National Comparative Audit of Blood Transfusion

2011 Audit of Blood Transfusion

in Adult Cardiac Surgery

St. Elsewhere's Hospital

Acknowledgements

We wish to thank all those who have participated in the 2011 Audit of Blood Transfusion in Adult Cardiac Surgery. We recognise that those giving up their valuable time have been many and that this will inevitably have been on top of a heavy workload. This audit would clearly not be possible without their support. We are equally grateful to many colleagues for their valuable and constructive comments.

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Contents

Executive Summary

Introduction

Previous audits of blood use in cardiac surgery have demonstrated significant variation between hospitals in the use of blood for similar operative procedures. This suggests there is inappropriate use of blood components in cardiac surgery which increases the risk of complications to patients and is a waste of a scarce and costly resource.

Methods

This audit set out to determine the transfusion practice for all adult patients undergoing cardiac surgery in the United Kingdom (UK) during a 3 month period in 2010. Data on each patient were obtained from the Cardiac Audit Database (CCAD) and blood transfusion laboratories. Patient identifiers were removed and the data sent to the National Comparative Audit of Blood Transfusion. An organisational audit collected information from each centre on blood loss management and transfusion guidelines.

Results

Clinical data were received from 25/38 (66%) of cardiac centres in the UK. Data on 6140 cardiac procedures were collected. Of these 6140 procedures, 3374 (55%) were CABG, 1231 (20%) were cardiac valve and 784 were CABG + valve (13%). The remaining 751 patients (12%) having other types of cardiac surgery were excluded, and among these were 353 who had undergone redo surgery. 68.3% of the CABG, cardiac valve and CABG + valve procedures were elective, 29.3% were urgent and 1.9% were emergency.

The range of usage of red blood cells and blood components was very wide across the different centres, e.g. for patients undergoing CABG, the mean use of red cells was 2.98 units (range 0-32), FFP 1.98 units (range 0-22), and platelets 1.85 units (range 0-23). There was similar variation in the proportion of CABG patients transfused e.g. between 22-67% patients received at least one unit of red cells across the different centres. The variation in use of blood and blood components was similar for the patients undergoing valve surgery or CABG + valve surgery. The mean number of red cells and blood components was lowest for CABG, and highest for CABG + valve with blood usage for valve surgery between the two.

17/38 (45%) centres returned an organisational survey about transfusion practice. 10/17 (59%) had a specific protocol for blood transfusion management in cardiac surgery. Only 2/17 (12%) had a protocol for assessment of patients for preoperative optimisation of Hb prior to elective cardiac surgery. Several centres stated they had no Hb trigger for red cell transfusion for patients either during cardiac bypass, post-bypass or for patients in intensive care. There was variation in the proportion of procedures for which intra-operative cell salvage was used, the proportion of patients treated with tranexamic acid, the use of thromboelastometry or thromboelastography for assessment of haemostasis, and the management of patients receiving anti-platelet therapy before surgery. 15/17 (80%) centres reviewed blood usage in cardiac surgery, but at variable intervals ranging from every month to annually.

Discussion

Previously published data for UK and non-UK adult cardiac surgery suggests that the variation in transfusion practice found in this national audit is as expected. Patient comorbidity and surgical complexity certainly accounts for some of the differences in transfusion rates for different operations. However, these alone do not adequately explain the three to ten - plus fold differences in blood usage between centres.

It is possible that there are significant differences in approach to the use of blood and blood components between centres. The organisational survey questioned a wide range of aspects of each centre's practices, and the results showed considerable differences between centres in the triggers for transfusion, the use of point of care testing, and in the use of measures to reduce and control haemorrhage. Furthermore, there were considerable differences between centres in the presence/absence of guidelines/protocols to identify and manage anaemia and haemostatic problems that occur in cardiac surgery patients perioperatively.

This audit has a range of limitations. It only includes data on 68% of UK adult cardiac surgical centres. The CCAD data on which it is based does not have data fully defining the clinical features of the patients undergoing surgery and their surgical treatment, nor detail of patients' short and long term outcomes both in relation to survival and post-surgical cardiovascular and other morbidity.

This audit should lead to future work defining UK cardiac surgical transfusion practice in greater detail and investigating how this may influence clinical outcomes. The wide range of transfusion practice found in this and other audits, and lack of evidence that this practice is linked to clinical benefit, merits further investigation. This would ideally involve a further audit constructed to ensure a 100% UK centre recruitment for the audit period, and to incorporate data on patient comorbidity, pharmacological treatment and surgical complexity. Furthermore, this should be linked to short to longer term data collection, and analysis of patient survival and other clinical outcomes. This would allow robust comparison of transfusion practice across UK centres, and for themes of best practice to be identified and national guidelines developed.

Summary of recommendations

Recommendation 1 – All centres should have a policy for the assessment and optimisation of Hb and anticoagulant and anti-platelet medication prior to cardiac surgery.

Recommendation 2 - All centres should have a protocol for the management of blood transfusion in cardiac surgery. This should include the triggers for transfusion, the use of intra-operative cell salvage, the use of anti-fibrinolytic drugs, and the assessment and management of bleeding.

Recommendation 3 – All centres should have standard operating procedures for near patient testing for the assessment of haemostasis in patients with excessive bleeding, supported by training and quality control assessment.

Recommendation 4 – All centres should conduct regular reviews of blood and blood component usage in cardiac surgery, and contribute data to future national audits of transfusion practice in cardiac surgery.

Recommendation 5 – Data on preoperative Hb and creatinine levels, and the amount of red blood cells, platelets, FFP and cryoprecipitate transfused should be added to the CCAD database and routinely collected to facilitate further audit of transfusion in cardiac surgery. Additionally, data on patients' short and long term outcomes, both in relation to survival and post-surgical cardiovascular and other morbidity, would assist in studies of the efficacy or otherwise of transfusion.

Introduction

Adult cardiac surgery utilises approximately 4% of all red cell transfusions [1]. Previous audits of blood use in cardiac surgery have demonstrated significant variation in the percentage of patients transfused with red cells and other blood components for similar operative procedures in apparently similar groups of patients [2] [3] [4].

A number of observational studies have demonstrated an increased risk of death and major complications in patients receiving transfusions around the time of cardiac surgery [5] [6].

Whilst both mechanical and pharmacological techniques have reduced the risk of exposure to red cell transfusion in routine, low risk elective coronary artery bypass graft (CABG) patients, many patients still receive red cells and other blood components. As cardiac surgery uses a significant percentage of blood components, it is important to ensure they are being used optimally and not unnecessarily.

Aims of the audit

The audit aims to define the transfusion practice for adult patients undergoing cardiac surgery in the United Kingdom (UK), as well as variation in practice between participating centres. An organisational audit was conducted to provide information on blood loss management and transfusion guidelines.

Audit standards

There are no defined standards for blood transfusion in cardiac surgery. The setting of standards may be possible after review of the results of this audit.

Methodology

Cardiac centres in the UK were asked to audit all adult patients having elective, urgent and emergency cardiac surgery within the period April, May and June 2010. CCAD* data is routinely held by cardiac centres, and data managers were asked to supply data from various CCAD data fields (see Appendix One). Data managers then passed these data to the Transfusion Laboratory Manager who supplied, for each patient, the preoperative Hb and creatinine levels (there was no limit as to when these were done as long as they preceded the day of operation), and how many units of red cells, FFP, platelets and cryoprecipitate were transfused in the period from the date of operation to the date of discharge/death. Data were then stripped of patient identifiers and sent to the National Comparative Audit of Blood Transfusion. An organisational questionnaire was available online for cardiac centres to complete (see Appendix Two).

**The National Institute for Cardiovascular Outcomes Research, based at University College London, operates the Central Cardiac Audit Database (CCAD), which collects information on cardiac surgical procedures. This is done in collaboration with the Society for Cardiothoracic Surgery and The British Congenital Cardiac Association.*

Results – Clinical Data

Please note that the data used in this report have not been risk adjusted

Participation

38 cardiac centres throughout the UK were invited to participate, with CCAD data received from 25 centres, giving a 66% participation rate. In total, data on 6140 cardiac procedures was collected. Of this 6140, 5389 (88%) had CABG, cardiac valve, or CABG + valve procedures covered by this audit *(see Table 2).*

Your site contributed data on 268 procedures

Table 1 – Participation of hospital sites by country

Participating sites	n	% of total
England	22	88%
Northern Ireland	1	4%
Scotland	2	8%

Population characteristics

Table 2 – Types of procedure

Procedures audited	National		Your site	
	n	%	n	%
CABG	3374	55%	**155**	**58%**
Valve	1231	20%	**66**	**25%**
CABG + Valve	784	13%	**26**	**10%**
Other	751	12%	**21**	**8%**
Total	**6140**	**100%**	**268**	**100%**

The data provided by centres are described in Table 2, but for the purposes of this audit the report concentrates on 3 cardiac surgical procedures in adult patients: Coronary Artery Bypass Grafts (CABG), Valve repair or replacement and CABG & Valve. Removing the 751 "Other" procedures leaves a total of 5389 cases to be audited. Among the 751 "Other" was 353 patients who had undergone redo surgery. Data on these cases were not included in the main analysis.

Table3 – Gender

Gender	National		Your site	
	n	%	n	%
Overall				
Male	4021	75%	**189**	**71%**
Female	1368	25%	**58**	**22%**
CABG				
Male	2763	82%	**126**	**67%**
Female	611	18%	**29**	**50%**

Table 4 – Age

Age	National		Your site	
	Range	Median	Range	Median
Overall				
Male	19-111	70	**30-92**	**70**
Female	21-96	75	**35-91**	**75**
CABG				
Male	36-94	69	**41-92**	**68**
Female	40-94	73	**50-91**	**70**
Age not stated	478 cases			

Table 5 – Operative urgency

Operative urgency	National		Your site	
	n	**%**	n	**%**
Elective	3682	68.3	**186**	**75%**
Urgent	1578	29.3	**61**	**25%**
Emergency	103	1.9	**0**	**0%**
Salvage	8	0.1	**0**	**0%**
Unknown	18	0.3	**0**	**0%**
Total	**5389**	100%	**247**	**100%**

Comment

These data are representative of UK cardiac surgical practice. It is of note that even with the dramatically improved access times to cardiological and cardiac surgical care in the last decade, almost a third of the cases of adult cardiac surgery in this audit occurred on an 'urgent' basis.

Urgent surgery may have a significant effect on the need for blood or blood component transfusion perioperatively due to lower pre-surgery Hb and the lack of time to discontinue any anticoagulants and anti-platelet agents which patients may be taking.

