicated for each hospital site.

The median number of designated haematology beds was 11, interquartile range (IQR) 4 to 18 and range 0 to 70. Nearly a quarter (24%, 32/135) of all organisations have no designated haematology beds. The majority (88%, 28/32) of these provide level 1 or 2a care. All organisations providing level 3 care have 10 or more beds.

Under direct care of Consultant Haematologist

8% of hospitals during working hours and 14% of hospitals out of hours do not provide patient care which was directly managed by a consultant haematologist. All of these hospitals provided either level 1 or level 2a care except for one level 2b hospital which provided direct consultant haematologist care during working hours but not out of hours.

Table 1: Are in-patients who require care, primarily because of a haematological problem, under the direct care of a Consultant Haematologist (148 hospitals)

	National (148)	
During working hours	92%	136
Out of hours	86%	127

Written guidelines

13% of hospitals (19/148) did not have written guidelines which cover haematology patients. The majority of these provide level 1 or level 2a care (11) however five provide level 2b care and three level 3 care. These hospitals could not complete further sections of the organisational audit.

How guidelines are made available to medical and nursing staff

Nearly all hospitals (98%) that provide guidelines use the intranet and most (59%) have specific teaching sessions at medical staff induction.

Table 2: How guidelines are made available to medical and nursing staff (125 of 129 hospitals that provided written guidelines stated how they were made available)

How guidelines are made available	National (125)	
Provided in written format at hospital induction to all new junior doctors	25%	31
Provided on hospital intranet	98%	122
Displayed on wall in haematology day unit	3%	4
Displayed on wall in haematology ward	2%	3
Specific teaching sessions provided at doctors' induction	59%	74
Provided in guideline/protocol folder on wards	18%	22
Other *	18%	23

*Other predominantly identified teaching sessions outside of induction (11/23) or on request form/prescription chart (7/23).

When the last local audit was performed to assess compliance with transfusion guidelines *(This could be of one or all blood component use and include additional specialties)*

69% of hospitals stated that local audit had been performed in the last 2 years: 51% (64/125) within one year and 18% (22/125) within one to two years.

Table 3: Timing of the last local audit performed to assess compliance with transfusion guidelines

Timing of last local audit	National (125)	
Less than 12 months	51%	64
12 to 18 months	10%	12
18 to 24 months	8%	10
24 to 36 months	7%	9
36 to 48 months	6%	7
48 to 60 months	3%	4
No local audit performed	15%	19

Information within local guidelines

Indication for transfusion

The following tables identify the patient category and threshold count, for each category, suggested by the National Blood Transfusion Committee (NBTC) Indications and Codes for transfusion. Some indication codes have been subdivided to understand if hospitals use different thresholds. Table 4 shows NBTC indications for red cell transfusion and the level of agreement in participating hospitals, while Table 6 shows NBTC indications for platelet transfusion and the level of agreement in participating hospitals.

Red cell Transfusions

127 hospitals provided details regarding the indication for red cell transfusion.
In the category of "surgery/medical/critical care" without additional risk factors, the main reason for non-compliance with NBTC thresholds was because a higher threshold of 80 g/L was used (17 hospitals in those under 65 years and 26 hospitals in those over 65 years). In the category of "History of IHD" similarly a higher threshold of 90 g/L was stated by most (14) non-compliant hospitals. In all other categories the main reason for disagreement with the NBTC threshold value was "indication not covered in local guidelines" and this was stated in 25 to 72 replies for each question (see Table 4).

There was no tendency for level 1 or 2a care organisations, compared to organisations with a higher level of care, to be less compliant with NBTC indications. A higher percentage of level 3 care hospitals used a threshold of 80 g/L rather than 70 g/L as an indication for transfusion when no other risk factors were present. In the category of "surgery/medical/critical care" 28% (8/29) of level 3 hospitals used a threshold of 80 g/L for those aged under 65 years compared to 11% (9/82) with lower levels of care; and 45% (13/29) of level 3 hospitals used a threshold of 80 g/L for those aged 65 years or older compared to 16% (13/83) with lower levels of care.

Platelet Transfusions

125 sites provided further details regarding the indication for platelet transfusion. Similar to the red cell transfusion guidelines the most common reason for non-compliance with the NBTC indications was "indication not covered in local guidelines". In the "Prophylaxis for chronic BMF not receiving intensive therapy" category this was stated by 63% (76/121) of hospitals who answered this question and in the "Pre-procedure for bone marrow aspirate and or trephine" category this was stated by 68% (82/121) of hospitals. For these two categories there was no clear association between the level of care provided and whether or not the indication was covered in the local guidelines. In all other platelet transfusion categories the answer "indication not covered in local guidelines" ranged from 8 to 51 replies (See Table 6).
When a threshold count was provided for the "Prophylaxis for chronic BMF not receiving intensive therapy" category, 21 hospitals indicated that they used a platelet count of 10 or 20 x 10^9/L. There was no clear association between stating a threshold and the level of care provided. Five hospitals stated threshold counts in the "Pre-procedure for bone marrow aspirate and or trephine" category and all provided level 3 (2) or level 2b (3) care.
Only 37% of local guidelines specified grades of bleeding to differentiate prophylactic from therapeutic transfusion and only 48% of these used the grades suggested in this audit.

Table 4: NBTC Codes for red cell transfusion

CLINICAL INDICATION for transfusion	NBTC Code	NBTC threshold (g/L)	Exact agreement with NBTC*	Disagreement
Acute blood loss in an emergency *(when normovolaemia achieved)*	R1	70	58% (73/126)	80 g/L (n=18), 90 g/L (n=2), clinical decision (n=4), not covered (n=29)
Surgery / medical / critical care				
Usual indication for red cell transfusion, age < 65 years	R2	70	74% (92/125)	80 g/L (n=17), 90 g/L (n=1), clinical decision (n=1), not covered (n=14)
Usual indication for red cell transfusion, age ≥ 65 years	R2	70	65% (81/125)	80 g/L (n=26), 90 g/L (n=4), clinical decision (n=1), not covered (n=13)
With cardiovascular disease or symptoms				
History of IHD	R3	80	74% (93/126)	70 g/L (n=3), 90 g/L (n=14), 100 g/L (n=2) clinical decision (n=1), not covered (n=13)
Chest pain; hypotension or tachycardia unresponsive to fluid resuscitation; or cardiac failure	R3	80	67% (85/126)	90 g/L (n=13), 100 g/L (n=2) clinical decision (n=1), not covered (n=25)
With severe sepsis	R4	90	39% (49/126)	70 g/L (n=4), 80 g/L (n=7), 100 g/L (n=1) clinical decision (n=1), not covered (n=64)
With traumatic brain injury	R4	90	37% (47/126)	70 g/L (n=3), 80 g/L (n=3), 100 g/L (n=1), not covered (n=72)
With acute cerebral ischaemia	R4	90	40% (50/126)	70 g/L (n=4), 80 g/L (n=3), 100 g/L (n=1), not covered (n=68)
Radiotherapy	R5	100	59% (74/126)	80 g/L (n=1), 90 g/L (n=2), 110 g/L (n=3), 120 g/L (n=4), clinical decision (n=1), not covered (n=41)
Chronic Anaemia				
Chronic anaemia age < 65 years	R6	80	60% (76/126)	60 g/L (n=1), 70 g/L (n=2), 90 g/L (n=1), 100 g/L (n=1), 110 g/L (n=1), individualised threshold (n=10), not covered (n=34)
Chronic anaemia age ≥ 65 years	R6	80	62% (78/126)	60 g/L (n=1), 90 g/L (n=1), 110 g/L (n=1), individualised threshold (n=10), not covered (n=35)
*if known				

Table 5: Does your guideline specify grades of bleeding to differentiate between prophylactic and therapeutic platelet transfusions? (125 hospitals)

	National	
YES	37%	46/125
If YES are the bleeding grades as stated in appendix D?		
YES	48%	22/46

Table 6: NBTC codes for platelet transfusion

CLINICAL INDICATION for transfusion	NBTC Code	NBTC threshold ($X10^9$)	Exact agreement with NBTC*	Disagreement
Prophylactic use in the absence of risk factors for bleeding				
Reversible BMF e.g. disease/treatment including allogeneic BMT but excluding autologous BMT	P1	10	93% (116/125)	20 x10^9 (n=1), Not covered (n=8)
Reversible BMF associated with autologous BMT	P1	10	80% (98/123)	20 x10^9 (n=2), Not covered (n=23)
Chronic BMF receiving intensive therapy	P1	10	81% (100/123)	20 x10^9 (n=3), Not covered (n=20)
Chronic BMF not receiving intensive therapy	P1	Not indicated	16% (19/121)	10 x10^9 (n=15), 20 x10^9 (n=6), clinical decision (n=5), Not covered (n=76)
Reversible BMF	P2	20	90% (112/125)	Not covered (n=13)
Chronic BMF	P2	20	86% (107/125)	Individualised threshold (n=1), no threshold/not indicated (n=1), not covered (n=16)
Central venous line insertion (tunnelled or untunnelled) excluding PICC line	P3	50	82% (101/123)	20 x10^9 (n=2), 40 x10^9 (n=1), 75 x10^9 (n=3), 80 x10^9 (n=1), no threshold/not indicated (n=2), not covered (n=13)
PICC line	P3	50	73% (90/123)	20 x10^9 (n=4), 30 x10^9 (n=1), 40 x10^9 (n=1), 75 x10^9 (n=2), no threshold/not indicated (n=2), not covered (n=23)
Lumbar puncture	P3	50	82% (102/125)	20 x10^9 (n=1), 40 x10^9 (n=2), 70 x10^9 (n=1), 75 x10^9 (n=3), 80 x10^9 (n=1), 100 x10^9 (n=1), not covered (n=14)
Percutaneous liver biopsy	P3	50	80% (100/125)	20 x10^9 (n=1), 60 x10^9 (n=1), 75 x10^9 (n=4), 80 x10^9 (n=2), not covered (n=17)
Major surgery	P3	50	71% (88/124)	60 x10^9 (n=1), 75 x10^9 (n=3), 80 x10^9 (n=6), 100 x10^9 (n=3), dependent on surgery (n=1), not covered (n=22)
Epidural anaesthesia	P3	80	64% (80/125)	40 x10^9 (n=1), 50 x10^9 (n=15), 70 x10^9 (n=1), 75 x10^9 (n=2), 100 x10^9 (n=4), clinical decision (n=1), not covered (n=21)
Spinal anaesthesia	P3	80	53% (66/125)	40 x10^9 (n=1), 50 x10^9 (n=14), 70 x10^9 (n=1), 75 x10^9 (n=1), 100 x10^9 (n=6), clinical decision (n=1), not covered (n=35)
CNS surgery (including posterior segment of eye)	P3	100	82% (101/123)	Not covered (n=22)

Bone marrow aspirate and or trephine	**P3**	**Not indicated**	28% (34/121)	10 x10^9 (n=1), 20 x10^9 (n=2), 50 x10^9 (n=1), 75 x10^9 (n=1), not covered (n=82)
Major haemorrhage	**P4**	**75**	75% (93/124)	50 x10^9 (n=9), 70 x10^9 (n=1), 80 x10^9 (n=7), 100 x10^9 (n=3), guided by TEG (n=1), not covered (n=10)
Bleeding with multiple trauma, or brain/eye injury, or spontaneous intracerebral haemorrhage	**P4**	**100**	86% (107/124)	80 x10^9 (n=2), not covered (n=15)
Bleeding	**P4**	**50**	72% (89/124)	20 x10^9 (n=1), 30 x10^9 (n=1), 75 x10^9 (n=2), 80 x10^9 (n=1), 100 x10^9 (n=1), one ATD (n=1), not covered (n=28)
Bleeding but considered non severe	**P4**	**50**	52% (65/124)	20 x10^9 (n=4), 30 x10^9 (n=2), based on symptoms (n=1), clinical decision (n=1), not covered (n=51)

*if known and applicable

CLINICAL AUDIT

Data Collection

We received data from 4796 patients. We removed 147 patient records because of: duplication (8), no red cell or platelet transfusion (12) or ineligible during the data cleaning process (127).

This provided 4649 patient records for analysis, submitted by 170 sites, median 27, inter-quartile range (IQR) 17 to 36, range 2 to 66. There were 4608 patients from 167 NHS hospitals in the United Kingdom, 32 patients from 2 hospitals in the Republic of Ireland and 9 patients from one English Independent hospital.

31% (1460/4649) of patients received both red cell and platelet transfusions. A total of 6109 transfusion episodes were analysed, 4328 red cell transfusion episodes and 1781 platelet transfusion episodes.

To see which sites participated in the audit, please see Appendix E.

Patient characteristics

Median age at the time of transfusion was 72 years (IQR 64 to 80), range 16 to 101 years.

40% were female (1859), 60% were male (2783), and 7 were unknown.

Weight was known for 71% (3305/4649), with a median of 72 kg (IQR 62 to 83). When weight was known 7% (219/3305) of patients weighed less than 50Kg.

Diagnosis

Myelodysplasia was the largest diagnostic category of patients requiring blood component transfusion at 28.5%. This increased to 35% if myelodysplastic/myeloproliferative neoplasms were included.

*other frequently included anaemia unknown/undergoing investigation, Cold Haemagglutinin Disease, Bone Marrow Failure and pancytopenia.Treatment
45% of patients were managed by blood component transfusion alone and 55% were receiving treatment in addition to transfusion.

30% of all patients were receiving intensive treatment for their haematological malignancy.

In 24% of all patients this was intensive chemotherapy, in 3.5% this was allogeneic stem cell transplant (SCT) and in 2.5% this was autologous SCT. 25% of all patients were receiving low dose chemotherapy.

