

2015 Audit of Patient Blood Management in Adults undergoing elective, scheduled surgery

Hospital Name

SUPPLEMENTARY INFORMATION REPORT

Your hospital participated in the 2015 National Comparative Audit of Patient Blood Management in Adults undergoing elective, scheduled surgery. Findings from this audit can help you to evaluate the quality of clinical staff's patient blood management practice in your hospital. This report provides detailed supporting information, such as the clinical characteristics of the audited patients.

- If you would like a summary of the key findings, please refer to the '**Key Findings**' report.
- If you would like the full findings on how your hospital performed in relation to each of the audit standards, please refer to the '**Full Findings**' report.

Who is this report for?

It is recommended that copies of supplementary report is used by the clinical audit project team to provide additional information to support action planning as outlined in the key findings and full findings reports.

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We wish to thank all those who have participated in the 2015 Audit of Patient Blood Management in Adults undergoing elective, scheduled 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.

We would also like to acknowledge the support of the Royal College of Anaesthetists and the Quality Audit and Research Coordinators in Trusts who helped to identify anaesthetic trainees to support the data collection.

HOSPITALS THAT AGREED TO PILOT THE AUDIT

Barking, Havering & Redbridge University Hospitals NHS Trust; Bedford Hospital NHS Trust; Central Manchester Hospitals NHS Foundation Trust; Conquest Hospital; Eastbourne Hospital; Great Western Hospitals NHS Foundation Trust; Kettering General Hospital NHS Foundation Trust; North Bristol NHS Trust; Papworth Hospital NHS Foundation Trust; Queen Elizabeth Hospital, King's Lynn; South Tees Hospital NHS Foundation Trust; Taunton & Somerset Hospital; The Leeds Teaching Hospitals NHS Trust; University of South Manchester NHS Foundation Trust.

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This report is intended to provide any additional, supporting information that may be of interest to clinical staff, but is not directly related to any of the audit standards.

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Background

Patient Blood Management (PBM) is evidence-based medicine as applied to transfusion practice. Although effective PBM can lead to more appropriate use of the limited donated blood supply, transfusion avoidance is not the primary goal. Instead, PBM involves the application of current best evidence to optimise the care and outcomes of all patients who may require transfusion during the course of their care.¹

PBM offers the potential for a “win-win” of patient outcome improvements, cost savings, as well as the public health benefit of reduced demand on donors:²

- Transfusion is a life-saving intervention in certain situations where no alternative exists, e.g. exsanguination or marrow failure. However, in most clinical settings, red cell transfusions are administered to patients without active bleeding. Findings from a broad range of randomised controlled trials, including hip fracture surgery, have indicated no evidence of benefit for policies of liberal transfusions (or even in some reports, signals of harm to patients when outcomes are compared to patients receiving restrictive use of blood).² Choosing transfusion as first-line option for treating presumed tissue oxygen deficit in surgical practice may therefore be inappropriate.
- The donated blood supply is limited and vulnerable to demographic changes as well as the impact of infective pandemics.³⁻⁴ Though the surgical use of blood has decreased over time,⁵ more can and should be done to limit demand on donors.
- Transfusion is more costly than commonly appreciated,⁶ and therefore minimising use of blood or consistent use of alternative management strategies would be attractive on financial grounds.⁷⁻⁸
- Transfusion, pre-operative anaemia and acute peri-operative anaemia all carry risk to patients⁹. PBM offers clinicians the opportunity to prevent their patients getting into situations where decisions must be made as to which of these risks is greater.

¹ Society for the Advancement of Blood Management. "Professional definition of PBM." Retrieved 28 December, 2014, from www.sabm.org/²

Spahn, D. R., O. M. Theusinger and A. Hofmann (2012). "Patient blood management is a win-win: a wake-up call." *Br J Anaesth* 108: 889-892.

² Murphy, M.F., Waters J.H, Wood E.M and Yazer M.H. (2013): . "Transfusing blood safely and appropriately." *BMJ*, 347 .

³ Spahn, D. R., H. Moch, A. Hofmann and J. P. Isbister (2008). "Patient blood management: the pragmatic solution for the problems with blood transfusions." *Anesthesiology* 109: 951-953.

⁴ Seifried, E., H. Klueter, C. Weidmann, T. Staudenmaier, H. Schrezenmeier, R. Henschler, A. Greinacher and M. M. Mueller (2011). "How much blood is needed?" *Vox Sang* 100: 10-21.

⁵ Tinegate, H., Chattree, S., Iqbal, A., Plews, D., Whitehead, J., & Wallis, J. P. (2013). Ten-year pattern of red blood cell use in the North of England. *Transfusion*, 53: 483-489.

⁶ Abraham, I. and D. Sun (2012). "The cost of blood transfusion in Western Europe as estimated from six studies." *Transfusion* 52: 1983-1988.

⁷ Spahn, D. R. (2010). "Anemia and patient blood management in hip and knee surgery: a systematic review of the literature." *Anesthesiology* 113: 482-495.

⁸ Ejaz, A., S. M. Frank, G. Spolverato, Y. Kim and T. M. Pawlik (2015). "Potential Economic Impact of Using a Restrictive Transfusion Trigger Among Patients Undergoing Major Abdominal Surgery." *JAMA Surg* 150: 625-630.