Table 6 – Patients transfused with Red Blood Cells

	National	Your site
No of units of RBC transfused	n patients	
0	2298	**170**
1	568	**22**
2	621	**28**
3	360	**8**
4	301	**6**
5	157	**3**
6-10	371	**8**
11-20	81	**1**
21+	40	**1**
Not stated	592	**0**
Total	**5389**	**247**

Table 7 – Patients transfused with Fresh, Frozen Plasma

	National	Your site
No of units of FFP transfused	n patients	
0	3706	**223**
1	122	**1**
2	389	**13**
3	55	**1**
4	242	**4**
5	18	**0**
6-10	100	**5**
11-20	21	**0**
21+	6	**0**
Not stated	730	**0**
Total	**5389**	**247**

Table 8 – Patients transfused with platelets

	National	Your site
No of units of platelets transfused	n patients	
0	3676	**220**
1	609	**1**
2	262	**23**
3	51	**1**
4	35	**1**
5	14	**0**
6-10	27	**1**
11-20	10	**0**
21+	2	**0**
Not stated	703	**0**
Total	**5389**	**247**

Table 9 – Patients transfused with cryoprecipitate

	National	Your site
No of units of Cryo transfused	n patients	
0	3544	**246**
1	80	**0**
2	92	**1**
3	8	**0**
4	14	**0**
5	7	**0**
6-10	4	**0**
11-20	1	**0**
21+	0	**0**
Not stated	1639	**0**
Total	**5389**	**247**

Table 10 – Blood component usage per procedure (CABG, Valve, CABG & Valve)

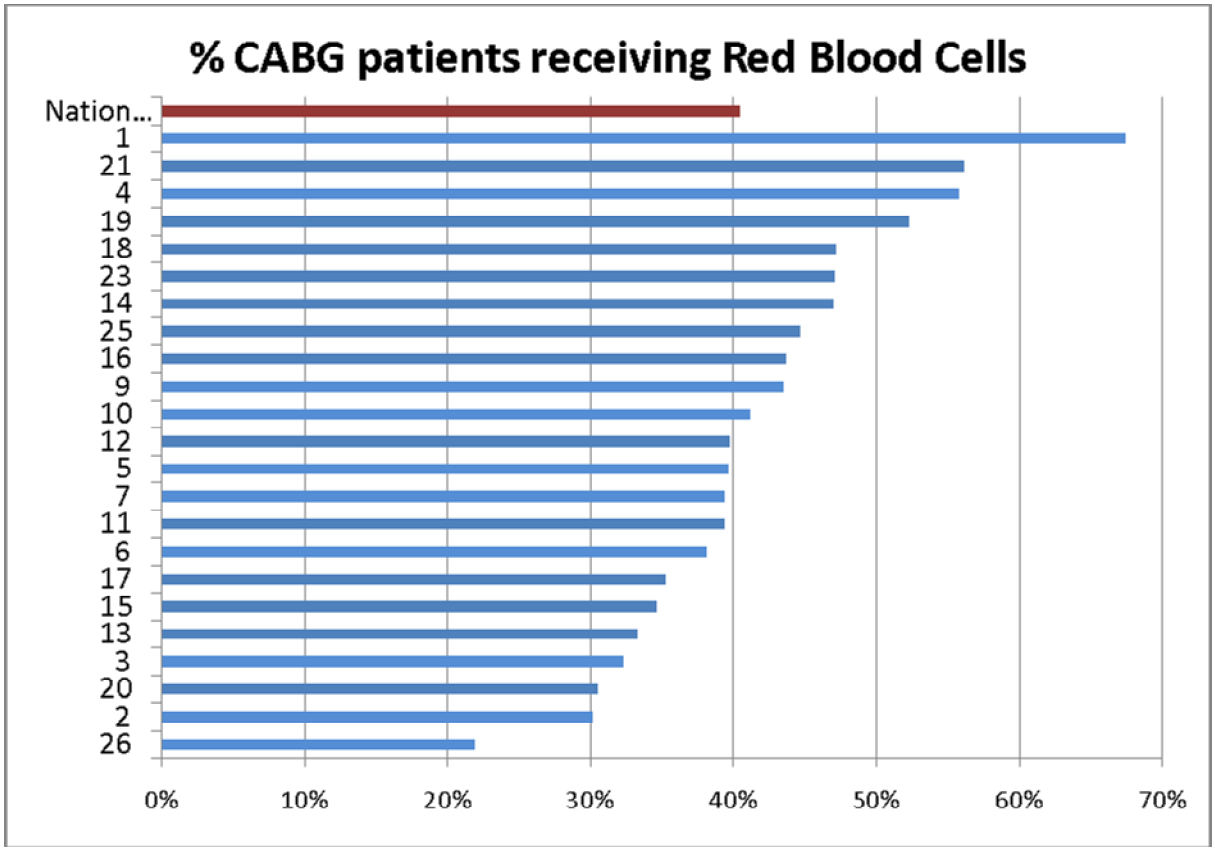
National				Your Site	
	Range	Mean		Range	Mean
CABG					
Red cells	0-32	2.98		**0-8**	**0.47**
FFP	0-22	1.98		**0-4**	**0.07**
Platelets	0-23	1.85		**0-2**	**0.12**
Cryoprecipitate	0-6	1.59		**0-2**	**0.01**
Valve					
Red cells	0-74	6.40		**0-21**	**1.65**
FFP	0-28	5.33		**0-8**	**0.68**
Platelets	0-12	4.90		**0-9**	**0.48**
Cryoprecipitate	0-12	0.10		**0**	**0**
CABG + Valve					
Red cells	0-49	9.62		**0-9**	**1.8**
FFP	0-37	8.04		**0-6**	**0.84**
Platelets	0-12	7.41		**0-2**	**0**
Cryoprecipitate	0-8	7.44		**0**	**0**