Table 7: Haematological diagnosis (4641 patients)

Haematological Diagnosis	National (N=4641)	
Acute leukaemia	22.0%	1023
Acute myeloid leukaemia excluding APML	18.6%	864
Acute promyelocytic leukaemia (APML)	0.6%	27
Acute lymphocytic leukaemia	2.5%	115
Other acute leukaemia	0.3%	17
Aplastic anaemia	4.3%	198
Chronic leukaemia	6.8%	314
Chronic lymphocytic leukaemia (CLL)	4.8%	224
Chronic myeloid leukaemia (CML)	1.1%	52
Other chronic leukaemia	0.8%	38
Lymphoma	14.8%	687
Burkitt's lymphoma	0.3%	16
Diffuse large B cell lymphoma (DLBCL)	5.3%	238
Follicular lymphoma	1.6%	71
Hodgkin's lymphoma (HL)	1.8%	83
Other lymphoma	5.9%	279
Myelodysplasia	28.5%	1323
Myelodysplastic/myeloproliferative neoplasms (includes CMML, JMML)	6.8%	314
Myeloproliferative neoplasms including myelofibrosis	6.4%	297
Myeloma/Plasma cell dyscrasia	12.7%	591
Other stated*	1.0%	48

Table 8: Treatment for haematological diagnosis

	National (4649)	
Was the patient receiving treatment (excluding transfusion) for their underlying current haematological diagnosis?		
YES	55%	2542/4625
If YES, was the patient undergoing allogeneic stem cell transplant?		
YES	3.5%	163/4625
If NO, was the patient undergoing autologous stem cell transplant?		
YES	2.5%	117/4625
If NO, Was the patient on an intensive chemotherapy programme in the last 6 weeks? *(excluding low dose chemotherapy e.g. azacitidine)*		
YES	24%	1122/4625

Participation in clinical trials

Many of the patients audited were participating in clinical trials, however none of these trials included a transfusion threshold for either RBC or platelet transfusion that deviated from the NBTC standards used in this audit.

SECTION A: RED CELL TRANSFUSION

4328 patients received a red cell transfusion (defined as all units transfused within a 24 hour period). One transfusion episode occurred in February and the date of transfusion was unknown for 16. All other transfusion episodes occurred in January (Appendix A, Figure 1).

There were 2859 day patient and 1447 inpatient red cell transfusion episodes. In 22 cases the location was unknown.

Indication for red cell transfusion

Principal reason for red cell transfusion

Table 9 identifies the main reason for transfusion. Hospitals were asked to select only one category. When more than one category was selected the reason for transfusion was prioritised to chronic transfusion programme, then symptomatic anaemia, then Hb level less than local threshold, in that order.

The largest category selected was symptomatic anaemia; however 41% of this group were reported to have mild symptoms only. At least 26% of transfusions were given as part of a chronic transfusion programme.

Table 9: Main reason for red cell transfusion (4328 patients)

	National (N=4328)	
A. Symptomatic anaemia	47%	2048
• ***Mild*** *(Chronic fatigue, loss of energy)*	*20%*	*844*
• ***Moderate*** *(Palpitations; Shortness of breath on exertion etc.)*	*22%*	*948*
• ***Severe*** *(Shortness of breath at rest; symptoms of ischaemic heart disease, such as chest pain; hypotension or tachycardia unresponsive to fluid resuscitation; cardiac failure)*	*4%*	*178*
• ***Unspecified***	*2%*	*78*
B. Hb level less than the local threshold	23%	1005
C. Chronic transfusion programme	26%	1114
D. Cannot determine reason for transfusion	3%	117
Not stated	1%	44

Although the majority of patients receiving red cells as part of a chronic transfusion programme had a diagnosis of myelodysplasia, around 40% did not

Table 10: Diagnosis of patients transfused as part of chronic transfusion programme

Diagnosis	National figures (1114 patients)	
Acute leukaemia	10.1%	113
Aplastic anaemia	7.2%	80
Chronic leukaemia	4.5%	50
Lymphoma	5.5%	61
Myelodysplasia	50.3%	560
Myelodysplastic/myeloproliferative neoplasms (includes CMML, JMML)	10.5%	117
Myeloproliferative neoplasms including myelofibrosis	9.9%	110
Myeloma/Plasma cell dyscrasia	5.9%	66
Other stated	0.5%	6

Clinical indication for transfusion

More than one category could be selected. The NBTC codes are shown after each option

Chronic anaemia was the indication for transfusion in 59% of all red cell transfusion episodes and the largest single category was chronic anaemia with bone marrow failure (35%).

Table 11: Clinical Indication for Transfusion (4325 patients)

Indication for Transfusion	National (N=4325)	
Acute blood loss (R1)	1.6%	69
Medical anaemia, age <65 years (R2)	13.4%	578
Medical anaemia, age ≥65 years (R2)	26.4%	1142
Medical anaemia in patients with cardiovascular disease (R3)	2.5%	107
Medical anaemia with sepsis (R4)	5.4%	233
Medical anaemia with CNS complications (R4)	0.3%	12
Anaemia in a patient receiving radiotherapy (R5)	0.3%	14
Chronic anaemia with bone marrow failure (BMF) due to MDS/AA/PNH (R6)	35.0%	1512
Chronic anaemia with BMF due to bone marrow infiltration (R6)	24.0%	1039
Other stated*	3.3%	142

* in 87% of cases the reason provided in other was “not stated”.

Transfusion Episode

Number of units transfused

One unit transfusions were given to 27% of inpatients and 13% of outpatients whereas 2 or 3 unit transfusions were given to 86% of day patients and 70% of inpatients. Fewer single unit transfusions were given to patients as part of a chronic transfusion programme (inpatients 24%, 22/91 and day patients 10%, 104/1014). Patients weighing less than 50kg received more single unit transfusions; however 7 day patients were given 3-unit transfusions.

Table 12: Number of red cell units transfused

Units transfused	Day patient (2859)		Inpatient (1447)		Unknown (22)	
One	13%	383	27%	390	23%	5
Two	74%	2116	64%	931	73%	16
Three	12%	338	6%	85	5%	1
Four to Eight	0.5%	13	3%	37	-	-
Not stated	0.3%	8	0.2%	3	-	-

Table 13: Patients weighing less than 50Kg (data available for 206 of 219).

Units transfused	Day patient (122)		Inpatient (84)	
One	22%	27	33%	28
Two	72%	88	56%	47
Three	6%	7	7%	6
Four	-	-	2%	2
Five	-	-	1%	1

Pre-transfusion Hb

94% of all patients had a pre-transfusion Hb measured within 24 hours of the start of the transfusion if they were an inpatient or within 72 hours of the start of the transfusion if they were a day patient. For inpatients this was 99% and for day patients this was 91%.

The median pre-transfusion Hb for all patients was 79g/L. The pre-transfusion Hb was lower for inpatients (76g/L) compared to day patients (81g/L) and this was so for all "reason for transfusion categories"; symptomatic anaemia (76g/L inpatient, 82g/L day patient), Hb less than threshold (75g/L inpatient, 76g/L day patient) and chronic transfusion programme (78g/l inpatient, 83g/L day patient). There was a trend for patients with severe symptoms of anaemia to have a lower Hb than patients with mild symptoms (inpatients: Hb 71 g/L severe symptoms, 78 g/L mild symptoms and day patients 79 g/L severe symptoms, 83 g/L mild symptoms), with values in patients with moderate symptoms in between.

Table 14: Pre-transfusion haemoglobin levels

	National (4328)	
Was a pre-transfusion Hb count performed within 24 hours of the start of the transfusion if the patient was an inpatient, or within 72 hours of the transfusion if the patient was a day patient?		
Day patients:	91%	2609/2856
Inpatients:	99%	1425/1444
ALL patients:	94%	4055/4322
If YES, what was the Hb (g/L)?		
Day patients: median (IQR)	81	(75-88), n=2602
Inpatients: median (IQR)	76	(69-80), n=1423
ALL patients: median (IQR)	79	(73-86), n=4046

Hb assessment between transfused units

When more than one unit was transfused 11.0% (116/1050) of inpatients and 0.5% (12/2452) of day patients had an Hb measured in between units.

Results were not dissimilar for patients weighing less than 50kg as only 14.5% (8/55) of inpatients and only one day case (1.1%, 1/95) had their Hb checked before further units were given.

Table 15: Hb measurement between transfused units if more than one unit was given

	National (4328)	
Day patients	0.5%	12/2452
Inpatients	11.0%	116/1050
ALL patients	3.7%	129/3519

Post-transfusion Haemoglobin

86% of inpatients and 6% of day patients had a post-transfusion Hb taken within 24 hours of the end of the transfusion episode. The median Hb value for inpatients was 91 g/L and for day patients 93g/L. The median Hb increment per unit transfused for inpatients was 9 g/L (median increment not calculated for day patients because of the low numbers). See Appendix A, Figure 2 for bar charts for post transfusion Hb, increment and increment per unit transfused.

Table 16: Post-transfusion Haemoglobin (Hb)

	National (4328)	
Was a post-transfusion Hb count performed within 24 hours of the end of the transfusion episode?		
Day patients:	6%	161/2850
Inpatients:	86%	1236/1442
ALL patients:	33%	1406/4314
If YES, what was the Hb (g/L)?		
Day patients: median (IQR)	93	(84-101), n=160
Inpatients: median (IQR)	91	(83-99), n=1236
ALL patients: median (IQR)	91	(83-100), n=1405

Total number of red cells given during the audit period

A total of 16,851 red cell units were known to be transfused during January 2016 to audited patients. 8389 of these were transfused during the episodes audited (4316 patients) and 8462 additional units were transfused (4255 patients) during this month. This is an underestimate as 12 audited transfusion episodes did not provide the number of units transfused and additional unit information was not provided for 73 patients. Correction for the whole sample of 4328 patients provides an estimate of 17,020 units and this equates to around 15% (17020/115217) of all red cell units issued to participating hospitals during this month (Appendix A Table 1).

Appropriate use algorithm

To evaluate the appropriateness of all red cell transfusions, including those associated with chronic anaemia, an algorithm was devised which considered the pre transfusion Hb, the time at which this was performed, NBTC Indications, individual patient thresholds, acute blood loss and symptoms of anaemia. Transfusions associated with either chronic anaemia or moderate symptoms were considered acceptable if the Hb was less than or equal to 100g/L and all transfusions associated with severe symptoms were considered acceptable if the patient was anaemic (see table 17 and Appendix B).

Using this algorithm 4328 transfusion episodes were assessed. 75% (3232/4328) were considered appropriate, 15% (649/4328) outside of guidance and in 10% (447/4328) appropriateness could not be determined. 331 transfusions were stated by auditors to be within their local guidelines however none of these had a clear NBTC indication or significant symptoms of anaemia and were classified as outside of guidance. This algorithm may have been too lenient by considering all transfusions with an Hb less than or equal to 100g/L as appropriate in patients with chronic anaemia but not known to be on a chronic transfusion programme. The algorithm was therefore revised to only accept those with an Hb of less than or equal to 100g/L if chronic anaemia was known to be associated with a chronic transfusion programme. This revised appropriate use to 59% (2535/4328), outside of guidance use to 30% (1290/4328) and appropriateness could not be determined in 12% (503/4328).

By further removing a higher threshold for patients with sepsis (now known to be unnecessary) appropriate use was reduced to 56% (2420/4328). Outside of guidance use was increased to 32% (1394/4328) and appropriate use could not be determined remained at 12% (514/4328).

Assessment according to BCSH level of care identified a lower appropriate use with a higher level of care. The main reason for this was that the percentage of cases transfused simply because their Hb was less than the local threshold increased according to level of care but the threshold used did not comply with the NBTC indications.

Table 17: Appropriate use (excluding cases which could not be assessed) and level of care for red cell transfusions

RBC appropriate use	Level of haematology care			
	Level 1	Level 2a	Level 2b	Level 3
Appropriate use	93% (85/91)	91% (811/891)	84% (993/1182)	75% (941/1256)
Appropriate use if chronic anaemia known to be associated with a chronic transfusion programme	71% (64/90)	77% (677/879)	64% (734/1154)	59% (732/1248)

SECTION B: PLATELET TRANSFUSION

1781 patients received a platelet transfusion. All were given in January apart from 9 in which the date of transfusion was unknown (Appendix A, Figure 3).

There were 719 day patient and 1052 inpatient platelet transfusion episodes. In 10 cases the location was unknown.

Indication for platelet transfusion

Principal reason for platelet transfusion

Table 18 identifies the main reason for transfusion. Hospitals were asked to select only one category.

The largest category selected was prophylactic platelet transfusion which accounted for 77% of all transfusion episodes. Pre-procedure and therapeutic transfusion categories were similar at 9% and 10% respectively. Within the therapeutic transfusion category 63% (115/182) were to treat non severe bleeding, grade 2, and 7% (13/182) to treat severe, grade 4 bleeding.

Table 18: Main reasons for transfusion

	National (N=1781)	
A. Prophylactic platelet transfusion to prevent bleeding and not having a procedure (*Modified WHO bleeding grade 0 or 1*)	77.4%	1379
B. Pre-procedure *(Modified WHO bleeding grade 0 or 1)*	9.0%	160
C. Therapeutic to treat bleeding:	10.2%	182
• *Modified WHO bleeding grade 2*	*6.5%*	*115*
• *Modified WHO bleeding grade 3*	*3.0%*	*54*
• *Modified WHO bleeding grade 4*	*0.7%*	*13*
D. Cannot determine reason for transfusion	1.7%	31
Not stated	1.7%	29

Clinical Indication for transfusion

More than one category could be selected. The NBTC codes are shown after each option.

The clinical indication reflected the principal reason for transfusion with prophylactic transfusion most frequently identified. Prophylaxis for reversible BMF was indicated in 32.3% of all transfusion episodes and 15.2% of transfusions were associated with reversible BMF with additional risk factors for bleeding. Prophylactic transfusion in patients with chronic BMF was also common and indicated in 16.8% of transfusions to prevent recurrence of a previous significant bleed and 14.8% of transfusions with current additional risk factors for bleeding. Pre-procedure and therapeutic categories appeared to be indications for transfusion in a similar number of cases. Bleeding but not major haemorrhage or associated with trauma/CNS bleed was documented in 7.1%.

Table 19: Clinical indication for transfusion

	National (N=1781)	
a) Prophylactic – *(modified WHO bleeding grade 0 or 1)*		
• Reversible bone marrow failure (BMF) due to haematological disease or treatment **(P1)**	32.3%	575
• Allogeneic stem cell transplant **(P1)**	4.0%	71
• Autologous stem cell transplant **(P1)**	3.3%	58
• Chronic BMF receiving intensive therapy (excluding low dose chemotherapy e.g. azacitidine) **(P1)**	5.9%	105
• Chronic BMF e.g. MDS, AA to prevent recurrence of previous bleed of modified WHO grade ≥2 **(P2)**	16.8%	300
• Prophylactic indication not described above ***(P1)**	0.7%	13
b) Prophylactic use in the presence of currently existing risk factors for bleeding (e.g. sepsis, antibiotic treatment, abnormalities of haemostasis) (P2) *modified WHO bleeding grade 0 or 1*		
• Reversible BMF	15.2%	270
• Chronic BMF	14.8%	264
c) Pre-procedure platelet transfusion (P3)		
• Central venous line insertion (tunnelled or untunnelled) excluding PICC line	2.0%	35
• Lumbar puncture	1.0%	18
• Percutaneous liver biopsy	-	-
• Major surgery (not involving eye or brain)	0.7%	12
• Epidural anaesthesia	0.1%	1
• CNS surgery (including posterior segment of eye)	0.2%	3
• Bone marrow aspirate and or trephine	1.0%	18
• PICC line insertion	0.8%	14
• Other organ biopsy (e.g. lung, splenic, renal)	0.2%	4
• Endoscopy only	0.8%	14
• Endoscopy and biopsy	0.4%	8
• Other procedures not described above**	2.8	49
d) Therapeutic Platelet transfusion (P4) – *modified WHO bleeding grade ≥ 2*		
• Major haemorrhage (WHO grade 3 or 4)	1.4%	25
• Multiple trauma, or brain/eye injury, or spontaneous intracerebral haemorrhage	0.6%	10
• Bleeding outside of categories above	7.1%	127
• Bleeding considered non severe	1.1%	20
e) In addition to the haematological malignancy or myeloid failure syndrome, please indicate if the patient has any of the specific conditions identified below		
• Platelet function defect – acquired (P5)	0.7%	12
• Disseminated intravascular coagulation (DIC) (P6)	0.6%	11
• Congenital platelet function defect (P7)	0.1%	1
• Heparin induced thrombocytopenia (HIT) (P8)	-	-
• Primary immune thrombocytopenia (ITP) (P8)	0.7%	12
• Post transfusion purpura (PTP) (P9)	-	-
• Thrombotic thrombocytopenic purpura (TTP)	-	-

*Prophylactic indication not described mainly included patients with symptoms where a low platelet count was unlikely to be the cause but possible e.g. blurred vision, headache.
**Pre-procedure indication not described included dental surgery, cataract surgery, minor surgery, pleural tap and central line removal.

Transfusion Episode

Number of units transfused

One unit transfusions were most common and given to 94% of all day patients and 86% of all inpatients. Prophylactic transfusions were associated with the highest percentage of single unit episodes with 93% overall: 96% for day patients and 90% for inpatients (**Platelet Standard 2**). A lower percentage of single units was given when the indication was pre-procedure (69% day patients and 67% inpatients) and a lower percentage was given to treat inpatient bleeding (80%) but not day patient bleeding (95%).

Table 20: Number of units transfused

Units transfused	Day patient (719)		Inpatient (1052)		Unknown (10)	
One	94%	673	86%	908	50%	5
Two	6%	40	12%	125	-	-
Three	0.6%	4	1%	12	10%	1
Four to Six	0.1%	1	0.6%	6	-	-
Not stated	0.1%	1	<0.1%	1	40%	4

Table 21: Single unit transfusion episodes according to indication

	Day patient	Inpatient	Unknown
All indications (1781)	94% (673/719)	86% (908/1052)	50% (5/10)
Prophylactic (1379)	96% (584/611)	90% (690/765)	100% (3/3)
Pre-procedure (160)	69% (35/51)	67% (72/108)	0% (0/1)
Therapeutic (182)	95% (40/42)	80% (111/138)	100% (2/2)
Cannot determine reason (31)	100% (11/11)	90% (18/20)	-
Not stated (29)	75% (3/4)	81% (17/21)	0% (0/4)

Were the platelets HLA matched?

6.6% (117/1765) of platelets transfusion episodes were HLA matched.

Pre-transfusion platelet count

95% of all patients had a pre-transfusion platelet count measured within 24 hours of the transfusion if they were an inpatient or within 48 hours of the transfusion if they were a day patient. For inpatients this was 98% and for day patients this was 90%.

Table 22: Pre-transfusion platelet count performed within 24 hours if patient was an inpatient or within 48 hours if patient was a day patient

		National (1781)
Day patients	90%	647/718
Inpatients	98%	1027/1051
ALL patients	95%	1681/1776

Was the pre-transfusion platelet count above the threshold stated in local guidelines?

In 28% of transfusion episodes the pre-transfusion platelet count was known to be above the threshold stated. A reason for non-compliance was provided for 79% of these cases and the most common reasons were: systemic infection (27%); platelet count anticipated to fall below threshold before next visit (27%); fever (24%) and previous significant bleed (19%). In only 26% was a higher threshold specified in the patient record.

Table 23: Was the pre-transfusion platelet count above the threshold stated in the local guidelines (1781 patients)

		National (1781)
Platelet count above the threshold stated in local guidelines		
YES	28%	447/1612
If YES, was there a reason for a higher threshold		
YES	79%	346/440
If YES, reason/s for a higher threshold :		
• Fever	24%	83
• Systemic infection	27%	95
• Abnormality of haemostasis	6%	21
• Therapeutic anticoagulation	6%	20
• Anti-platelet agent	0.3%	1
• Previous significant bleed	19%	65
• Recent major surgery (within one week)	1%	4
• Participation in a trial where higher threshold specified	1%	3
• On medication where higher threshold specified – please state medication *and* threshold*	3%	10
• Platelet concentrate due to expire at midnight of day of transfusion	1%	3
• Platelet count anticipated to fall below threshold before next visit to outpatients	27%	95
• Other stated**	8%	26
If platelet count was above threshold (n=443), was a higher threshold specified in the notes?		
YES	26%	101/388

*medication stated to require a higher platelet threshold included lenalidamide and dexamethasone, ATG, ATRA, Bortezomib, Ibrutnib and Idelalisib.
**other reason for a higher threshold included advised by consultant haematologist, APML, risk of/possible cerebral bleeding, organ infiltrate, severe GVHD,

Platelet count assessment in between transfused units

When more than one unit was transfused 35% (50/143) of inpatients and 4.4% (2/45) of day patients had a platelet count measured in between units.

When the indication was limited to prophylaxis 42% (31/74) of inpatients and 7% (2/27) of day patients had a platelet count measured in between units.

Table 24: If more than one unit was given was a platelet count checked in between transfused units?

	National (189)	
Day patients	4.4%	2/45
Inpatients	35.0%	50/143
ALL patients	27.5%	52/189

Post-transfusion platelet count

89% of inpatients and 19% of day patients had a post-transfusion platelet count taken within 24 hours of the end of the transfusion episode.

When the indication was limited to prophylaxis the median increment was 13 x 10^9/L (n=751) with 26% (193/751) of transfusion episodes obtaining an increment of $\leq$ 5 x 10^9/L. There was no obvious difference in increment or refractoriness when calculated for each unit transfused (when more than one unit was given) and no obvious difference between inpatients and day patients.

Table 25: Was a post-transfusion platelet count taken within 24 hours of the transfusion?

		National (1781)	
Day patients:		19%	137/711
Inpatients:		89%	931/1046
ALL patients:		61%	1072/1764
For those who received prophylactic platelets:			
POST minus PRE platelet count (x 10^9/L)			
ALL patients: median (IQR)		13	(5-23), n=751
	Change of 5 or less	26% (193/751)	

Total number of platelet concentrates given during the audit period

A total of 8851 platelet units were calculated to have been transfused during January to the patients audited. 1997 of these were transfused during the audited episodes (1775 patients) and 6854 additional units were transfused (1765 patients) during this month. This is an underestimate as 6 audited transfusion episodes did not provide the number of units transfused and additional unit information was not provided for 16 patients. Correction for the whole sample of 1781 patients provides an estimate of 8920 platelet units and this equates to around 45% (8920/19687) of all red cell units received by participating hospitals during this month (Appendix A, Table 2).

Appropriate use algorithm

To evaluate the appropriateness of platelet transfusion algorithms for prophylactic use, pre-procedure and therapeutic use were devised. The prophylactic use was further divided into 3 groups – patients with reversible bone marrow failure (BMF), patients with chronic BMF receiving non-intensive treatment and patients with chronic BMF receiving intensive treatment. The latter group were receiving treatment in an attempt to reverse BMF therefore a threshold platelet count of 10 was applied. For the prophylactic and pre-procedure algorithms the following were considered: pre-transfusion platelet count, the time at which this was performed, NBTC Indications and individual patient thresholds. For the therapeutic algorithm the pre-transfusion platelet count, the time at which this was performed and the grade of bleeding were considered (see table 26 and Appendix B).

Prophylactic transfusions

Overall a total of 1379 platelet transfusions were assessed. 55% (756/1379) were considered appropriate, 37% (512/1379) outside of guidance and in 8% (111/1379) appropriateness could not be determined. In 4 cases the transfusions were given to patients with ITP and in 67 cases the transfusions were given to patients with chronic BMF but it was unclear if they received intensive or non-intensive therapy. This left 638 episodes to be assessed in patients with reversible BMF and 670 episodes to be assessed in patients with chronic BMF. Within the chronic BMF category 639 were managed with non-intensive treatment and 31 with intensive treatment.

Reversible Bone Marrow Failure

72% (459/638) were considered appropriate, 22% (142/638) outside of guidance and in 6% (37/638) appropriateness could not be determined.
Of note 153 transfusions, with a pre-transfusion platelet count greater than 10 x 10^9/L, were stated by auditors to be within their local guidelines. In 71 of these 153 episodes however no additional risk factors for bleeding were documented and they were classified as outside of guidance.

Where the count was documented to be above local guidelines, 62% (77/124) were accepted as appropriate as an additional risk factor was documented. This was likely to have been lenient as a significant number documented risks of fever and platelet count anticipated to fall below threshold prior to next attendance.
62% (289/474) of patients received a prophylactic platelet transfusion for reversible bone marrow failure without additional risk factors, when the count was less than or equal to 10 x 10^9/L (**Platelet Standard 1**).

Chronic Bone Marrow Failure receiving intensive therapy.

This group accounted for only 2% (31/1379) of all prophylactic platelet transfusion episodes. 77% (24/31) were judged appropriate and 23% (7/31) outside of guidance. 8 transfusions, with a pre-transfusion platelet count of more than 10 x $10^{9/}$/L were stated by auditors to be within their local guidelines. In 5 of these 8 episodes however no additional risk factor for bleeding was stated and they were classified as outside of guidance.

Chronic Bone Marrow Failure receiving non-intensive therapy.

43% (273/639) were judged appropriate, 56% (359/639) outside of guidance (**Platelet Standard 3**) and in 1% (7/639) appropriateness could not be determined. 460 transfusions were stated by auditors to be within their local guidelines. In 298 of these 460 episodes (65%) however no risk factor for bleeding was stated and they were classified as outside of guidance.

Level of Care

Overall, assessment according to level of care identified a trend towards improved appropriate prophylactic use and a higher level of care. This was because of use in patients with reversible bone marrow failure. There was no improved practice in level 2b or level 3 care units for the management of patients with chronic BMF receiving non intensive treatment – (see table 27).

Pre-procedure transfusions

A total of 160 platelet transfusions were assessed. 61% (97/160) were considered appropriate, 19% (31/160) outside of guidance and in 20% (32/160) appropriateness could not be determined. 106 transfusions were stated by auditors to be within their local guidelines however by applying NBTC indications 18 of these were outside of guidance and in 12 appropriateness could not be determined.

In cases assessed against the NBTC threshold of 50 (e.g. prior to a laparotomy, liver biopsy, transbronchial biopsy, indwelling line insertion,etc.), with no other risk factors for bleeding stated, 84% (42/50) were considered appropriate, and 16% (8/50), with counts above 50, outside of guidelines (**Platelet standard 4**).

3 cases were reported prior to operations in critical sites such as the eye or brain. 2 (67%) had a platelet count < 100 x 10^9/L and 1 (33%) had a platelet count greater than 100 x 10^9/L (**Platelet standard 5**).

Within the transfusion episodes considered to be outside of guidance were 14 (9% of all pre-procedure cases) given prior to a bone marrow biopsy (**Platelet Standard 6**).

There was no clear difference between levels of care and appropriate use (see table 27).

Therapeutic transfusions

182 platelet transfusions were assessed. 87% (159/182) were considered appropriate, 6% (11/182) outside of guidance and in 7% (12/182) appropriateness could not be determined. Out of the 159 transfusions considered appropriate 5% (8/159) were associated with CNS bleeding, 12% (19/159) with major haemorrhage however the vast majority 83% (132/159) were associated with lower grades of bleeding and judged appropriate with a platelet count of less than or equal to 50 x 10^9/L.

There was no clear difference between levels of care and appropriate use (see table 27).