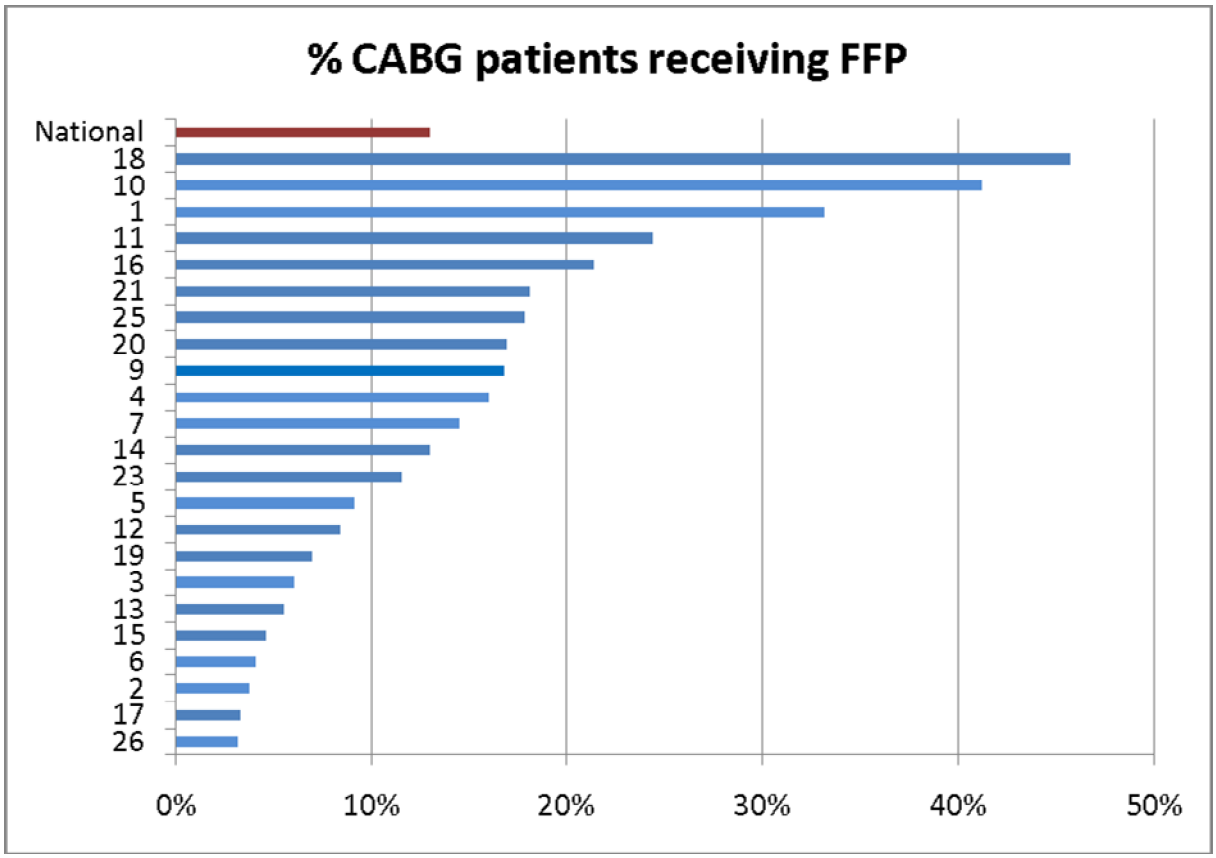
Comment

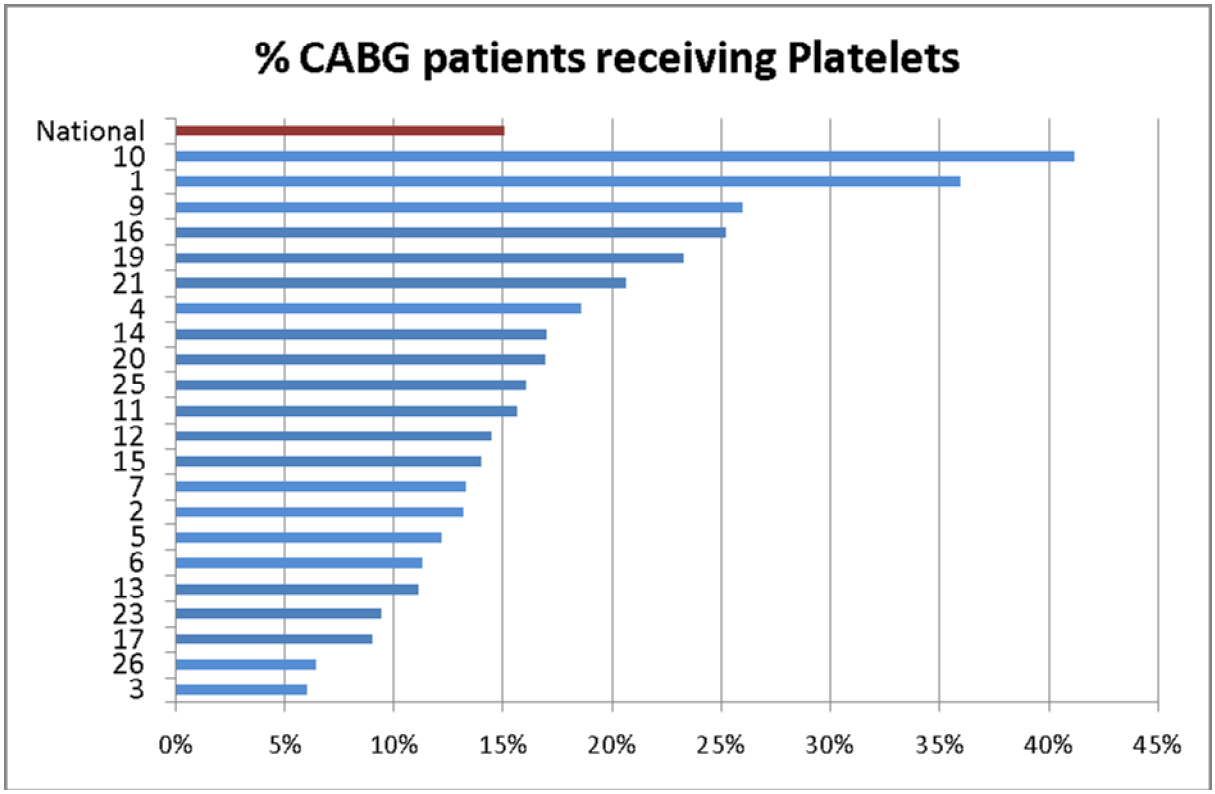
The 'range' of use of red cells and blood components is very wide. The data show, as expected, that patients having CABG & valve surgery are transfused more red cells and blood components than valve surgery alone patients, and patients having CABG surgery are transfused the least red blood cells and blood components.

In the following figures, the site identity has been anonymised with a code number. There is no site code for St. Elsewhere's Hospital.

Figure 1 - % of CABG patients receiving blood components





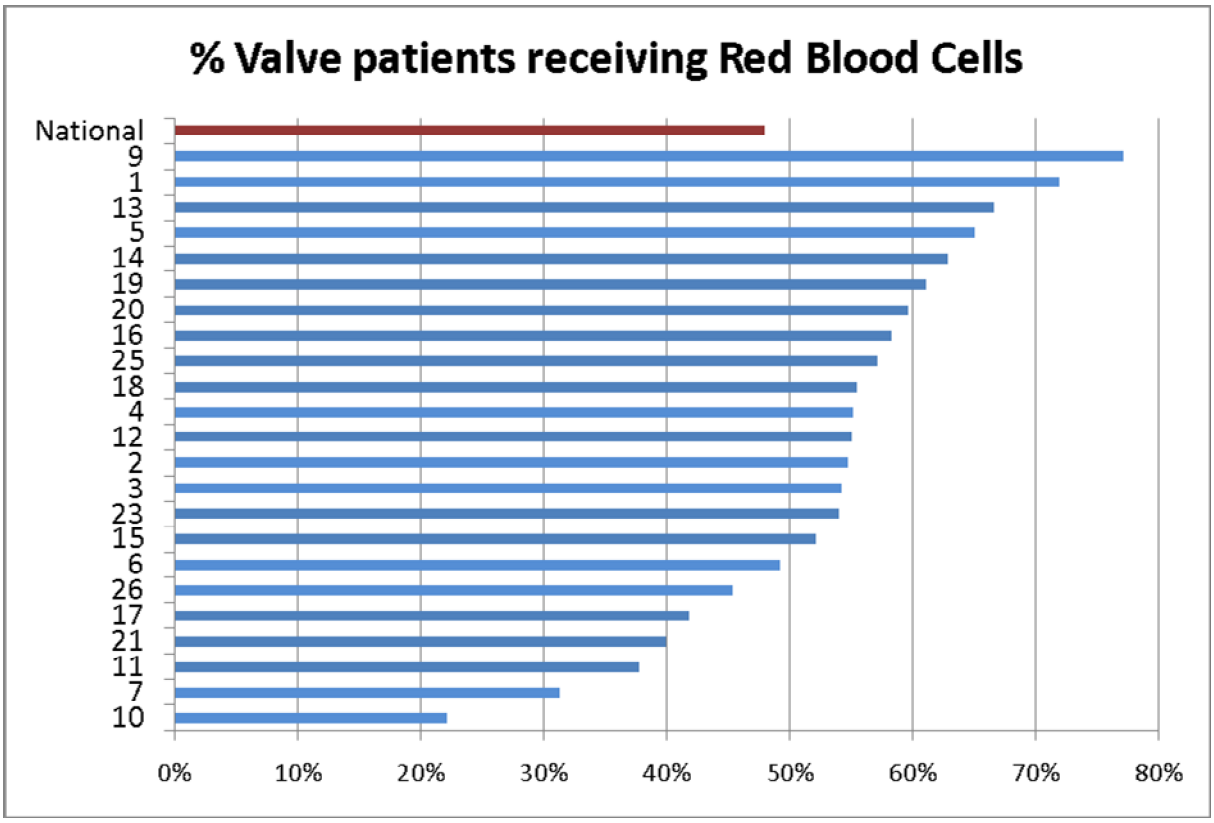


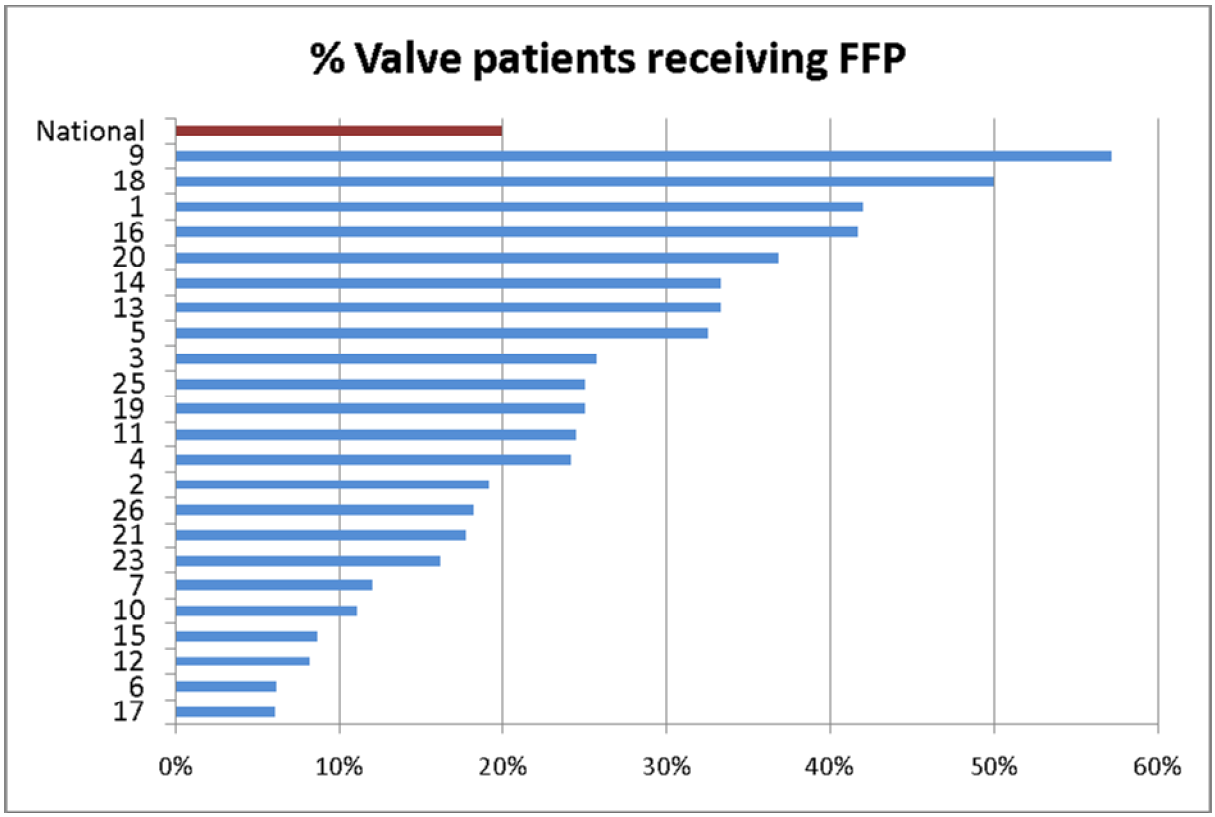
Comment

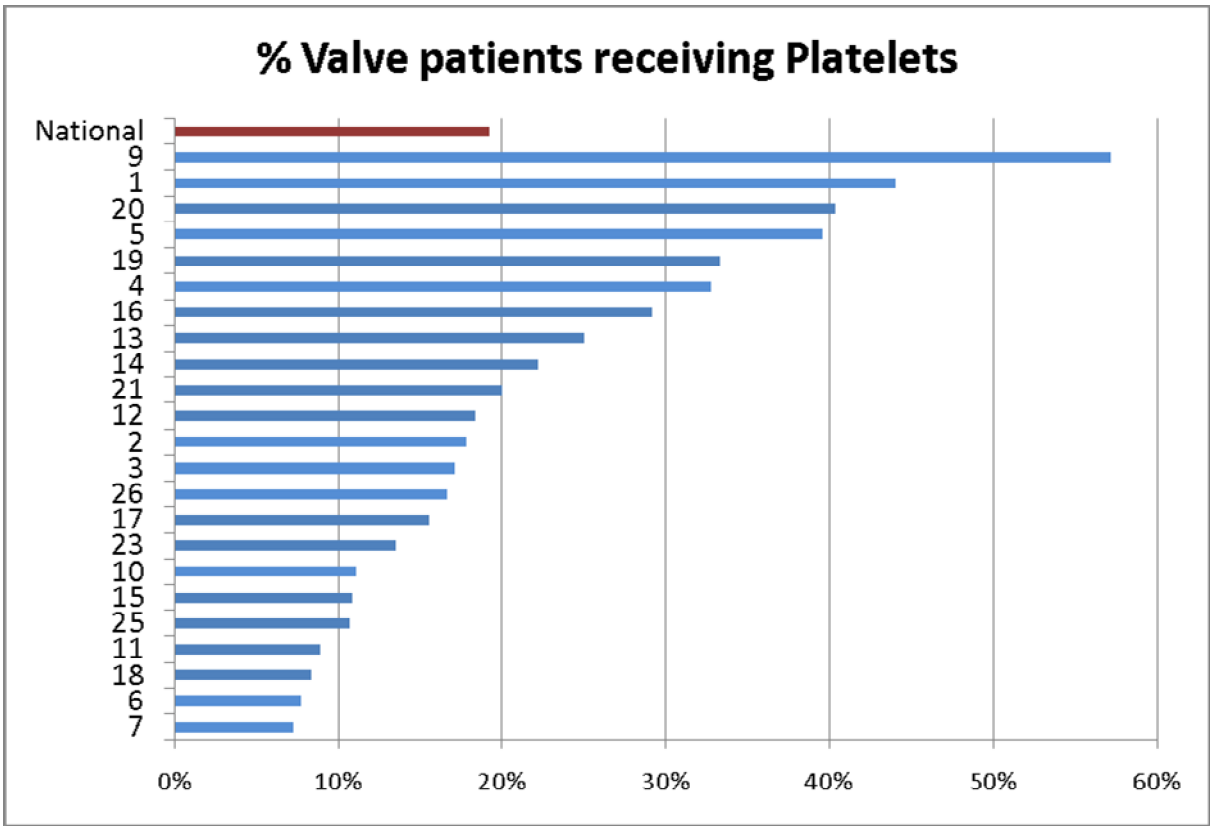
The percentages of patients being transfused with red cells varies from approximately 20-60%. The percentages of patients being transfused with platelets and FFP varies from approximately 5-45%.