Reason for transfusion	Total number transfusions (% of 1781)	Appropriate	Outside of guidance	Unable to assess
PLATELET				
Prophylactic	**1379 (77%)**	**55% (756)**	**37% (512)**	**8% (111)**
• Reversible BMF	638 (36%)	72% (459)	22% (142)	6% (37)
• Chronic BMF (non-intensive therapy)	639 (36%)	43% (273)	56% (359)	1% (7)
• Chronic BMF (intensive therapy)	31 (2%)	77% (24)	23% (7)	-
• Unable to categorise	71 (4%)	-	6% (4)	94% (67)
Pre-procedure	**160 (9%)**	**61% (97)**	**19% (31)**	**20% (32)**
Therapeutic	**182 (10%)**	**87% (159)**	**6% (11)**	**7% (12)**
Unable to determine	**31 (2%)**	**-**	**-**	**100% (31)**
Not stated	**29 (2%)**	**-**	**-**	**100% (29)**

Table 26: Appropriate use of platelet transfusions (1781 patients)

Table 27: Appropriate use (excluding cases which could not be assessed) and level of care

	Level 1	Level 2a	Level 2b	Level 3
Prophylactic appropriate use	40% (4/10)	55% (75/136)	54% (196/363)	64% (408/633)
• Reversible BMF	0% (0/1)	69% (22/32)	72% (107/149)	80% (297/370)
• Chronic BMF (non- intensive therapy	44% (4/9)	50% (48/96)	41%(86/209)	40% (98/245)
• Chronic BMF (intensive therapy)	0	83% (5/6)	60% (3/5)	81% (13/16)
Pre-procedure	0	73% (8/11)	70% (31/44)	79% (44/56)
Therapeutic	100% (2/2)	93% (28/30)	93% (51/55)	93% (54/58)

Discussion

This was a large audit with participation from 151 hospitals in the organisational audit and 170 hospitals in the clinical audit. This represented 136/141 (96%) eligible English NHS Trusts. A total of 4649 patient records were analysed providing 6109 transfusion episodes. When additional units received by audited patients during the audit period were included this accounted for around 15% (17020/115217) of all red cells and 45% (8920/19687) of all platelet concentrates requested by participating hospitals. When appropriate we have made comparisons with the previous 2010 NCA report of platelet use in haematology patients (table 28).

Organisational audit

Standards

Two standards were defined for the organisational audit – the availability of written guidelines and the implementation of local audit to assess compliance. It is essential for all hospitals to have access to written guidelines so that clinical staff are aware of best practice and therefore astonishing to identify in this audit that 13% (19/148) did not (***Standard 1***). 51% (64) of hospitals stated that local audit had been performed within the last 12 months (***Standard 2***). Although an improvement compared to a previous NCA in haematology in 2010 when compliance was only 43%, regular audit of practice remains a problem. This is likely to reflect the fact that audit is very labour intensive, the work load in hospitals is increasing and there is currently no IT solution.

Local guidelines

When guidelines were available the most common method of access was the intranet and this was stated by 98% of hospitals. Overall there was poor compliance with NBTC indications for transfusion in local hospital guidelines ranging from 93% to only 16% compliance for specific indications. The most common reason for non-compliance was 'indication not covered in local guidelines'. In the indications for platelet transfusion, prophylaxis for chronic BMF not receiving intensive therapy 'indication not covered' was stated by 63% of hospitals (76/121) with only 16% stating that platelet transfusion was not required. In the pre-procedure for bone marrow biopsy category 'indication not covered' was stated by 68% of hospitals (82/121) with only 28% stating that platelet transfusion was not necessary. Without clear guidance to the contrary unnecessary transfusion is a likely consequence and is demonstrated in the clinical section of this audit report. The only categories where indication not covered were not the main reason for non-compliance were in the red cell transfusion sections 'anaemia without additional risk factors' and anaemia with a 'history of IHD'. In both of these groups lack of compliance was around 30% and the main reason was use of a higher threshold. In addition to poor compliance with NBTC indications only 37% of local guidelines clearly differentiated prophylactic platelet use from use in the presence of bleeding. Without this distinction it is probable that patients were transfused platelets for clinically insignificant bleeding.

Level of care and organisational information

62% (93/151) of all hospitals who took part in this audit provided either level 2b or level 3 care. There was a clear relationship between inpatient bed numbers and the level of care, and direct consultant haematology management and the level of care. 88% (28/32) of organisations without designated beds, and the vast majority of

hospitals who did not provide direct consultant haematology management provided either level 1 or 2a care. In contrast level 3 care was associated with a minimum of 10 designated beds and provided both working hours and out of hours direct consultant haematology supervision.

Conversely there was no tendency for level 1 or 2a care organisations, compared to organisations with a higher level of care, to be less compliant with either red cell or platelet transfusion NBTC indications. In fact a larger proportion of level 3 hospitals used a higher threshold for red cell transfusion when no other risk factors were present (28% if aged < 65 and 45% if aged ≥ 65) and all 5 hospitals which stated platelet count thresholds prior to a bone marrow biopsy provided level 3 (two hospitals) or level 2b (3 hospitals) care.

Clinical Audit

The patient population was largely elderly with a median age of 72 years. Myelodysplasia, largely a disease of the elderly, was the single most common diagnostic category at 28.5% and 70% of all patients audited were managed without curative intent by either transfusion alone or with the addition of low dose chemotherapy. In 59% of red cell transfusion episodes the indication was chronic anaemia and at least 26% of episodes were associated with a chronic red cell transfusion programme. In 77% of platelet transfusion episodes the indication was prophylactic and within this group 53% (737/1379) were given to patients with chronic BMF.
As the number of elderly people in the population is increasing blood use within the haematology patient population would also be expected to increase making compliance with best practice and limiting transfusion to only those who are likely to benefit essential if availability is to continue to meet demand.

Red blood cell transfusion

Process

6% (267/4322) of transfusion episodes did not have a pre-transfusion Hb measured within 24 hours in inpatients or 72 hours in day patients (**Red cell *standard 1***). As was predictable more one unit transfusions were given to inpatients compared to day patients; however as only 27% of all inpatient transfusions were single units there is likely to be significant room for improvement. 7% (219/3305) of all patients weighed less than 50 kg and although this group received more single unit transfusions, very few patients had an Hb check when further units were given (14.5% [8/55] of inpatients and only one day patient [1/95]). 7 patients weighing less than 50 kg received 3 unit transfusions as day patients. This practice is unsafe because it puts patients at risk of Transfusion Associated Circulatory Overload (TACO). When more than one unit was transfused only 11% (116/1050) of inpatients and 0.5% (12/2452) of day patients had an Hb measured in between units demonstrating again significant room for improvement.

Appropriate use

Standards

Five red cell specific standards were used to assess compliance with NBTC Hb thresholds. As there is no Hb threshold to define appropriate transfusion in chronic anaemia these standards were limited to patients with reversible BMF which formed only 30% (1220/4055) of all cases with a pre-transfusion Hb. The results highlighted significant deviation with only 17% (163/955) compliance for use of a threshold of

70g/L for patients without additional risk factors (**Red cell *standard 2***). There was also poor compliance for patient with risk factors of cardiovascular disease with only 30% (18/60) having an Hb of less than 80g/L (**Red cell *standard 3***). These results are in keeping with the organisational audit results which identified that the most common reason for deviation from the NBTC guidance in these groups was use of a higher threshold. The organisational results however did not predict the scale of the problem. Compliance was much better at 98% for patients with severe sepsis or acute cerebral ischaemia (**Red cell *standard 4***) and 100% for those receiving radiotherapy (**Red cell *standard 5***) where higher thresholds of 90g/L and 100g/L were applied.

Appropriate Use Algorithm

The construction of an appropriate use algorithm allowed the inclusion of all patients and assessed symptoms of anaemia. A threshold Hb of 10g/L to define appropriate use in patients with chronic anaemia is in keeping with a current pilot feasibility study which aims to assess quality of life and transfusion thresholds in patients with myelodysplastic syndromes. Despite this more generous approach only 59% to 75% of all red cell transfusions were considered to be appropriate, depending upon whether only those known to be on a chronic transfusion programme or all those with chronic anaemia were allowed a higher threshold. Removal of a threshold of 90g/L for severe sepsis, now known to be unnecessary, reduced appropriate use by a further 3%.

Platelet transfusion

Process

5% (95/1776) of transfusion episodes did not have a pre-transfusion platelet count measured within 24 hours in inpatients or 48 hours in day patients. One unit transfusions were usual and given on 89% of all occasions (94% day patients and 86% inpatients). Predictably more single units were used as prophylaxis at 93% (Platelet standard 2) which may be a small improvement compared to the previous audit. Prophylactic platelets are routinely given to stable patients and therefore allow analysis of everyday practice. In this group when more than one unit was transfused, it would be reasonable to expect a platelet count measured in between units.

However, only 42% (31/74) of inpatients and 7% (2/27) of day patients had this performed which demonstrates that this procedure is not yet standard. When a post prophylactic transfusion platelet count was performed 26% had an increment of less than or equal to 5 x 10^9/L indicating little benefit.

Appropriate use

Standards

Six platelet specific standards were used to assess compliance with NBTC indications for transfusion. 5 of these standards could be compared with results from the 2010 audit and in most there was either an improvement or no change. In patients with a reversible cause for BMF and no other risk factors for bleeding the platelet count was less than or equal to 10 x 10^9/L in 62% (289/474) of all episodes (**Platelet *standard 1***).

Although far from ideal this was a significant improvement compared to 2010 when 54% compliance was reported. There was probably also an improvement in prophylactic single unit transfusions (93% v 90%) and the number of transfusions

given pre-procedure with a threshold platelet count below 50 x 10^9/L (**Platelet *standard 4***) (84% v 81%) compared to 2010.

There was no difference in the percentage of platelet transfusions pre-procedure where the only indication was to prior to a bone marrow biopsy (**Platelet *standard 6***). In this audit stable patients with chronic bone marrow failure were assessed and for whom prophylactic platelet transfusions are not indicated (**Platelet *standard 3***). In this group 56% (359/639) were given prophylactic transfusions.

Although an astonishing result this was predictable from the organisational audit which identified that only 16% of hospital guidelines specify that prophylactic transfusions in this population are not required.

Appropriate Use Algorithms

Appropriate use algorithms were constructed for prophylactic, pre-procedure and therapeutic platelet use. Within the prophylactic group appropriate use was 72% associated with reversible BMF, 43% associated with chronic BMF not receiving intensive therapy (as above) and 77% associated with chronic BMF receiving intensive therapy. There was no difference in level of care and appropriate use in chronic BMF. Appropriate use algorithms for prophylaxis are not comparable to the 2010 audit results as only one algorithm was used then and only patients with MDS, but no other causes of chronic BMF, were excluded.

Pre-procedure and therapeutic algorithms were comparable and appropriate use results were similar and are provided below. Of particular disappointment is the lack of obvious improvement in the use of platelet transfusion prior to bone marrow biopsy.
This result, in common with other poor results, was predicable from the organisational audit where only 28% of hospitals stated that platelet transfusion was unnecessary.

Table 28: Comparison of compliance with 2010 NCA of use of platelets in haematology patients

Audit finding	2010	2016
Written local guidelines	96%	87%
Local audit within 12 months	43%	51%
Pre-transfusion platelet count within 24 hrs if inpatient and 48 hrs if outpatient	92%	95%
Prophylactic use in reversible BMF without additional risk factors the threshold platelet count is 10 x 10^9/L	54%	62%
Single adult unit prophylactic platelet transfusion	90%	93%
Prior to most invasive procedures, without additional risk factors for bleeding, the threshold platelet count is 50 x 10^9/L	81%	84%
Prior to operations in critical sites e.g. eye or brain the threshold platelet count is 100 x 10^9/L	100%	*67%
Percentage of all pre-procedure cases transfused when only a bone marrow biopsy was performed	9%	9%
Pre-procedure appropriate use algorithm	64	61
Therapeutic appropriate use algorithm	84	87

*Only 3 cases were reported and one had a platelet count above 100

Revised BCSH guidelines

Revised BCSH guidelines for platelet transfusion are shortly to be released and are often associated with lower platelet transfusion threshold counts than those currently recommended and used in this audit.

To identify the potential impact of this new guidance on appropriate use in this audit, additional algorithms were developed. Using these algorithms pre-procedure appropriate use reduced from 61% to only 31% and therapeutic appropriate use reduced from 87% to 79%.

Although a separate prophylactic use algorithm was not constructed the new guidance recommends hospitals consider a no-prophylactic strategy for patients post autologous stem cell transplant.

If this was implemented prophylactic appropriate use would also be expected to fall. The revised guidance will therefore support hospitals to reduce platelet transfusion which this audit has clearly identified as necessary.

Conclusions

This was a large audit of high blood use haematology patients. During the audit period the sample of audited patients used around 15% of all red cells requested by participating hospitals and 45% of all platelet concentrates requested by participating hospitals. The majority of patients were elderly with a median age of 72 years and 70% were managed without curative intent. In 59% of red cell transfusion episodes the indication was chronic anaemia. 77% of all platelet transfusions were given as prophylaxis and 53% of these (41% of all platelet transfusion episodes) were to patients with chronic bone marrow failure.

Although accepted good practice, single unit red cell transfusions were uncommon even in inpatients, and three unit transfusions were given to low weight patients, which is unsafe. Single unit platelet transfusions were much more common and occurred in 93% of all prophylactic transfusion episodes. When more than one unit of platelets was given as prophylaxis however checking a count in between units was uncommon and likely to indicate over use. Red cell appropriate use was at best 75% and this was using a generous Hb threshold of 100g/L plus symptomatic assessment for patients with chronic anaemia. 62% of prophylactic transfusions for reversible bone marrow failure were given when the platelet count was less than or equal to 10 x 10^9/L, an improvement compared to 54% in 2010. Platelet appropriate use was 72% for prophylaxis in this reversible bone marrow failure group but in contrast only 43% for prophylactic use in chronic bone marrow failure.

Although most hospital units had access to guidelines for blood component use red cell transfusion thresholds were frequently higher than national recommendations and platelet transfusion guidance did not usually define grades of bleeding or state that prophylaxis was not required for chronic bone marrow failure. Compliance was similar across all levels of care. Under these circumstances the results of the clinical audit are not unexpected and regular local audit would be of limited value to improve practice against national standards. Given the high blood use in this elderly haematology population and evidence that this group is likely to increase it is imperative to limit transfusion to only those who are likely to benefit. In the NCA of platelet use in haematology in 2010 poor transfusion practice in patients with reversible BMF was reported and improved practice is evident in prophylactic pre-transfusion platelet count compliance and likely appropriate use.

It is now clear that attention is also required to improve practice in patients with chronic BMF. This needs to start with clear national guidance which states when transfusion is not required as well as when it is and adoption of these standards into all hospital haematology units of all levels. Audit of practice can then provide the information required to plan for legitimate future transfusion needs. Timely electronic audit methods will need to be introduced before regular audit can be achieved in most hospitals.

Appendix A – Additional Figures

Figure 1: Date of red cell transfusion audited

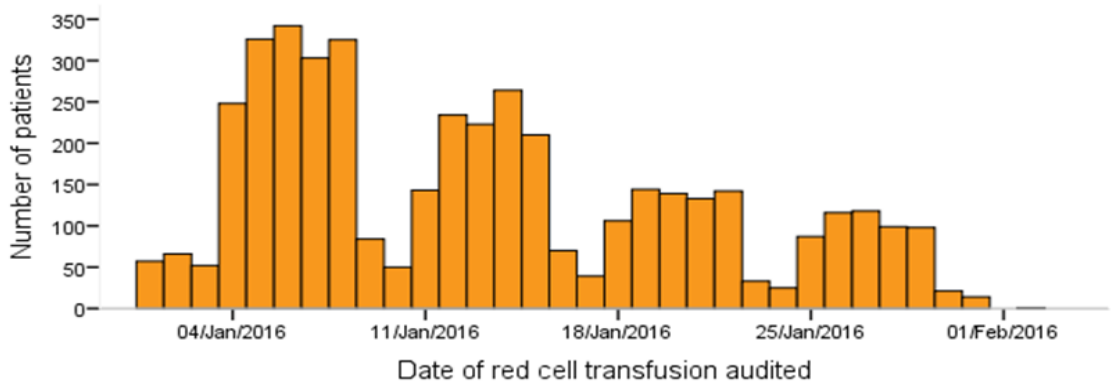


Figure 2a: Histogram for post transfusion Hb for inpatients.

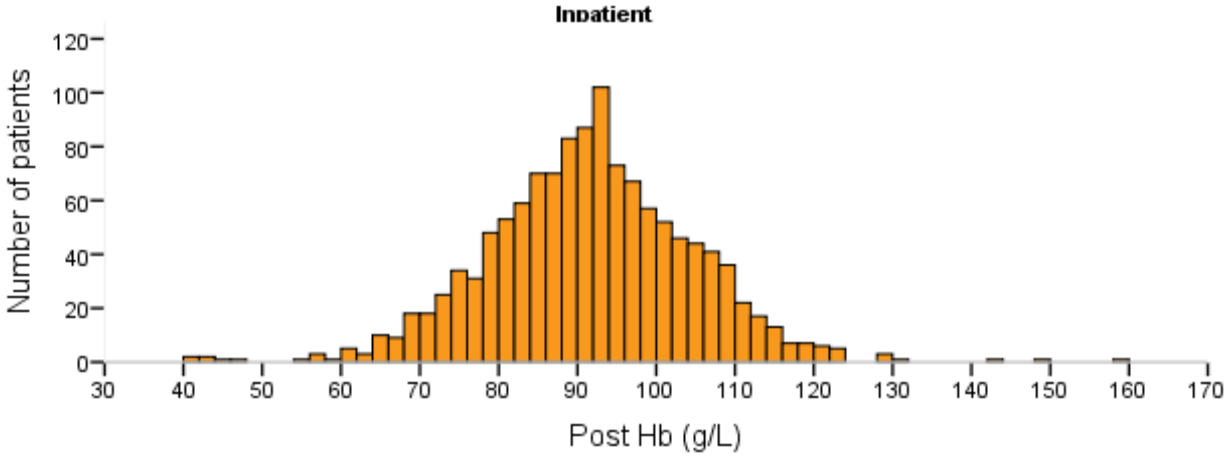


Figure 2b: Histogram for post transfusion Hb increment for inpatients.

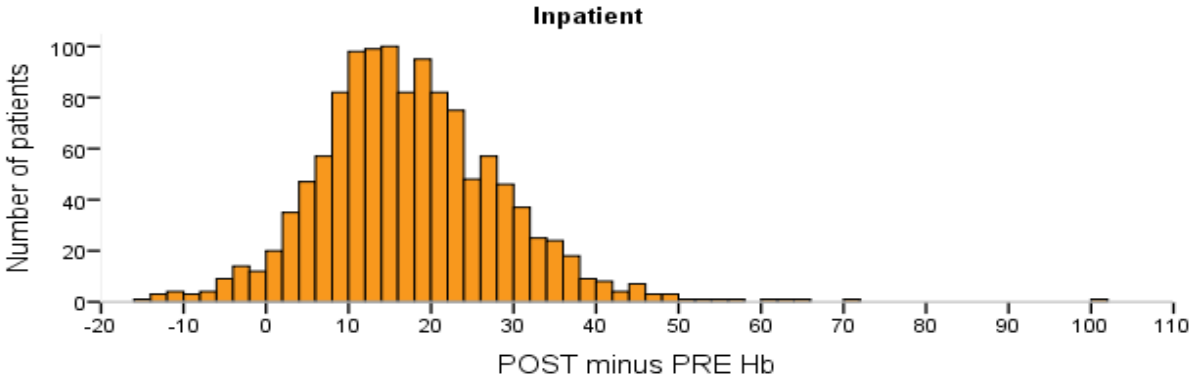


Figure 2c: Histogram for post transfusion Hb increment per unit transfused for inpatients.

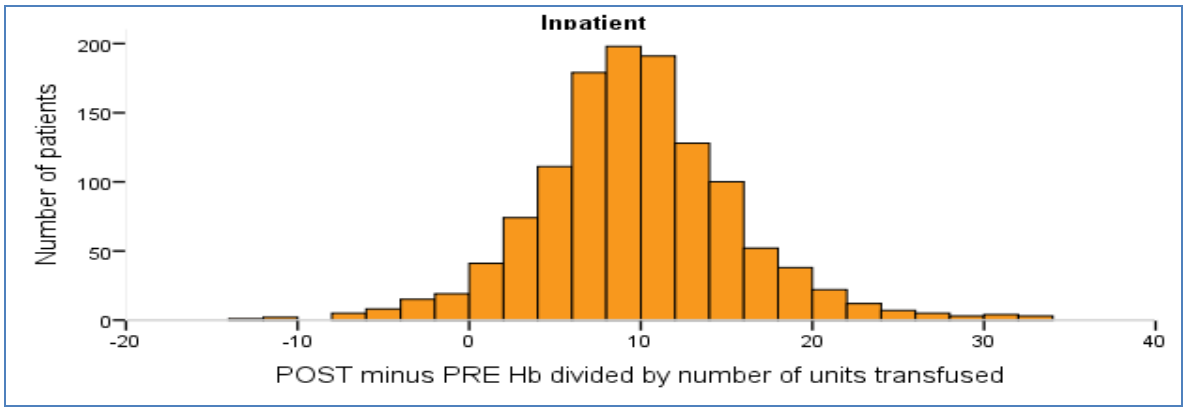


Figure 3: Date of platelet transfusion audited

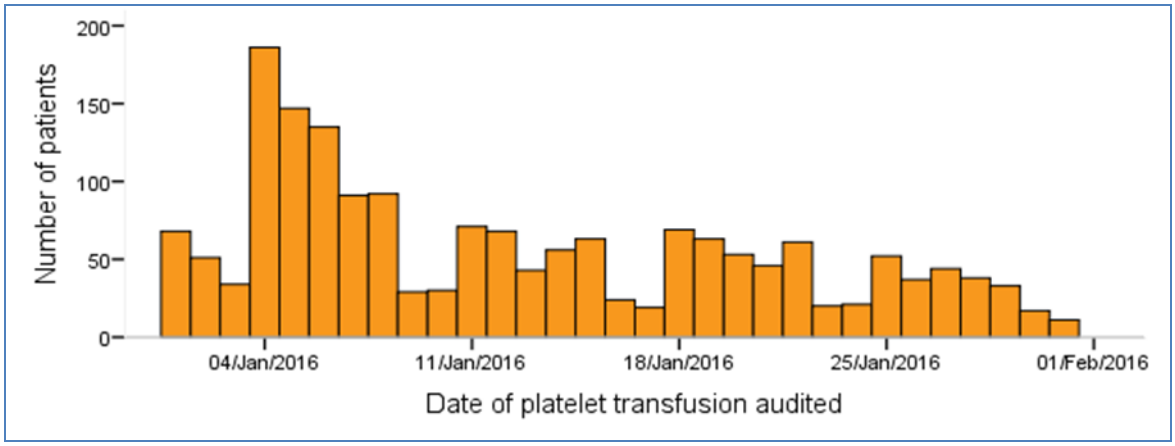


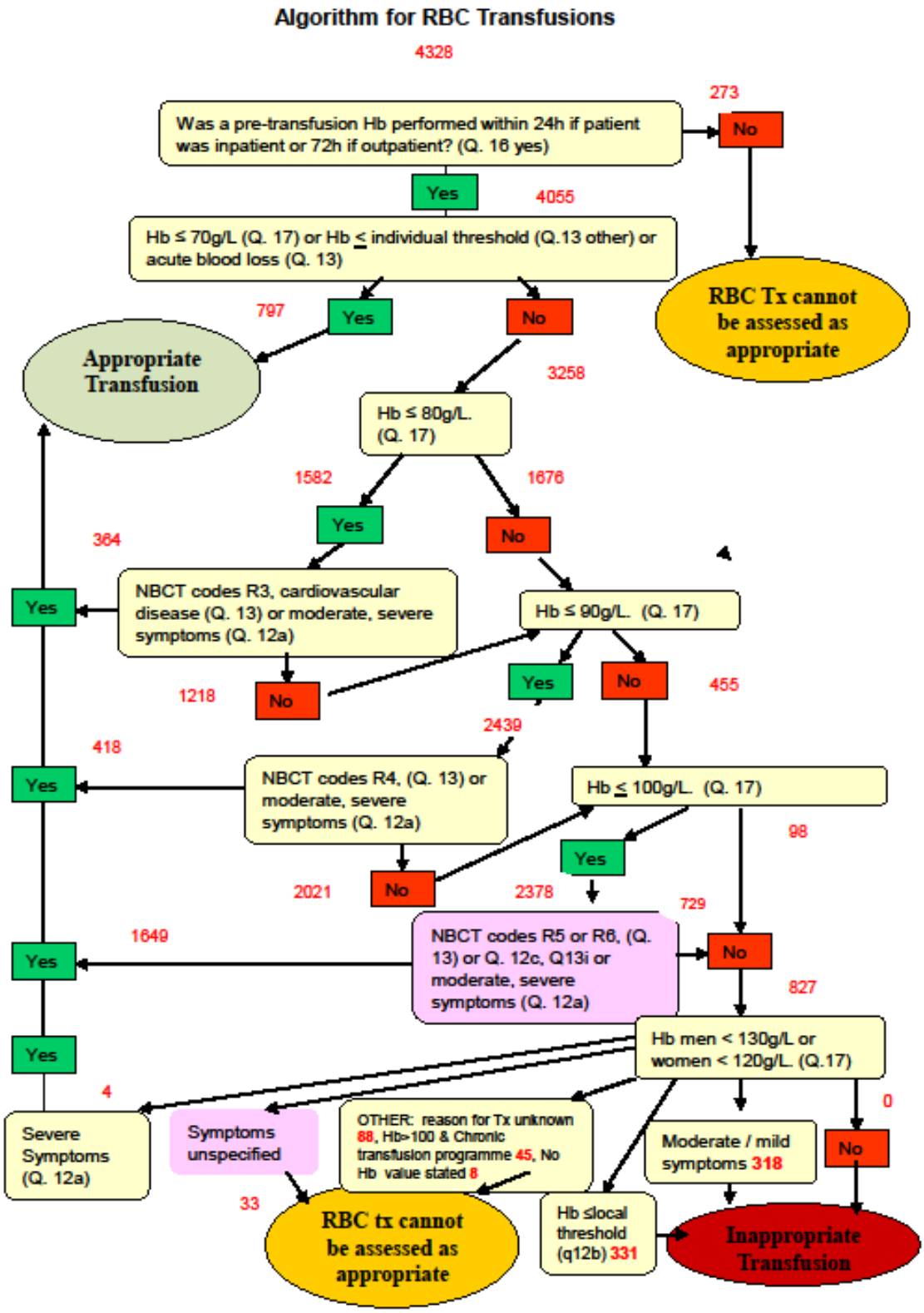
Table 1: Number of additional red cells patients received in January 2016

	National (4255)	
Median (IQR)	1	0 to 3
None	46.4%	1974
One	6.1%	260
Two	20.7%	882
Three	7.1%	304
Four	6.7%	285
Five	3.2%	135
Six	3.0%	128
Seven	1.8%	75
Eight	1.7%	71
Nine	0.8%	34
Ten or more (10-76)	2.5%	107