The data from which this analysis is derived have not been corrected for differences in the patient populations in the different centres. Although there may be some variation in the clinical profiles of patients between different cardiac surgical centres, they are unlikely to provide an adequate explanation for the substantial differences in transfusion rates between centres. Each cardiac surgical centre can use this information to consider aspects of their surgical and transfusion practice and determine whether their use of blood could be reduced.

Figure 2 - % of valve patients receiving blood components





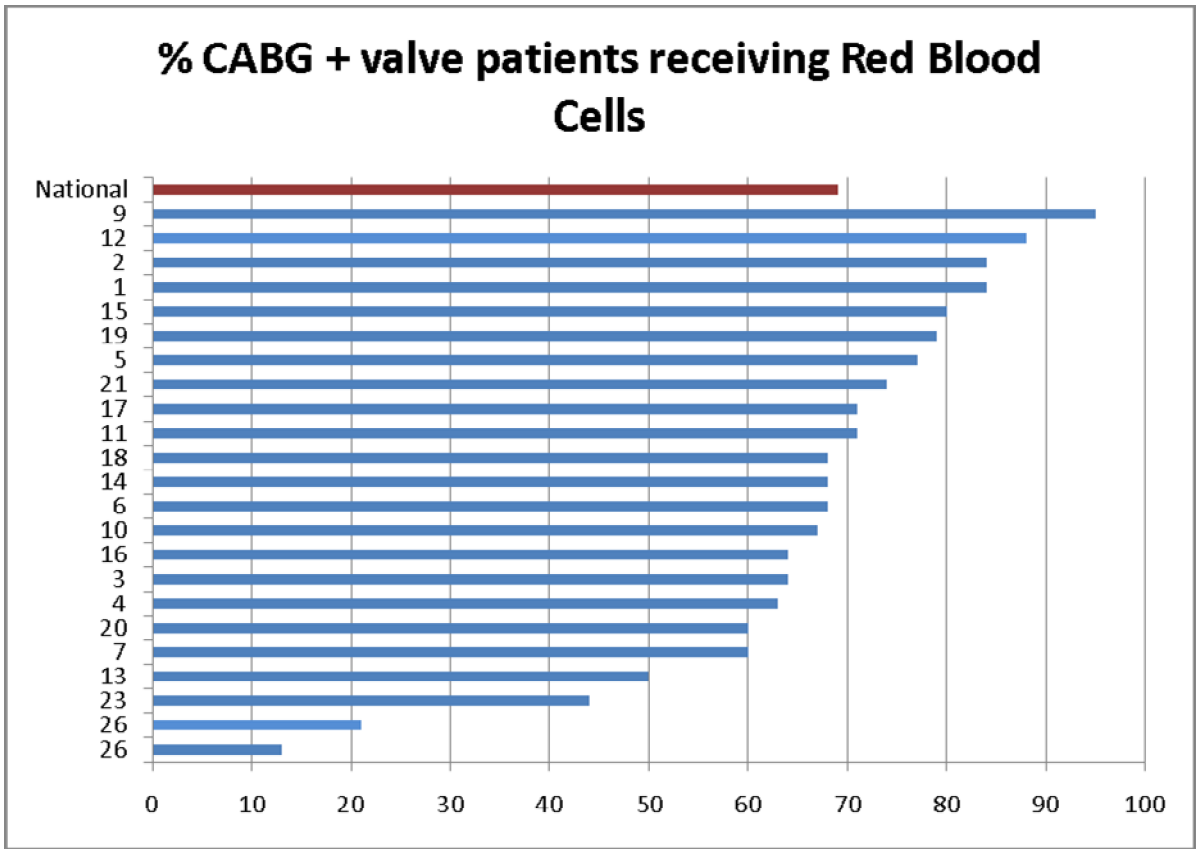


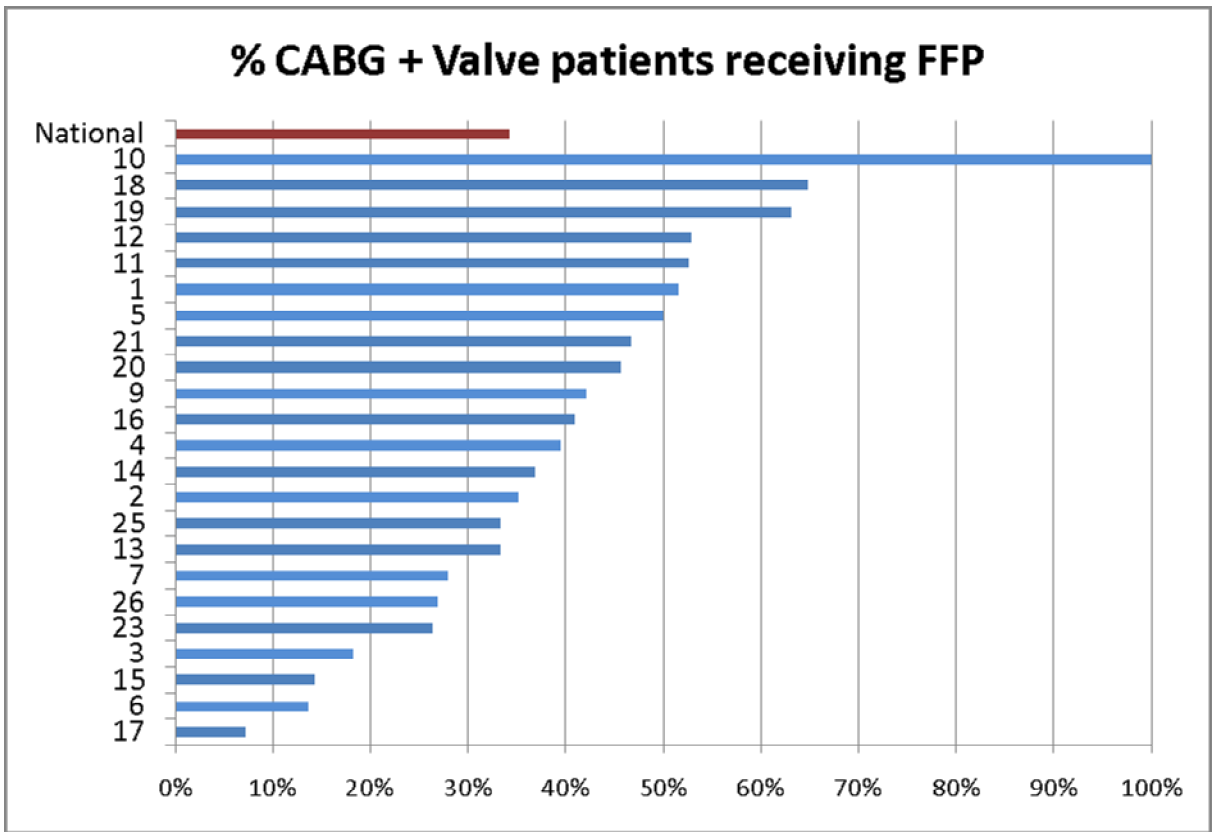
Comment

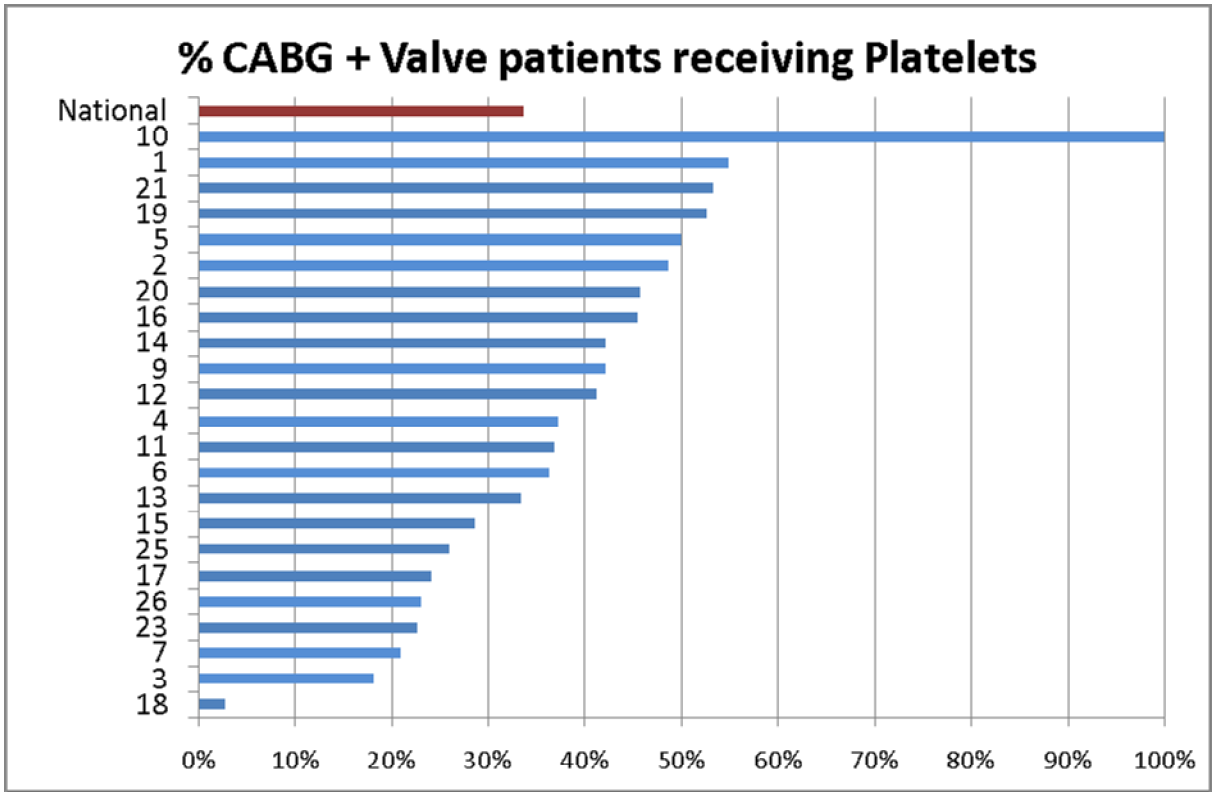
The percentages of patients being transfused with red cells, FFP and platelets vary considerably.