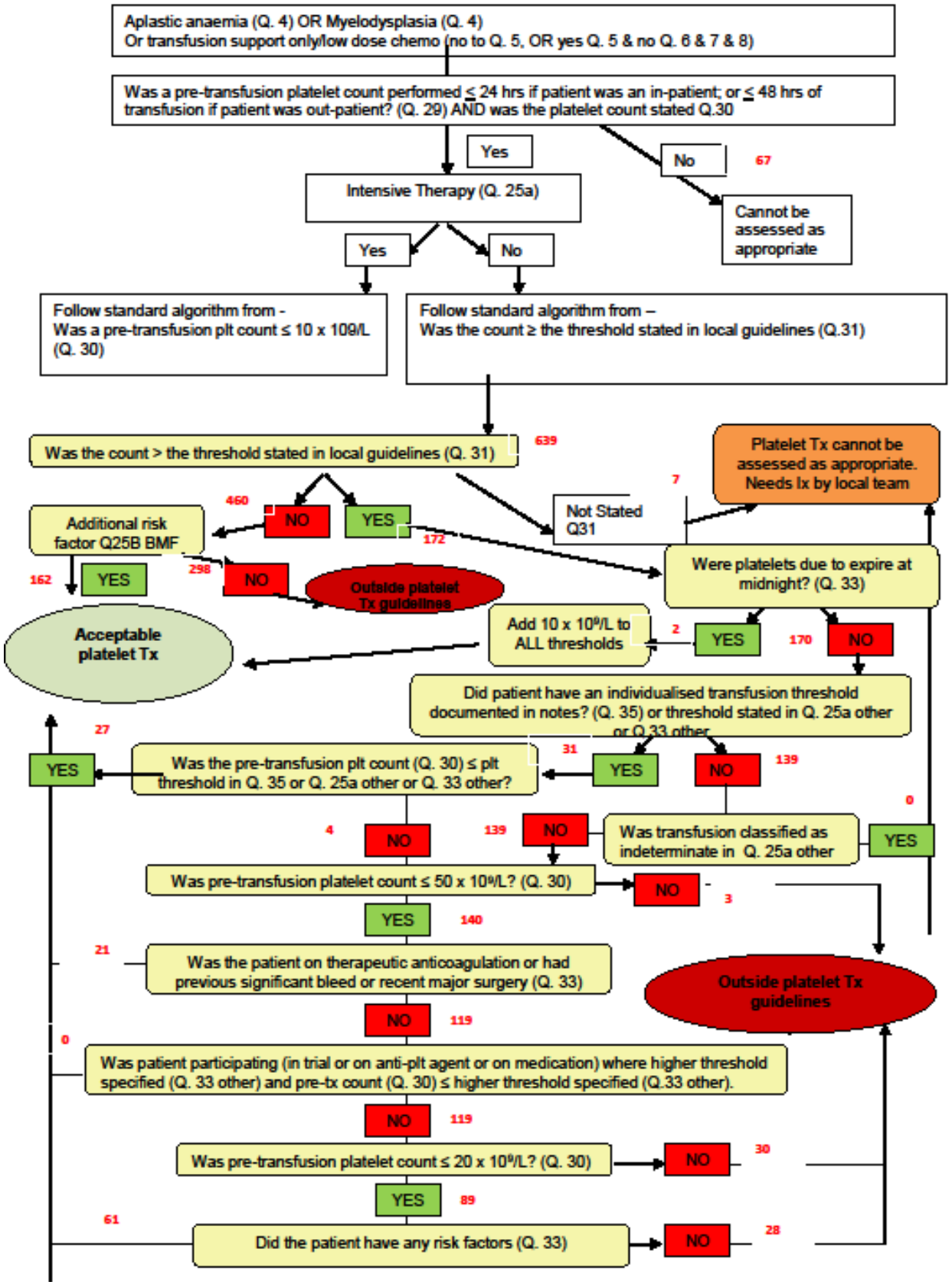
Table 2: Number of additional platelets received in January 2016

	National (1765)	
Median (IQR)	2	0 to 5
None	26.3%	464
One	13.8%	243
Two	11.3%	200
Three	11.3%	199
Four	7.8%	138
Five	5.5%	97
Six	3.7%	66
Seven	4.6%	82
Eight	2.9%	52
Nine	2.7%	48
Ten to nineteen	8.3%	147
Twenty or more (20 to 51)	1.6%	29

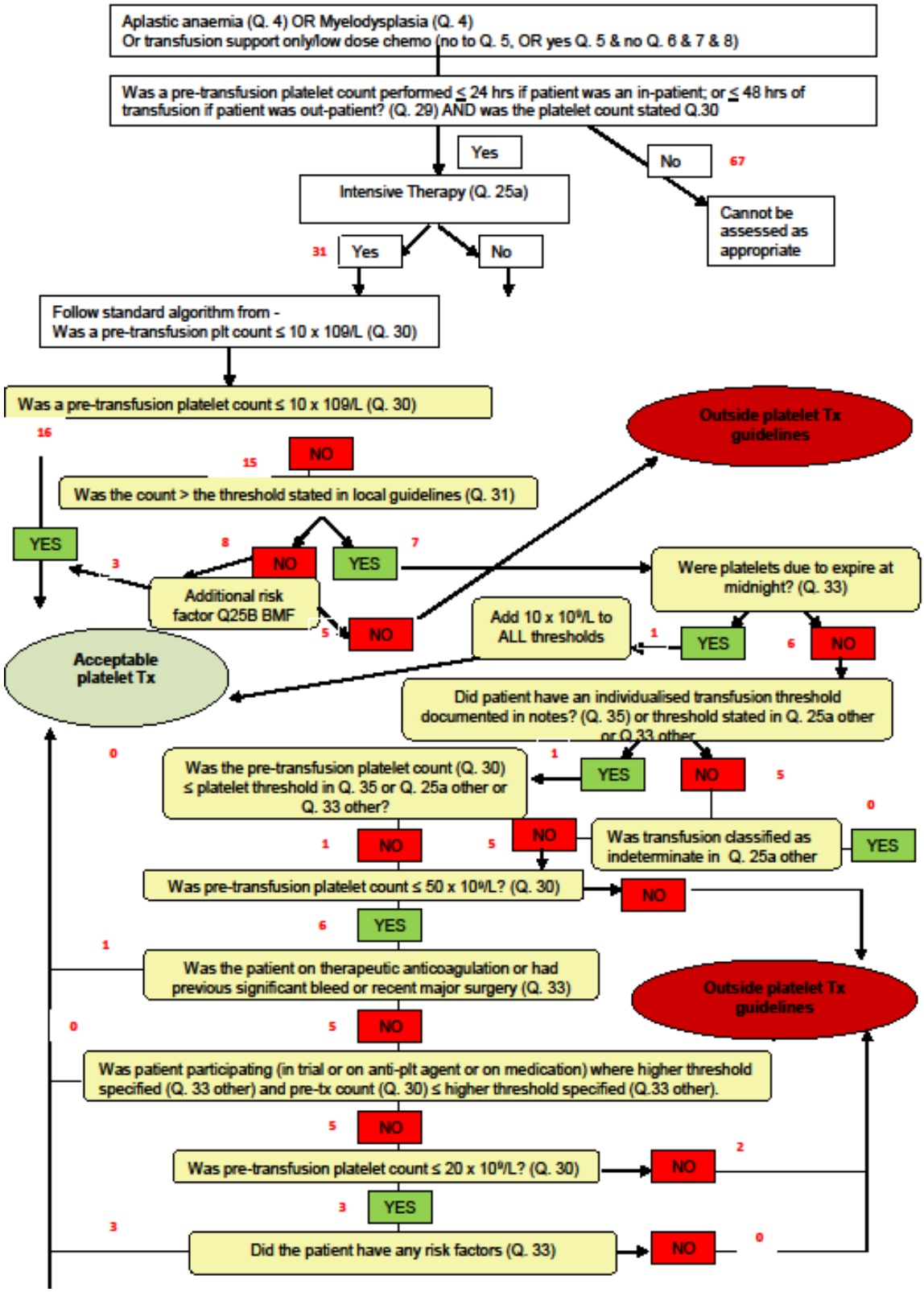
Appendix B – Analysis Algorithms



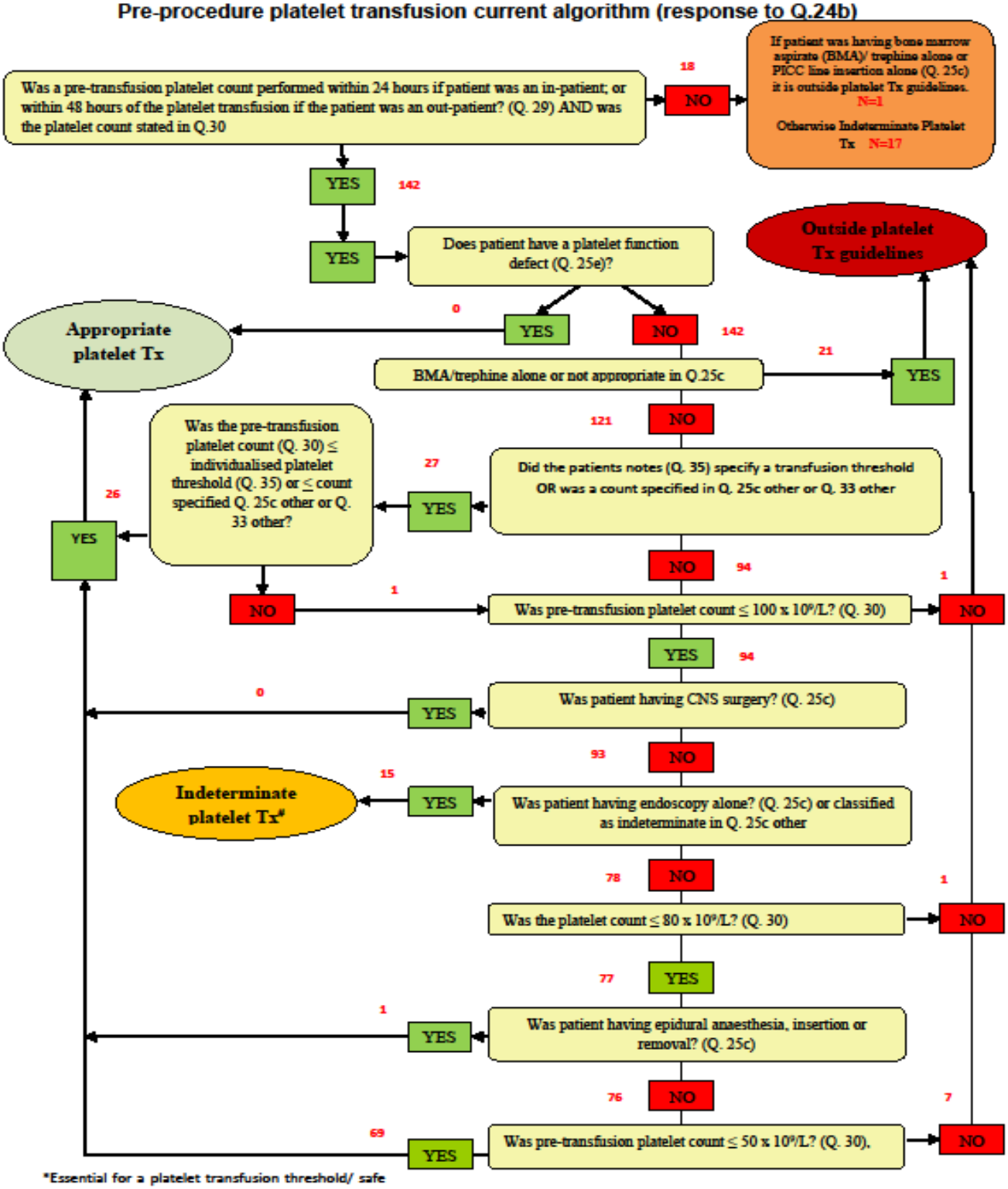
Prophylaxis for Aplastic Anaemia/MDS/transfusion support only - Non Intensive N=639



Prophylaxis for Aplastic Anaemia/MDS/transfusion support only – Intensive N=31

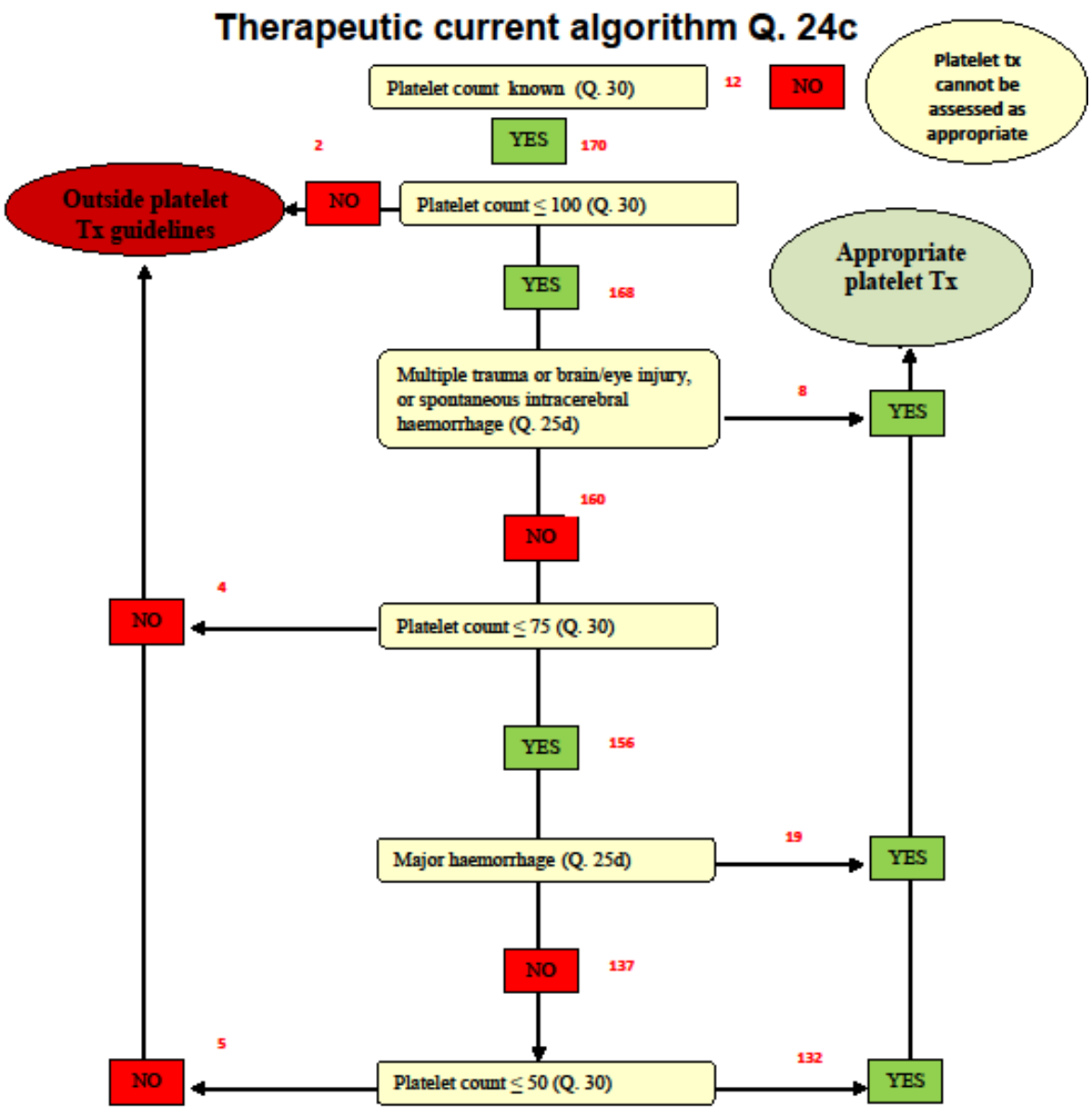


Pre-procedure platelet transfusion current algorithm (response to Q.24b)



*Essential for a platelet transfusion threshold/ safe platelet count to be documented in the notes if it differs from the general guidelines. This allows adequate communication between haematologists, surgeons, anaesthetists and radiologists. Q. 45 gives reason why transfusion threshold was altered.