The data from which this analysis is derived have not been corrected for differences in the patient populations in the different centres. Although there may be some variation in the clinical profiles of patients between different cardiac surgical centres, they are unlikely to provide an adequate explanation for the substantial differences in transfusion rates between centres. Each cardiac surgical centre can use this information to consider aspects of their surgical and transfusion practice and determine whether their use of blood could be reduced.

Figure 3 - % of CABG + Valve patients receiving blood components







Comment

The percentages of patients being transfused with red blood cells, FFP and platelets vary quite considerably.

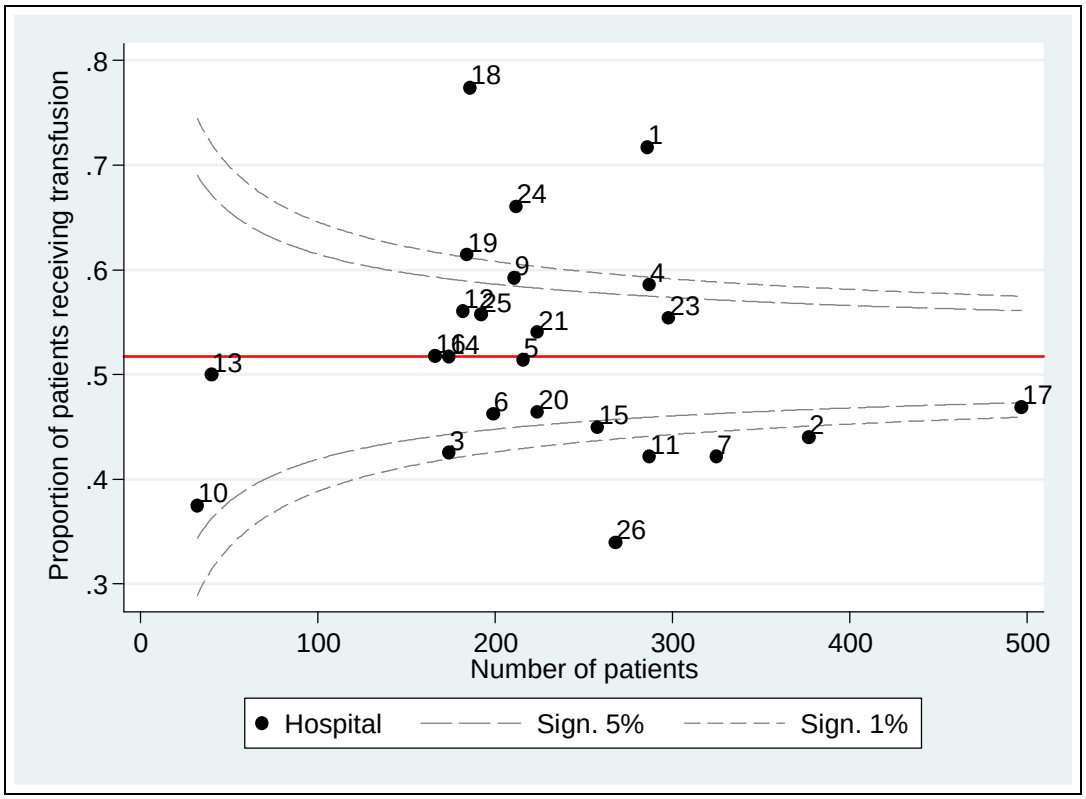
The data from which this analysis is derived have not been corrected for differences in the patient populations in the different centres. Although there may be some variation in the clinical profiles of patients between different cardiac surgical centres, they are unlikely to provide an adequate explanation for the substantial differences in transfusion rates between centres. Each cardiac surgical centre can use this information to consider aspects of their surgical and transfusion practice and determine whether their use of blood could be reduced.

Funnel Plots

The funnel plots below demonstrate the proportion of patients transfused with red cells, platelets and FFP. Transfusion exposure has not been adjusted for differences in patient caseload between units. Hatched lines represent 95% and 99% confidence intervals, as indicated, and were calculated using the asymptotic normal approximation for the binomial distribution.

Note: Missing data for platelets and FFP have been treated as indicating zero units. We have no data for site number 8

Figure 4 - Red cell transfusion

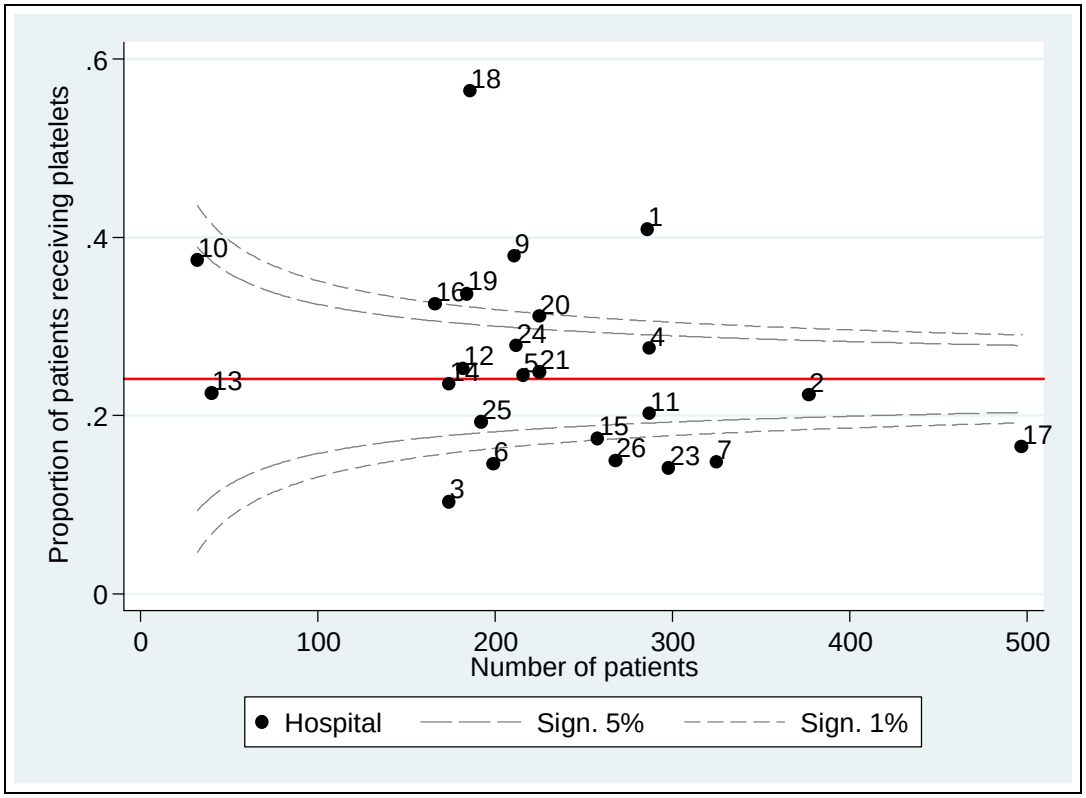


Comment

Seven cardiac centres were found to transfuse significantly more of their patients with red cells than expected and seven centres transfuse significantly less.

The data from which this analysis is derived have not been corrected for differences in the patient populations in the different centres. Although there may be some variation in the clinical profiles of patients between different cardiac surgical centres, they are unlikely to provide an adequate explanation for the substantial differences in transfusion rates between centres. Each cardiac surgical centre can use this information to consider aspects of their surgical and transfusion practice and determine whether their use of blood could be reduced.

Figure 5 – Platelets

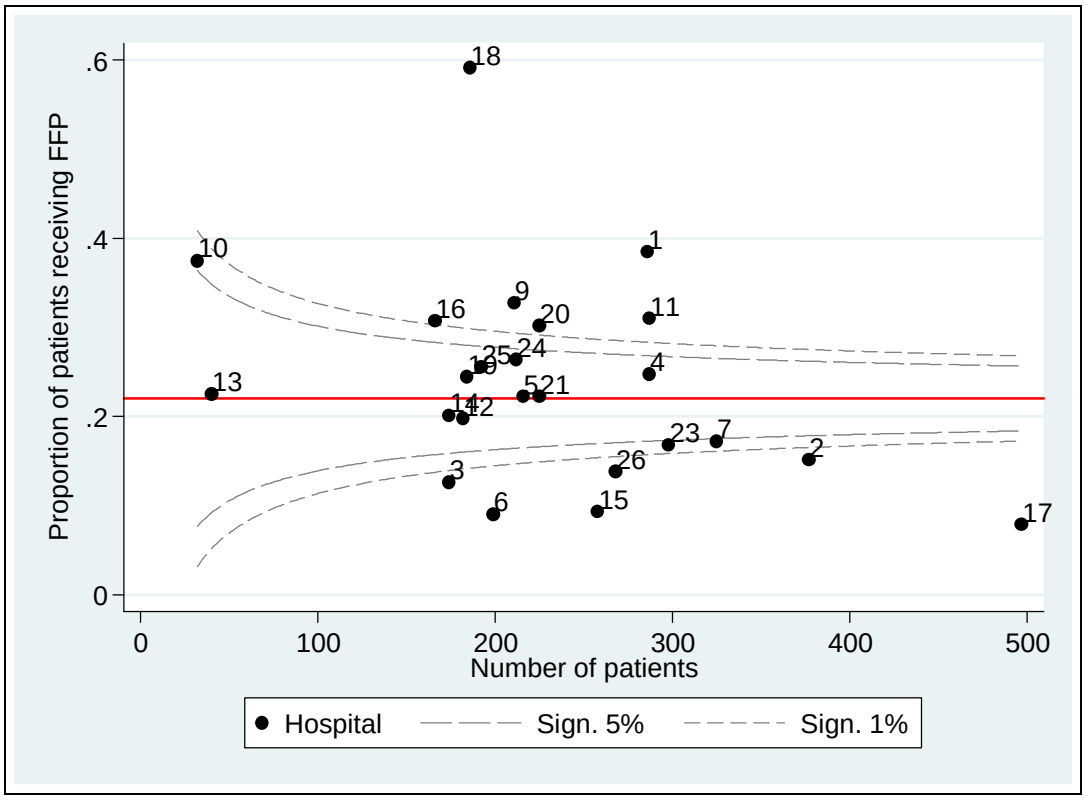


Comment

Five cardiac centres were found to transfuse significantly more of their patients with platelets than expected and nine centres transfuse significantly less.

The data from which this analysis is derived have not been corrected for differences in the patient populations in the different centres. Although there may be some variation in the clinical profiles of patients between different cardiac surgical centres, they are unlikely to provide an adequate explanation for the substantial differences in transfusion rates between centres. Each cardiac surgical centre can use this information to consider aspects of their surgical and transfusion practice and determine whether their use of blood could be reduced.

Figure 6 – FFP



Comment

Seven cardiac centres were transfusing significantly more of their patients with FFP than expected and eight centres transfuse significantly less.

The data from which this analysis is derived have not been corrected for differences in the patient populations in the different centres. Although there may be some variation in the clinical profiles of patients between different cardiac surgical centres, they are unlikely to provide an adequate explanation for the substantial differences in transfusion rates between centres. Each cardiac surgical centre can use this information to consider aspects of their surgical and transfusion practice and determine whether their use of blood could be reduced.

Results – Organisational Survey

Participating sites were asked to complete an online organisational survey to provide information on the context in which care is provided. 17/38 (45%) sites returned a questionnaire. Data are shown below each organisational questionnaire asked.

1. Do you have a specific protocol for blood transfusion management in cardiac surgery?
10/17 (59%) sites had a specific protocol.
Your site did not provide details

2. Do you have a protocol for assessment of patients for preoperative optimisation of haemoglobin (Hb) prior to elective cardiac surgery?
2/17 (12%) sites had a protocol.
Your site did not provide details

2a. If yes, estimate the proportion of patients preoperatively assessed for Hb optimisation.
One site assessed 76 – 100% of patients, while the other assessed 51 – 75 % of patients.

3. Do you have a stated Hb trigger for red cell transfusion for patients on CPB; patients post-CPB and patients in ICU?
Table 11

National	No trigger	<60 g/L	<70 g/L	<80 g/L	<90 g/L	Other*
Patients on CPB	5	4	6	2	-	-
Patients post-CPB	6	-	4	7	-	-
Patients in ICU	2	-	5	7	2	1

*Details not known

Table 12

Your site	
Patients on CPB	DK
Patients post-CPB	DK
Patients in ICU	DK

4. Estimate the proportion of procedures for which intra-operative cell salvage is used
Table 13

Number of sites using ICS, and the % of patients in which it is used		Your site
1-25%	1	DK
26-50%	5	DK
51-75%	2	DK
76-100%	9	DK

5. Estimate the proportion of patients given tranexamic acid

Table 14

Number of sites giving TA, and the % of patients in which it is used		Your site
1-25%	1	DK
26-50%	-	DK
51-75%	2	DK
76-100%	14	DK

6. Do you use Aprotinin?

5/17 (29%) sites use Aprotinin in addition to or instead of tranexamic acid, but no sites use Aprotinin routinely. It is used in the following groups of circumstances:-

- High risk of bleeding such as those undergoing complex valve surgery with history of previous cardiac surgery;
- Aortic surgery;
- High risk endocarditis in patients undergoing aortic surgery;
- Named patients only in particular circumstances, e.g. endocarditis;
- Complex redo procedures;
- Refractory bleeding;
- Acute endocarditis;
- Aortic dissection;
- Aortic arch replacement.

7. Products used for the management of excessive bleeding and protocols for their use

Sites were asked if they used and had a protocol for the use of Recombinant Factor VIIa, Prothrombin Concentrate Complex (PCC) and Fibrinogen concentrate.

Table 15

National (n = 17)	Used	Not used	No response	Have protocol	Do not have protocol	No response
Recombinant Factor VIIa	15	-	2	10	6	1
PCC	8	8	1	5	6	6
Fibrinogen	7	9	1	3	6	8
Your site	**Used**	**Not used**	**No response**	**Have protocol**	**Do not have protocol**	**No response**
Recombinant Factor VIIa	DK	DK	DK	DK	DK	DK
PCC	DK	DK	DK	DK	DK	DK
Fibrinogen	DK	DK	DK	DK	DK	DK

7a. Is anything else used for the management of bleeding?
Responses included: Sutures, Fresh Frozen Plasma (FFP), platelets, cryoprecipitate, Desmopressin (DDAVP), and Bioglue.

8. Estimate the proportion of procedures during which you use Thromboelastometry or Thromboelastography for assessment of haemostasis

Table 16

Number of sites using TEG or RoTEM, with proportion of procedures		Your site
None	2	DK
1-25%	4	DK
26-50%	3	DK
51-75%	2	DK
76-100%	6	DK

8a. If you do use TEG/RoTEM, then please answer the following:

Table 17 - 15/17 sites have operators, with some sites having more than one type of operator. 2 sites do not use TEG or RoTEM.

Who are your TEG/RoTEM operators?	n sites	Your site
Laboratory staff	-	DK
ODPs	8	DK
Anaesthetists	5	DK
Perfusionists	6	DK
Other	7	DK

Table 18- 15/17 sites using TEG/RoTEM responded

National	Yes	No	No response	Your site
Use approved by POC Testing committee?	12	2	1	**DK**
Have an SOP?	13	2	-	**DK**
Have a training programme & training log?	13	1	1	**DK**
Undertake regular quality control assessment?	14	-	1	**DK**

9 & 10. Do you have a protocol for the management of patients on warfarin?

Table 19

National	Yes	No	Your site
For elective cardiac surgery	13	4	**DK**
For emergency cardiac surgery	9	8	**DK**

11. Products used first line for immediate warfarin reversal

Table 20

National	Yes	No	Not stated	Your site
PCC	11	6	-	**DK**
FFP	11	5	1	**DK**
Solvent detergent-treated plasma	4	11	2	**DK**
Other	1	16	-	**DK**

12. Do you give vitamin K to patients needing warfarin reversal?
15 sites do give vitamin K while 2 do not.

13. Do you have a protocol for management of antiplatelet therapy in elective surgery?
13 sites do have a protocol while 4 do not.

14 – 15. The use of aspirin & Clopidogrel
Data from these questions are shown in Appendix Three. There was a wide range of responses to these questions.

16. Do you request platelets to be available prior to cardiac surgery in patients on anti-platelet drugs?
11 sites reported that the request platelets for selected patients which 6 never request platelets. Data on the use of platelets in selected patients is shown in Appendix Three.

If you request platelets for selected cases, for which categories of patients are they requested: On aspirin alone; On Clopidogrel alone; On combination therapy?
1 site requests platelets for emergency surgery only when patients are on aspirin alone. Where patients are on Clopidogrel alone, 3 sites request platelets for elective surgery while 5 request them for emergency surgery. 2 sites request platelets for both types of surgery.
Where patients are on combination therapy, 7 sites request platelets for elective surgery while 7 request them for emergency surgery. 5 sites request platelets for both types of surgery.

16a. Do you use platelets for selected cases not shown above? If so, please give details of other use
See Appendix Three

16b. If you transfuse platelets to patients on anti-platelet drugs, how many Adult Therapeutic Doses (ATDs) do you use?

Table 21 (n=11)

National	1 ATD used	2 ATDs used	No response	Your site
For elective cardiac surgery	7	2	2	DK
For urgent cardiac surgery	5	4	2	DK

17. Do you review blood and component usage data for cardiac surgery?
15 sites do review usage while 2 do not.

17i) If you review usage, how often is it reviewed?
8 sites review usage annually, 1 reviews it every 6 month, 3 review it every 3 months and 2 review it monthly. 1 site did not give details.

17ii) When you review usage data, where are the data presented?
7 sites review it at the Hospital Transfusion Committee as well as at a meeting of cardiac surgeons and anaesthetists, while 4 sites only review it at a meeting of cardiac surgeons and anaesthetists.

If data are reviewed at another meeting, give details.
See Appendix Four for details

17iii) When reviewed data are presented, what kinds of data are shown?

Table 22

National	Yes	No	Your site
Proportion of patients transfused by specific procedure and/or by individual surgical teams	10	7	**DK**
Median/mean blood component usage by specific procedure and/or by individual surgical teams	7	10	**DK**
Other	6	0	**DK**

If other data are presented, give details:

- Blood wastage figures;
- Breaches of Blood Safety Quality Regulations;
- Proportion of patients transfused;
- Use of platelets by speciality and by surgeon;
- Reason for transfusion and perioperative data.

If data are reviewed at another meeting, give details

6 sites additionally review data, as follows:

- HTC meets every 2 months and reviews unit use overall. In house annual meeting reviews use and per patient transfusion, etc.
- The data are collated and reviewed at quarterly "blood interest meetings" which involve haemovigilance practitioners, theatre and CSICU nursing staff and anaesthetists (but rarely surgeons)
- Circulated to individual surgeons and anaesthetists with individual doctor comparisons
- The divisional governance meeting is a forum for presentation of blood and blood product review but not set at annual review specifically
- The data are presented by the Medical Director at the Hospital's Medical Advisory Committee meeting.
- Emailed to anaesthetists and intensivists. Occasionally to surgeons.

Comments:
It is of concern that only just over half the sites had a protocol specifically covering blood management in cardiac surgery. While a protocol or guideline will not assist in the management of all (especially complex) patients, it may help with reducing variation in practice and minimise the use of blood and inappropriate transfusion. Only 2 of the 17 sites responding had protocols for testing for and management of anaemia preoperatively. This represents a missed opportunity to optimise the preoperative Hb by administering oral or intravenous iron if required. The implementation of agreed local guidelines for red cell transfusion based on evidence based guidelines [7] in non-bleeding patients should reduce variation in practice.