No threshold guidance within BCSH guidelines. Threshold of 50 x 10^9/L for endoscopy plus biopsy


Therapeutic current algorithm Q. 24c
Platelet count known (Q. 30)
12
NO
Platelet tx cannot be assessed as appropriate
YES
170
2
Outside platelet Tx guidelines
NO
Platelet count ≤ 100 (Q. 30)
YES
168
Appropriate platelet Tx
Multiple trauma or brain/eye injury, or spontaneous intracerebral haemorrhage (Q. 25d)
8
YES
160
NO
4
NO
Platelet count ≤ 75 (Q. 30)
YES
156
19
Major haemorrhage (Q. 25d)
YES
NO
137
5
NO
Platelet count ≤ 50 (Q. 30)
132
YES

Appendix C – Patient Audit Tool

Please provide the job titles of everyone who was involved in the completion of this form

Auditor(s) job title

Patient Characteristics

1. What is the patient's gender? ☐ Male ☐ Female

2. What was the patient's age at the time you audited this transfusion episode? ☐

3. What was the patient's weight (kilograms)*?* ☐

Diagnosis

4. What is the current haematological diagnosis? (*occasionally more than one may apply)*

Acute leukaemia (tick one of the options below)

☐ Acute myeloid leukaemia excluding APML
☐ Acute promyelocytic leukaemia (APML)
☐ Acute lymphocytic leukaemia
☐ Other acute leukaemia
☐ **Aplastic anaemia**

Chronic leukaemia (tick one of the options below)

☐ Chronic lymphocytic leukaemia (CLL)
☐ Chronic myeloid leukaemia (CML)
☐ Other chronic leukaemia

Lymphoma (tick one of the options below)

☐ Burkitt's lymphoma
☐ Diffuse large B cell lymphoma (DLBCL)
☐ Follicular lymphoma
☐ Hodgkin's lymphoma (HL)
☐ Other lymphoma

☐ **Myelodysplasia**
☐ **Myelodysplastic/myeloproliferative neoplasms (includes CMML, JMML)**
☐ **Myeloproliferative neoplasms including myelofibrosis**
☐ **Myeloma/Plasma cell dyscrasia**
☐ **Other** (please state)

Treatment

5. Was the patient receiving treatment (excluding transfusion) for their underlying current haematological diagnosis?

☐ Yes ☐ No

If yes, go to Q6. If no, go to Q9

6. Was the patient undergoing allogeneic stem cell transplant?

☐ Yes ☐ No

If yes, go to Q9. If no, go to Q7

7. Was the patient undergoing autologous stem cell transplant?

☐ Yes ☐ No

If yes, go to Q9. If no, go to Q8

8. Was the patient on an intensive chemotherapy programme in the last 6 weeks? *(excluding low dose chemotherapy e.g. azacitidine)*

☐ Yes ☐ No

9. Was the patient participating in a clinical study?

☐ Yes ☐ No

If yes, please state the name of the study

10. Did this patient have a red cell transfusion in January 2016?

☐ Yes ☐ No

If yes, go to Q11. If no, go to Q22

Red Cell Transfusion

11. Was the patient an ☐ Inpatient? or a ☐ Day patient?

Indication for the Red Cell Transfusion that you are auditing

12. Please select one of the 4 broad categories **(a, b, c, d)** below which best describes the reason for transfusion.

a) ☐ Symptomatic anaemia

If yes, please indicate severity grade

- ☐ **Mild** *(Chronic fatigue, loss of energy)*
- ☐ **Moderate** *(Palpitations; Shortness of breath on exertion etc.)*
- ☐ **Severe** *(Shortness of breath at rest; symptoms of ischaemic heart disease, such as chest pain; hypotension or tachycardia unresponsive to fluid resuscitation; cardiac failure)*
- ☐ **Unspecified**

b) ☐ Hb level less than the local threshold

c) ☐ Chronic transfusion programme

d) ☐ Cannot determine reason for transfusion

13. What was the clinical indication for transfusion?

(More than 1 code may be used. NBTC codes are shown after each option)

- ☐ Acute blood loss (R1)
- ☐ Medical anaemia, age <65 years (R2)
- ☐ Medical anaemia, age ≥65 years (R2)
- ☐ Medical anaemia in patients with cardiovascular disease (R3)
- ☐ Medical anaemia with sepsis (R4)
- ☐ Medical anaemia with CNS complications (R4)
- ☐ Anaemia in a patient receiving radiotherapy (R5)
- ☐ Chronic anaemia with bone marrow failure (BMF) due to MDS/AA/PNH (R6)
- ☐ Chronic anaemia with BMF due to bone marrow infiltration (R6)
- ☐ Other, please specify

14. What was the date of the red cell transfusion that you are auditing? (dd:mm)

☐☐ ☐☐ 2016

15. How many units were given in this transfusion episode?
(A transfusion episode is defined as all units transfused within a 24 hour period)

☐☐

16. Was a pre-transfusion Hb count performed within 24 hours of the start of the transfusion if the patient was an inpatient, or within 72 hours of the transfusion if the patient was a day patient? ☐ Yes ☐ No

17. If yes to Q16, what was the Hb? ☐☐☐ g/L

If only one unit was given go to Q19, if more than one unit was given please answer Q18

18. Was the Hb measured after each unit transfused? ☐ Yes ☐ No

19. Was a post-transfusion Hb taken within 24 hours of the end of the transfusion episode? ☐ Yes ☐ No

20. If yes to Q19, what was the Hb? ☐☐☐ g/

21. How many additional red cells units did this patient receive in the month of January 2016?

☐☐☐

22. Did the patient receive a platelet transfusion in January 2016? ☐ Yes ☐ No

If yes, go to Q23. If no, you have finished this questionnaire

Platelet transfusion

23. Was the patient an ☐ Inpatient? or a ☐ Day patient?

Indication for the platelet transfusion that you are auditing

To assist you in completing this section, please refer to the bleeding grade definitions shown on page 11

24. Please select one of the 4 broad categories **(a,b,c,d)** below which best describes the reason for transfusion. If therapeutic to treat bleeding (modified WHO bleeding grade 2 or above) please indicate grade.

a). Prophylactic platelet transfusion to prevent bleeding and not having a procedure
Modified WHO bleeding grade 0 or 1 ☐ **Now go to Q25**

b). Pre-procedure
Modified WHO bleeding grade 0 or 1 ☐ **Now go to Q25**

c). Therapeutic to treat bleeding
Modified WHO bleeding grade 2 ☐ **Now go to Q25**
Modified WHO bleeding grade 3 ☐ **Now go to Q25**
Modified WHO bleeding grade 4 ☐ **Now go to Q25**

d). Cannot determine the reason for transfusion ☐ **Now go to Q26**

25. What was the clinical indication for transfusion (a,b,c,d,e)?

(please tick all codes that apply. NBTC codes are shown after each option)

a) Prophylactic - *modified WHO bleeding grade 0 or 1*
☐ Reversible bone marrow failure due to haematological disease or treatment (P1)
☐ Allogeneic stem cell transplant (P1)
☐ Autologous stem cell transplant (P1)
☐ Chronic BMF receiving intensive therapy (excluding low dose chemotherapy e.g. azacitidine) (P1)
☐ Chronic BMF e.g. MDS, AA to prevent recurrence of previous bleed of modified WHO grade ≥2 (P2)
☐ Prophylactic indication not described above (please state) (P1)

b) Prophylactic use in the presence of currently existing risk factors for bleeding (e.g. sepsis, antibiotic treatment, abnormalities of haemostasis) (P2) *modified WHO bleeding grade 0 or 1*

☐ Reversible BMF
☐ Chronic BMF

c) Pre-procedure platelet transfusion (P3)

- ☐ Central venous line insertion (tunnelled or untunnelled) excluding PICC line
- ☐ Lumbar puncture
- ☐ Percutaneous liver biopsy
- ☐ Major surgery (not involving eye or brain)
- ☐ Epidural anaesthesia
- ☐ CNS surgery (including posterior segment of eye)
- ☐ Bone marrow aspirate and or trephine
- ☐ PICC line insertion
- ☐ Other organ biopsy (e.g. lung, splenic, renal)
- ☐ Endoscopy only
- ☐ Endoscopy and biopsy
- ☐ Other procedures not described above *(Please state)*

d) Therapeutic Platelet transfusion (P4) – *modified WHO bleeding grade ≥ 2*

- ☐ Major haemorrhage (WHO grade 3 or 4)
- ☐ Multiple trauma, or brain/eye injury, or spontaneous intracerebral haemorrhage
- ☐ Bleeding considered non severe
- ☐ Bleeding outside of categories above

e) In addition to the haematological malignancy or myeloid failure syndrome, please indicate if the patient has any of the specific conditions identified below

- ☐ Platelet function defect – acquired (P5)
- ☐ Disseminated intravascular coagulation (DIC) (P6)
- ☐ Congenital platelet function defect (P7)
- ☐ Heparin induced thrombocytopenia (HIT) (P8)
- ☐ Primary immune thrombocytopenia (ITP) (P8)
- ☐ Post transfusion purpura (PTP) (P9)
- ☐ Thrombotic thrombocytopenic purpura (TTP)

Platelet transfusion episode

26. What was the date of the platelet transfusion 2016 that you are auditing? (dd:mm) ☐☐ ☐☐

27. How many units of platelets were given in this transfusion episode? ☐☐
(A transfusion episode is defined as all units transfused within a 24 hour period)

28. Were the platelets HLA matched? ☐ Yes ☐ No

29. Was a pre-transfusion platelet count performed within 24 hours of the transfusion if the patient was an inpatient, or within 48 hours of the transfusion if the patient was a day patient?

☐ Yes ☐ No

If yes, go to Q30. If no, go to Q36

30. If yes to Q30, what was the platelet count? ☐☐☐ x 10^9/L

31. Was the platelet count above the threshold stated in local guidelines? ☐ Yes ☐ No

If yes, go to Q32. If no, go to Q36

32. Was there a reason for a higher threshold? ☐ Yes ☐ No

If yes, go to Q33. If no, go to Q36

33. Please select from the list below reason/s for a higher threshold:

☐ Fever
☐ Systemic infection
☐ Abnormality of haemostasis
☐ Therapeutic anticoagulation
☐ Anti-platelet agent
☐ Previous significant bleed
☐ Recent major surgery (within one week)
☐ Participation in a trial where higher threshold specified
☐ On medication where higher threshold specified – please state medication *and* threshold

☐ Platelet concentrate due to expire at midnight of day of transfusion
☐ Platelet count anticipated to fall below threshold before next visit to outpatients
☐ Other, please state

34. Was a higher threshold specified in the notes? ☐ Yes ☐ No

35. If yes to Q34, please state threshold specified | |

If only one unit was given go to question 37, if more than one unit was given please answer 36.

36. Was a platelet count checked in between transfused units? ☐ Yes ☐ No

37. Was a post-transfusion platelet count taken within 24 hours of the transfusion? ☐ Yes ☐ No

38. If yes to Q37, what was the platelet count? ☐☐☐ x 10^9/L

39. How many additional platelet units did this patient receive within the month of January 2016? ☐☐

END OF AUDIT TOOL

Appendix D – Organisational Questionnaire

Section 1: General Information

1. What level of haematology care does your hospital provide? (according to BCSH criteria - see definitions in appendix 1)

Level 1 ☐ **Level 2a** ☐ **Level 2b** ☐ **Level 3** ☐

2. At your hospital how many in-patient beds have been designated haematology beds (includes all types of haematology patient)?

3. Are patients who require in patient care primarily because of a haematological problem under the direct care of a consultant haematologist during working hours?

Yes ☐ **No** ☐

4. Are patients who require in patient care primarily because of a haematological problem under the direct care of a consultant haematologist out of hours?

Yes ☐ **No** ☐

5. Do you have local written guidelines for the use of blood component transfusion in haematology patients? *These may be the same as national guidelines and used for all other patients in the hospital.* **Yes** ☐ **No** ☐

If no, this is the end of the questionnaire. Please state how decisions regarding when to transfuse blood are made.

If yes, continue questions below.