Centres should also have an agreed approach to haemostasis management in patients undergoing cardiac surgery. This should include preoperative risk assessment together with a defined strategy for management of anticoagulant and antiplatelet therapy [7] [8] [9]. The majority of the 17 centres responding do use near patient global testing for haemostasis (TEG/RoTEM), although there was considerable variation in the proportion of procedures where testing was carried out.

Most centres review blood usage in cardiac surgery although the frequency of review varied from monthly to annually. The data reviewed included both the proportion of patients transfused by specific procedure and/or by individual surgical teams in 10/17 centres and the median/mean blood component usage by specific procedure and/or by individual surgical teams in 7/17 centres.

Discussion & Recommendations

Previously published data for UK and non-UK adult cardiac surgery suggests that the variation in transfusion practice found in this national audit is as expected. [2-4] [10] Patient comorbidity and surgical complexity certainly accounts for some of the differences in transfusion rates for different operations. However, these alone do not adequately explain the three to ten - plus fold differences in blood usage between centres.

It is possible that there are significant differences in approach to the use of blood and blood components between centres. The organisational survey questioned a wide range of aspects of each centre's practices, and the results showed considerable differences between centres in the triggers for transfusion, the use of point of care testing, and in the use of measures to reduce and control haemorrhage. Furthermore, there were considerable differences between centres in the presence/absence of guidelines/protocols to identify and manage anaemia and haemostatic problems that occur in cardiac surgery patients perioperatively.

This audit has a range of limitations. It only includes data on 68% of UK adult cardiac surgical centres. The CCAD data on which it is based does not have data fully defining the clinical features of the patients undergoing surgery and their surgical treatment, nor detail of patients' short and long term outcomes both in relation to survival and post-surgical cardiovascular and other morbidity.

The results of the organizational questionnaire highlight the need for action in certain key areas. First, it is recommended that all centres should have a policy for the detection and timely correction of anaemia preoperatively in patients undergoing elective cardiac surgery. A recent UK study showed that preoperative anaemia is a strong predictor of increased transfusion requirement, risk of ICU stay and death during cardiac surgery. [11]

All centres should also have a protocol for management of antithrombotic therapy in patients undergoing cardiac surgery. It is recommended that patients should have a preoperative risk assessment for thromboembolism and bleeding. There are UK guidelines for the management of surgery in patients on oral anticoagulants and these in particular promote the use of prothrombin complex concentrate rather than FFP for emergency reversal of warfarin. [7] [8] [9] There appears to be significant variation in relation to the management of anti-platelet therapy prior to elective surgery: the availability of protocols will help promote a more standardized approach both within and between centres. Centres should have standard operating procedures for near patient testing supported by training and quality control assessment, and algorithms to guide blood component management based on near patient testing results.

The regular review of data in relation to use of blood and components in cardiac surgery within each centre can help highlight any significant variation in transfusion practice and, supported by a local transfusion protocol, can be a real driver for change.

This would promote more appropriate use of blood and blood components and also the implementation of transfusion avoidance strategies which are being promoted as part of the national Patient Blood Management initiative. [12]

The organisational survey collected data on a wide range of aspects relating to patient haematological assessment and management perioperatively. There was a range in the numbers of centres providing detail around different aspects of the survey. There are considerable differences between centres in the use of assessment/testing, in the use of pharmacological/haematological adjuncts to reduce and control haemorrhage, and in the use of mechanical adjuncts to reduce haemorrhage and transfusion. The variability of responses and the range of sites that organisational data was gathered in makes it challenging to perceive themes of practice and to try and define elements of best practice. If further, and potentially more detailed, audit of transfusion practice is undertaken, then this could include obtaining this organisational data from all UK adult cardiac centres. In the presence of centre specific data linked to more information about surgical patient population and surgical procedure complexity, it may be possible to make recommendations about some aspects of the organisation of perioperative transfusion practice.

Data on preoperative Hb and creatinine levels, and the amount of red blood cells, platelets, FFP and cryoprecipitate transfused should be added to the CCAD database and routinely collected to facilitate further audit of transfusion in cardiac surgery. Additionally, data on patients' short and long term outcomes, both in relation to survival and post-surgical cardiovascular and other morbidity, would assist in studies of the efficacy or otherwise of transfusion.

Conclusions

This report presents data derived from an audit and organisational survey enquiring into transfusion practice in adult cardiac surgery in the UK.

Data were requested from 38 centres performing adult cardiac surgery in the UK. Data was provided by 25 of these centres, for the months of April to June inclusive, during 2010. The data was collated into the audit database from data which was collected prospectively at each of the sites performing cardiac surgery.

Data was gathered by selecting data submitted as part of the CCAD dataset and linking this to the transfusion database of the cardiac surgical centres.

Data was submitted on 6140 patients. The audit was designed to collect data on patients having one of three categories of operation; coronary artery bypass grafting [CABG] only; cardiac valve repair or replacement only surgery; and CABG with cardiac valve repair or replacement. Data selected for further audit excluded patients having surgery outside of the three defined operative categories. Therefore data on 5389 patients was included for further analysis. This total included 3374 patients having CABG surgery; 1231 patients having valve repair/replacement surgery and 784 patients having CABG and valve repair/replacement surgery. This audit set is 5389/28508 (19%) of adult patients having cardiac surgery with data submitted to the CCAD database for the UK in 2010.

In audited patients having CABG alone, 43% of patients overall were transfused with allogeneic red blood cells with a range of 22% to 67% of patients when considered by centre [mean number of units transfused were 2.98]. In the same patient group, 13% of patients overall were transfused with Fresh Frozen Plasma with a range of 3% to 46% of patients when considered by centre [mean number of units transfused were 1.98]. Finally, in the same patient group, 16% of patients overall were transfused with platelets with a range of 4% to 42% of patients when considered by centre [mean number of units transfused were 1.85].

In audited patients having valve repair/replacement surgery alone, 52% of patients overall were transfused with allogeneic red blood cells with a range of 22% to 78% of patients when considered by centre [mean number of units transfused were 6.40]. In the same patient group, 23% of patients overall were transfused Fresh Frozen Plasma with a range of 7% to 57% of patients when considered by centre [mean number of units transfused were 5.33]. Finally in the same patient group, 21% of patients overall were transfused with platelets with a range of 7% to 57% of patients when considered by centre [mean number of units transfused were 4.90].

In audited patients having CABG with valve repair/replacement surgery, 72% of patients overall were transfused with allogeneic red blood cells with a range of 13% to 95% of patients when considered by centre [mean number of units transfused were 9.62].

In the same patient group, 32% of patients overall were transfused with Fresh Frozen Plasma with a range of 7% to 100% of patients when considered by centre [mean number of units transfused were 8.04]. Finally in the same patient group, 32% of patients overall were transfused with platelets with a range of 3% to 100% of patients when considered by centre [mean number of units transfused were 7.41].

Patient comorbidity, pharmacological treatment and perioperative and surgical complexity will account for some of the differences in transfusion rates for different operations and different allogeneic components of blood. However, there is a three to ten plus fold difference in transfusion likelihood for patient populations between centres. It is likely that there are significant differences in approach to the use of allogeneic red cells and other allogeneic blood component between centres.

Previously published data for UK and non-UK adult cardiac surgery suggests that the findings of this audit for mean percentage of patients transfused red cells, FFP and platelets are within the range to be expected [2-4] [10]. The features and extent of worsened outcome for patients who receive allogeneic transfusion peri-cardiac surgery are well defined [5] [6]. With this evidence, the wide range of transfusion practice, and lack of evidence that this practice is linked to need or benefit, merits further investigation.

This audit should lead to future work defining UK cardiac surgical transfusion practice in greater detail and investigating how this may influence clinical outcomes. This would ideally involve a further audit constructed to ensure a 100% UK centre recruitment for the audit period, and to incorporate data on patient comorbidity, pharmacological treatment and surgical complexity. Furthermore, this should be linked to short to longer term data collection and analysis of patient survival and other clinical outcomes. This would allow robust comparison of transfusion practice across UK centres, themes of best practice to be identified and national guidelines developed.