6. How are your guidelines made available to medical and nursing staff?

☐ Provided in written format at hospital induction to all new junior doctors
☐ Provided on hospital intranet
☐ Displayed on wall in haematology day unit
☐ Displayed on wall in haematology ward
☐ Specific teaching sessions provided at doctors' induction
☐ Provided in guideline/protocol folder on wards
☐ Other (please state)

7. When was your last local audit performed to assess compliance with transfusion guidelines? *(This could be of one or all blood component use and include additional specialties)*

☐ < 12 months
☐ 12-18 months
☐ 18-24 months
☐ 24-36 months
☐ 36-48 months
☐ 48-60 months
☐ No local audit performed

Section 2: Local Guidelines

The table below is based on the NBTC Indications and codes for transfusion. Please identify which indications your local guideline includes and where applicable the threshold used.

Red Blood Cells			
Q8. CLINICAL INDICATION for transfusion	**NBTC Code**	**Q8a. Is indication local guideline (Yes/No)**	**Q8b. If yes, state threshold**
Acute blood loss in an emergency	**R1**		
Surgery / medical / critical care			
Usual indication for red cell transfusion, age < 65 years	**R2**		
Usual indication for red cell transfusion, age ≥ 65 years	**R2**		
With cardiovascular disease or symptoms	**R3**		
History of ischaemic heart disease			
Chest pain; hypotension or tachycardia unresponsive to fluid resuscitation; or cardiac failure			
With severe sepsis	**R4**		
With traumatic brain injury	**R4**		
With acute cerebral ischaemia	**R4**		
Surgery / medical / critical care If different risk factors to those above please state and the threshold used			
Radiotherapy	**R5**		
Chronic Anaemia	**R6**		
Chronic anaemia age < 65 years			
Chronic anaemia age ≥ 65 years			
Platelets			

Q9. Does your guideline specify grades of bleeding to differentiate prophylactic from therapeutic transfusion?		**Yes ☐ No ☐**	
Q10. If yes are the bleeding grades as stated in appendix 2?		**Yes ☐ No ☐**	
Q11. CLINICAL INDICATION for transfusion		**Q11a. Is indication local guideline (Yes/No)**	**Q11b. If yes, state threshold**
Prophylactic use in the absence of risk factors for bleeding	**P1**		
Reversible BMF e.g. disease/treatment excluding auto BMT			
Reversible BMF associated with auto BMT			
Chronic BMF receiving intensive therapy			
Chronic BMF, prophylaxis to prevent further recurrent bleeding (grade $\geq$ 2 using bleeding grade in appendix 2)			
Prophylactic – indication not described above. Please state indications with threshold platelet count used			
Prophylactic use if risk factors for bleeding present (e.g. sepsis, antibiotic treatment, abnormalities of haemostasis)	**P2**		
Reversible BMF			
Chronic BMF			
Prophylactic use if risk factors for bleeding and different threshold platelet count used to those identified above. Please state risks with threshold platelet count used			
Pre-invasive procedure or surgery	**P3**		
Central venous line insertion (tunnelled or untunnelled) except PICC			
Lumbar puncture			
Percutaneous liver biopsy			
Major surgery			
Epidural anaesthesia			
CNS surgery (including posterior segment of eye)			
Bone marrow aspirate and or trephine			
PICC line			
Other procedures not described above. Please state procedures with threshold platelet count used			
Therapeutic Platelet transfusion	**P4**		

Major haemorrhage			
Multiple trauma, or brain/eye injury, or spontaneous intracerebral haemorrhage			
Bleeding (grade ≥ 2 as in appendix 2) but considered non severe			
Bleeding outside of categories above			
Specific clinical situations. Please indicate threshold if different to those stated above			
Platelet function defect – acquired. e.g. anti-platelet agents, uraemia	P5		n/a
Disseminated intravascular coagulation (DIC)	P6		
Thrombotic thrombocytopenic purpura (TTP)	P6		
Platelet function defect - congenital	P7		n/a
Primary immune thrombocytopenia (ITP)	P8		
Heparin induced thrombocytopenia (HIT)	P8		
Post-transfusion purpura (PTP)	P9		
Specific clinical situation not described above. Please state with threshold platelet count used			

Definitions

Levels of Haematology Care

Level 1 care requires facilities for delivering treatment that would not normally be expected to result in significant neutropenia, although this might occur for a brief period (less than 7 days). Such treatment can be given on an out-patient basis, either orally or intravenously. Examples of this level of treatment include oral hydroxycarbamide and melphalan.

Level 2a care requires facilities for delivering treatment that more predictably results in short periods of bone marrow suppression, with neutropenia of usually less than 7 days duration. Examples include CHOP, ABVD, rituximab containing combinations (FCR, R-CVP, R-CHOP etc.), bortezomib therapies and non-intensive treatment for acute myeloid leukaemia (AML).

Level 2b care requires facilities for delivering treatment that will predictably cause prolonged periods of neutropenia, would normally be given on an in-patient basis, and which may need to be given at weekends as well as during the week. These regimens are more complex to administer than at level 1 or 2a (for example, in terms of drug scheduling) and have a greater likelihood of resulting in medical complications in addition to predictable prolonged neutropenia. Consequently, the resources required to deliver these more complex regimens are greater than at level 1 or 2a. Such regimens include those used to treat AML with curative intent, and salvage chemotherapy regimens for relapsed aggressive histology lymphomas (for example DHAP, IVE).

Level 3 care requires facilities for delivering complex treatment regimens and, as with level 2b, may have a high incidence of complications. In addition these treatments are designed for rare haematological malignancies where centralisation of care at regional centres is considered to be advantageous, for example in terms of the familiarity of the biology of the rare diseases and the treatment protocols used. An example of this is the modern in-patient management phase of acute lymphoblastic leukaemia (ALL).

Modified WHO definition of bleeding events

Grade 1

- Mild/moderate petechiae, purpura.
- Mild/moderate oropharyngeal bleeding, epistaxis <30 minutes in duration

Grade 2

- Melaena, haematemesis, haemoptysis, fresh blood in stool, musculoskeletal bleeding or soft tissue bleeding ***not requiring red cell transfusion within 24 hours of onset and without haemodynamic instability***
- Profuse epistaxis or oropharyngeal bleeding *i.e.> 30 minutes in continuous duration*
- Symptomatic oral blood blisters *i.e. bleeding or causing discomfort*
- Extensive petechiae, purpura *i.e. numerous in number and/or positioned on either face or abdomen and/or spreading by comparison to previous assessment*
- Visible blood in urine
- Bleeding from invasive sites requiring 2 ≥ changes of dressings in a 24 hr period
- Unexpected vaginal bleeding saturating 2 ≥ pads with blood in a 24hr period
- Red cells in body cavity fluids obvious macroscopically
- Retinal haemorrhage with/without visual impairment

Grade 3

- Melaena, haematemesis, haemoptysis, haematuria -including intermittent gross bleeding without clots, abnormal vaginal bleeding, fresh blood in stool, epistaxis, and oropharyngeal bleeding, bleeding from invasive sites, musculoskeletal bleeding, or soft tissue bleeding ***requiring red cell transfusion specifically for support of bleeding within 24 hours of onset and without haemodynamic instability***
- Body cavity fluids reported as grossly bloody in laboratory, nursing, or medical notes
- CNS bleeding noted on CT (computerized tomography) without clinical consequences

Grade 4

- Debilitating bleeding including retinal bleeding with visual impairment*
- Non-fatal CNS bleeding with neurological signs and symptoms
- Bleeding associated with haemodynamic instability (hypotension, >30 mm Hg change in systolic or diastolic HP)
- Fatal bleeding from any source

**visual impairment is defined as a field deficit, and patients with suspected visual impairment require an opthalmologic consultation*

Appendix E – Sites that participated in the audit

Addenbrooke's Hospital
Airedale NHS Foundation Trust
Altnagelvin Area Hospital
Barnet Hospital
Barnsley Hospital NHS Foundation Trust
Barts Health NHS Trust
Basildon and Thurrock University Hospitals NHS Foundation Trust
Basingstoke & North Hampshire Hospital
Belfast Health and Social Care Trust
Betsi Cadwaladr University Health Board
Birmingham City Hospital
Birmingham Heartlands Hospital
Bishop Auckland Hospital
Blackpool Victoria Hospital
Bradford Teaching Hospitals NHS Foundation Trust
Bronglais Hospital
Buckinghamshire Healthcare NHS Trust
Calderdale and Huddersfield NHS Foundation Trust
Central Manchester University Hospitals NHS Foundation Trust
Chelsea & Westminster Hospital
Chesterfield Royal Hospital
City Hospital Campus Nottingham
Colchester Hospital University NHS Foundation Trust
Conquest Hospital
Countess of Chester Hospital NHS Foundation Trust
County Hospital (Stafford)
Craigavon Area Hospital
Croydon Health Services NHS Trust
Darlington Memorial Hospital
Dartford and Gravesham NHS Trust
Derriford Hospital
Doncaster and Bassetlaw Hospitals NHS Foundation Trust
Dorset County Hospital NHS Foundation Trust
East and North Hertfordshire NHS Trust
East Cheshire NHS Trust
East Lancashire Hospitals NHS Trust
Eastbourne Hospital
Epsom Hospital
Forth Valley Royal Hospital
Frimley Park Hospital
Furness General Hospital
George Eliot Hospital
Glangwili General Hospital
Gloucestershire Hospitals NHS Foundation Trust
Guys and St Thomas' NHS Foundation Trust

Harrogate and District NHS Foundation Trust
Hinchingbrooke Hospital
Homerton University Hospital
Hull Royal Infirmary
Imperial College Healthcare NHS Trust
James Paget University Hospital
Kent & Canterbury Hospital
Kettering General Hospital
King's College Hospital
Kingston Hospital
Lancashire Teaching Hospitals NHS Foundation Trust
Leighton Hospital
London North West Healthcare NHS Trust
Luton and Dunstable Hospital NHS Foundation Trust
Maidstone and Tunbridge Wells NHS Trust
Medway NHS Foundation Trust
Mid Essex Hospital Services NHS Trust
Milton Keynes NHS Foundation Trust
Musgrove Park Hospital
Nevill Hall Hospital
Norfolk & Norwich University Hospital
North Bristol NHS Trust
North Cumbria University Hospitals NHS Trust
North Middlesex University Hospital NHS Trust
North Tees and Hartlepool NHS Foundation Trust
Northampton General Hospital
Northern Devon Healthcare NHS Trust
Northumbria Healthcare NHS Foundation Trust
Our Lady's Hospital Navan
Oxford University Hospitals NHS Foundation Trust
Peterborough and Stamford Hospitals NHS Foundation Trust
Poole Hospital NHS Foundation Trust
Prince Charles Hospital
Prince Philip Hospital
Princess Alexandra Hospital
Princess Royal University Hospital Farnborough
Queen Alexandra Hospital
Queen Elizabeth Hospital Birmingham
Queen Elizabeth Hospital Gateshead
Queen Elizabeth Hospital Woolwich
Queen Elizabeth The Queen Mother Hospital
Queen's Hospital Burton
Queen's Hospital Romford
Raigmore Hospital
Royal Berkshire Hospital
Royal Bolton Hospital
Royal Cornwall Hospital
Royal Derby Hospital
Royal Devon and Exeter NHS Foundation Trust
Royal Glamorgan Hospital
Royal Gwent Hospital

Royal Hampshire County Hospital
Royal Lancaster Infirmary
Royal Marsden Hospital Chelsea
Royal Marsden Hospital Sutton
Royal Stoke University Hospital
Royal Surrey County Hospital
Royal United Hospital
Salford Royal NHS Foundation Trust
Salisbury NHS Foundation Trust
Sandwell General Hospital
Scarborough General Hospital
Sherwood Forest Hospitals NHS Foundation Trust
Singleton Hospital
South Tees Hospitals NHS Foundation Trust
South Tyneside District Hospital
South Warwickshire NHS Foundation Trust
Southport and Ormskirk Hospital NHS Trust
St. George's Hospital
St. Helens and Knowsley Teaching Hospitals NHS Trust
St. Helier Hospital
St. Mary's Hospital Isle of Wight
St. Peter's Hospital
St. Richard's Hospital
St. Vincent's University Hospital Dublin
Stockport NHS Foundation Trust
Sunderland Royal Hospital
Surrey and Sussex Healthcare NHS Trust
Tameside Hospital NHS Foundation Trust
The Christie NHS Foundation Trust
The Dudley Group of Hospitals NHS Foundation Trust
The Great Western Hospital
The Hillingdon Hospitals NHS Foundation Trust
The Ipswich Hospital NHS Trust
The Leeds Teaching Hospitals NHS Trust
The London Clinic
The Mid Yorkshire Hospitals NHS Trust
The Newcastle upon Tyne Hospitals NHS Foundation Trust
The Pennine Acute Hospitals NHS Trust
The Rotherham NHS Foundation Trust
The Royal Bournemouth Hospital
The Royal Hallamshire Hospital
The Royal Liverpool and Broadgreen University Hospitals NHS Trust
The Royal Wolverhampton Hospitals NHS Trust
The Shrewsbury and Telford Hospital NHS Trust
The Whittington Hospital NHS Trust
The York Hospital
Torbay and South Devon NHS Foundation Trust
United Lincolnshire Hospitals NHS Trust
University College London Hospitals NHS Foundation Trust
University Hospital Aintree

University Hospital Lewisham
University Hospital Llandough
University Hospital of North Durham
University Hospital of South Manchester NHS Foundation Trust
University Hospital of Wales
University Hospital Southampton NHS Foundation Trust
University Hospitals Bristol NHS Foundation Trust
University Hospitals Coventry and Warwickshire NHS Trust
University Hospitals of Leicester NHS Trust
Walsall Healthcare NHS Trust
Warrington and Halton Hospitals NHS Foundation Trust
West Hertfordshire Hospitals NHS Trust
West Middlesex University Hospital
West Suffolk NHS Foundation Trust
Westmorland General Hospital
Weston Area Health NHS Trust
Wexham Park Hospital
William Harvey Hospital
Wirral University Teaching Hospital NHS Foundation Trust
Withybush General Hospital
Worcestershire Acute Hospitals NHS Trust
Worthing Hospital
Wrightington, Wigan and Leigh NHS Foundation Trust
Wye Valley NHS Trust
Yeovil District Hospital