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Appendix One – CCAD Dataset

CCAD Sequence & Field Name	CCAD Sequence & Field Na
1.01 Hospital	3.33 Native Tricuspid valve other path
1.06 Date of Birth	3.34 Native Pulmonary valve other path
1.07 Gender	3.35 Reason Repeat aortic valve replacement
1.08 Administrative Category	3.36 Reason Repeat Mitral valve replacement
2.01 Angina Status Pre-Surgery	3.37 Reason Repeat Tricuspid valve replacement
2.02 Dyspnoea Status Pre-Surgery	3.38 Reason Repeat Pulmonary valve replacement
2.03 N Previous MIs	3.39 Other Reason for Repeat Aortic Valve Replacement
2.04 Interval between Surgery and last MI	3.40 Other Reason for Repeat Mitral Valve Replacement
2.05 Previous PCI	3.41 Other Reason for Repeat Tricuspid Valve Replacement
2.07 Previous Surgical Interventions	3.42 Other Reason for Repeat Pulmonary Valve Replacement
2.08 Date Last Cadiac Operation	3.43 Aortic Valve Procedure
2.09 Diabetes Management	3.44 Mitral Valve Procedure
2.10 Hx of Hypertension	3.45 Tricuspid Valve Procedure
2.11 Smoking Status	3.46 Pulmonary Valve Procedure
2.12 Renal Disease	3.47 Aortic Valve Implant Type
2.13 Hx of Pulmonary Disease	3.48 Mitral Valve Implant Type
2.14 Hx of Neurological Disease	3.49 Tricuspid Valve Implant Type
2.16 Hx of Neurological Dysfunction	3.50 Pulmonary Valve Implant Type
2.17 Extracardiac arteriopathy	3.51 Aortic implant prosthesis name
2.18 Pre operative heart rhythm	3.52 Aortic implant prosthesis model
2.19 Left or right Heart Catheterisation	3.53 Aortic valve or ring serial number
2.20 Date Last Catheterisation	3.54 Aortic valve or ring size
2.21 Extent of Coronary Vessel Disease	3.55 Mitral implant prosthesis name
2.22 Left Main Stem Disease	3.56 Mitral implant prosthesis model
2.23 PA Systolic	3.57 Mitral valve or ring serial number
2.24 AO Valve Gradient	3.58 Mitral valve or ring size
2.27 Ejection Fraction	3.59 Tricuspid implant prosthesis name
2.28 LV Ejection Fraction Category	3.60 Tricuspid implant prosthesis model
2.29 IV Nitrates	3.61 Tricuspid valve or ring serial number
2.30 Cardiogenic Shock Preop	3.62 Tricuspid valve or ring size
2.31 IVInotropes	3.63 Pulmonary implant prosthesis name
2.32 Ventilated Preop	3.64 Pulmonary implant prosthesis model
2.33 IABP	3.65 Pulmonary valve or ring serial number
2.34 IABP Indication	3.66 Pulmonary valve or ring size
2.35 Operative Urgency	3.67 N Aortic Segments operated on
2.36 N Previous Heart Operations	3.68 Ao Root Path
2.37 Height	3.69 Ao Root Proc
2.38 Weight	3.70 Ao Ascending Path
3.01 Admission Date	3.71 Ao Ascending Proc
3.02 Procedure Date	3.72 Ao Arch Path
3.03 Responsible Consultant Surgeon	3.73 Ao Arch Proc
3.04 Responsible Consultant Anaesthetist	3.74 Ao Descending Path
3.05 First Operator	3.75 Ao Descending Proc
3.06 First Operator Grade	3.76 Ao Abdominal Path
3.07 First Operator - Calman Year	3.77 Ao Abdominal Proc
3.08 First Assistant	3.78 Cardiopulmonary bypass
3.09 First Assistant Grade	3.79 Myocardial Protection
3.10 First Assistant - Calman Year	3.80 Cardioplegia solution
3.11 Cardiac Procedures	3.81 Cardioplegia temperature
3.12 Other Cardiac Procedures	3.82 Cardioplegia infusion mode
3.14 NGrafts	3.83 Cardioplegia timing
3.15 Graft site	3.84 Non cardioplegic protection
3.16 Graft conduit	3.85 Cumulative Bypass time
3.17 Graft Anastomos	3.86 Cumulative cross clamp time
3.18 NValves Repaired/Replaced	3.87 Circulatory arrest time
3.19 Aortic Valve Haemodynamics	4.01 Reoperation
3.20 Mitral Valve Haemodynamics	4.06 Discharge Date
3.21 Tricuspid Valve Haemodynamics	Pre-Op HB
3.22 Pulmonary Valve Haemodynamics	Pre-Op Creatinine
3.23 Aortic Valve Explant	Red Blood Cell Units
3.24 Mitral Valve Explant	FFP
3.25 Tricuspid Valve Explant	Platelets Transfused
3.26 Pulmonary Valve Explant	Cryoprecipitate Transfused
3.27 Native Aortic Valve Path	
3.28 Native Mitral Valve Path	
3.29 Native Tricuspid Valve Path	
3.30 Native Pulmonary Valve Path	
3.31 Native aortic valve other path	
3.32 Native Mitral valve other path	

Appendix Two – Organisational questionnaire

1. Do you have a specific protocol for blood transfusion management in cardiac surgery? **Yes** **No**

2. Do you have a protocol for assessment of patients for preoperative optimisation of haemoglobin (Hb) prior to elective cardiac surgery? **Yes** **No**

2a. If Yes, please estimate the proportion of patients preoperatively assessed for Hb optimisation. *(circle one option)*

None **1 – 25%** **26 – 50%** **51 – 75%** **76 – 100%**

3. Do you have a stated Hb trigger for red cell transfusion for the following? *(Please tick as appropriate)*

						If yes, please indicate trigger level									
On CPB	Yes		No			<60 g/l		<70 g/l		<80 g/		<90 g/l		Other	
Post CPB	Yes		No			<60 g/l		<70 g/l		<80 g/		<90 g/l		Other	
In ITU	Yes		No			<60 g/l		<70 g/l		<80 g/		<90 g/l		Other	

4. Please estimate proportion of procedures for which intra-operative cell salvage is used.

None **1 – 25%** **26 – 50%** **51 – 75%** **76 – 100%**

5. Please estimate the proportion of patients given tranexamic acid.

None **1 – 25%** **26 – 50%** **51 – 75%** **76 – 100%**

6. Do you use aprotonin? **Yes** **No**

6a. If Yes, please state in which patients:

7. Do you use the following for the management of excessive bleeding?

						If yes, do you have a protocol?			
Recombinant factor VIIa	Yes		No			Yes		No	
Prothrombin Complex Concentrate	Yes		No			Yes		No	
Fibrinogen concentrate	Yes		No			Yes		No	

7a. If you use anything else for the management of excessive bleeding, please give details below. Otherwise, please leave blank.

8. Please estimate proportion of procedures during which you use Thromboelastometry or Thromboelastography for assessment of haemostasis.

None **1 – 25%** **26 – 50%** **51 – 75%** **76 – 100%**

8a. If you do use TEG/RoTEM then please answer following:

i) Who are the operators? *(Circle as many as apply)*

Lab staff **ODPs** **Anaesthetists** **Perfusionists** **Other**

ii) Is use approved by Trust Point of Care Testing Committee? **Yes** **No**

iii) Do you have a Standard Operating Procedure? **Yes** **No**

iv) Do you have a training programme and training log? **Yes** **No**

v) Do you undertake regular quality control assessment? **Yes** **No**

9. Do you have a protocol for management of patients on warfarin for *elective* cardiac surgery? **Yes** **No**

10. Do you have a protocol for management of patients on warfarin for *emergency* cardiac surgery? **Yes** **No**

11. Do you use any of these products first line for immediate warfarin reversal?

i) Prothrombin Complex Concentrate **Yes** **No**

ii) Fresh Frozen Plasma **Yes** **No**

iii) Solvent detergent treated plasma e.g. Octaplas **Yes** **No**

iv) Other **Yes** **No**

12. Do you **also give** Vitamin K to patients needing warfarin reversal? **Yes** **No**

13. Do you have a protocol for management of antiplatelet therapy in elective surgery? **Yes** **No**

14. Do you stop aspirin in all patients undergoing elective surgery? **Yes** **No**

14a. If No, in which patients do you continue aspirin?

14b. If Yes, how many days before surgery do you stop aspirin? *(Circle one response)*

3 days **5 days** **Other**

15. Do you stop Clopidogrel in all patients undergoing elective surgery? **Yes** **No**

15a. If No, in which patients do you continue clopidogrel?

15b. If Yes, how many days before surgery do you stop clopidogrel?

3 days **5 days** **Other**

16. Do you request platelets to be available prior to cardiac surgery in patients on antiplatelet drugs? *(Circle one response)*

For selected cases **Never**

If "For selected cases", is this for patients:

	Elective surgery					*Emergency surgery*			
On aspirin alone	Yes		No			Yes		No	
On Clopidogrel alone	Yes		No			Yes		No	
On combination therapy	Yes		No			Yes		No	

16a. Does your "For selected cases" include use for other patients?
(*If so,* please *specify, otherwise leave blank)*

16b. If you transfuse platelets for patients on anti-platelet drugs, how many ATDs* do you use?

Elective surgery ____ Urgent surgery ____

**ATD – adult therapeutic dose of platelets*

17. Do you review blood and component usage data for cardiac surgery? **Yes** **No**

If yes, please state

i) How often? **Annually** **Every 6 months** **Every 3 months** **Monthly**

ii) Where are the data presented? *(Tick as many as apply)*

Hospital Transfusion Committee

Meeting of cardiac surgeons and anaesthetists

Other – please state

iii) What data are presented? *(Tick as many as apply)*

Proportion of patients transfused by specific procedure and/or by individual surgical teams

Median/mean blood component usage by specific procedure and/or by individual surgical teams

Other – please state

Appendix Three – The use of Aspirin and Clopidogrel

14. Do you stop aspirin in all patients undergoing elective surgery?
5 sites do stop aspirin while 12 do not.

For those that continue aspirin, they do so in a range of patients, including all patients and those at high risk. A full range of responses can be seen at Appendix Three.

All patients
All patients undergoing coronary artery bypass grafting
The default position is to continue aspirin except in exceptional circumstances
If patients are on Aspirin Multiplate Platelet Function analysis and TEG are routinely performed.
Operator dependent and varies from not stopping to 7 days and patient symptom and disease related
Surgeons' preference but most patients continue aspirin
Recent stenting
Patent stents or critical lesions in proximal vessels
Port access cases and some named patients at consultants discretion All other cases stop 7 days before surgery
High risk patients. Stents. Urgent cases scheduled at short notice.
Unstable angina, IABP insertions, Left main stem lesions and for inpatients at the discretion of the cardiologist

14b. If you stop aspirin, how many days before surgery do you stop it?
Those that do stop aspirin stop at either 5 days before surgery or at some other, unspecified time period.

15. Do you stop Clopidogrel in all patients undergoing elective surgery?
13 sites do stop Clopidogrel while 4 do not.

For those that continue Clopidogrel, they do so in

- Critical stenoses and patent stents may on occasions continue until surgery.
- Would continue if severe coronary disease or drug eluting stent in situ.
- Recent coronary artery stents
- If patients are on Clopidogrel, Multiplate Platelet Function analysis and TEG are routinely performed.
- Patients inserted with Drug-Eluting stent within 12 months

15b. If you stop Clopidogrel, how many days before surgery do you stop it?
Those that do stop Clopidogrel stop at either 5 days or 3 days before surgery or at some other, unspecified time period.

16a. If the use of platelets for selective cases is not covered by the table above, for what other reasons are they used?

- If there was a potential problem for elective surgery then we might request availability pre-op if on Aspirin or Clopidogrel, but not routinely
- Usually at the discretion of the anaesthetist. If there is borderline thrombocytopenia platelets may be ordered for patients who are on aspirin alone. If platelets are ordered they are held in the laboratory until disconnection from CPB and then transfused. We generally do not transfuse platelets prior to CPB unless advised to do so by a haematologist.
- Selected complex cases
- Usually at surgeon or anaesthetists discretion for those on combination therapy
- We have expensive Platelet Function analysis available in theatre for all cases. If Platelet Function is compromised then we will order Platelets on standby. Platelets and other clotting factors are always administered following evidence from either TEG or Multiplate analysis. We also have access in theatre to a Full Blood Count Analyser for Platelet and Hb. We are yet to analyse our data fully but we have observed that Aspirin inhibition alone rarely affects bleeding during or after surgery.
- Depends on surgical consultant and off pump vs. on pump surgery. May continue aspirin up to three days prior to off pump CABG. One surgeon insists on platelets if aspirin or clopidogrel given in last seven days. Others will wait and see if bleeding is excessive unless clopidogrel given in last three days.