⁹ Kotzé, A., Harris, A., Baker, C., Iqbal, T., Lavies, N., Richards, T., Ryan K., Taylor C. & Thomas, D. (2015). British Committee for Standards in Haematology Guidelines on the Identification and Management of Pre-Operative Anaemia. *British Journal of Haematology*. DOI: 10.1111/bjh.13623

Despite many national¹⁰ and international¹¹⁻¹² recommendations being published in favour of PBM implementation, evidence suggests variability in uptake across the UK. A national survey of organisational arrangements indicated that only the minority of Trusts had adequate time in medical and nursing job plans for PBM, and that many Trusts did not have mechanisms for the reliable use of transfusion alternatives where appropriate.¹¹

References:

This audit was undertaken to document and understand clinical staff's current use of red cell transfusion and patient blood management approaches in adults undergoing elective, scheduled surgery in relation to 11 audit standards developed by the audit group. The audit is important at a number of levels:

- It **provides national comparative data on PBM practice across the UK**. Surgical blood use has decreased over time as a proportion of total blood use, but no national data is available on the breadth of PBM adoption across the country.
- For hospitals and individual clinicians, it **provides data on how patients are managed along the surgical pathway**. It is nowadays common for multiple clinicians to have input into one patient's care – aggregating data from multiple times (from referral to pre-assessment to surgery and post-operatively) **may inform pathway design and help target improvement programmes**.

The recommendations developed aim to achieve improved implementation of Patient Blood Management and red cell transfusion practice in surgical patients and consequently improved patient outcomes

PBM measures

The following table illustrates the PBM measures that are appropriate to the index operations. PBM measures are the standard of care for each procedure and ideally all aspects of PBM should have been attempted unless contraindicated or optional.

Timing of transfusion	Procedure								
	Primary unilateral / bilateral total hip replacement	Primary unilateral / bilateral and revision total knee replacement	Unilateral revision hip replacement	Surgery for #NOF	Colorectal resection for any indication	Open arterial surgery	□ Primary coronary artery bypass graft □ Valve replacement +/- CABG	Urological surgery: Cystectomy Nephrectomy	Simple or complex hysterectomy
Pre operative	A	A	A	C	A	A	A	A	A
	B	B	B		B	B	B	B	B
Intra operative	A	A	A	D	A	A	A	A	A
	D	D	D		D	D	E	D	D
	G		F			F	F	G	G
Post operative	A	A	A	D	A	A	A	A	A

¹⁰ National Blood Transfusion Committee. (2014). "Patient Blood Management: An evidence-based approach to patient care." Retrieved 2 February, 2015, from <http://www.transfusionsguidelines.org.uk/uk-transfusion-committees/national-blood-transfusion-committee/patient-blood-management>.

¹¹ World Health Organisation. (2010). "Sixty-third world health assembly. Agenda Item 11.17: Availability, safety and quality of blood products WHA 63.12." Retrieved 9 September, 2015, from http://apps.who.int/gb/ebwha/pdf_files/WHA63/A63_R12-en.pdf.

¹² Australian National Blood Authority. (2011). "Patient Blood Management Guidelines Module 2: Peri-operative." Retrieved 9 July, 2015, from <http://www.blood.gov.au/system/files/documents/pbm-module-2.pdf>

	D	D	D		D	D	E	D	D
	G	H	F			F	F	G	G
	H		H				H		
PBM Measures Key									
A	Pre-operative anaemia optimisation								
B	Pre-operative management of patients on anticoagulants and antiplatelet agents								
C	Pre-operative management of patients on oral anticoagulants								
D	Tranexamic acid								
E	Tranexamic acid/aprotinin								
F	Intra-operative cell salvage								
G	Optional: Intra-operative cell salvage								
H	Optional: Post-operative cell salvage								

Standard 1: Pre-operative anaemia optimisation

Clinical staff must ensure that patients listed for elective major blood loss surgery have an Hb measured at least 14 days preoperatively and act upon results¹³

Standard 2: Pre-operative transfusion indicated

Clinical staff should only prescribe a pre-operative transfusion in patients undergoing elective major blood loss surgery if the Hb is less than the defined Hb threshold for transfusion¹⁴

Standard 3: Pre-operative transfusion indicated only if pre-operative anaemia optimisation has been attempted

Clinical staff should only prescribe a pre-operative transfusion in patients undergoing elective major blood loss surgery if the Hb is less than the defined Hb threshold for transfusion² and pre-operative anaemia optimisation has been attempted

Standard 4: Pre-operative transfusion - single unit approach

For patients receiving a pre-operative transfusion, clinical staff should prescribe one unit of red cells at a time and re-check Hb before prescribing a further unit

¹³ . Anaemia is defined as Hb of less than 130g/L in men less than 120g/L in women

¹⁴ . Hb less than 70g/L in patients without acute coronary ischaemia or less than 80g/L in patients with acute coronary ischaemia

Standard 5:**Pre-operative anticoagulant and antiplatelet management**

- For patients undergoing elective major blood loss surgery who are taking oral anticoagulants and/or antiplatelet agents, clinical staff must stop the oral anticoagulant and/or antiplatelet agent(s) at least 5 days pre-operatively (unless there are good reasons to continue) and document the management plan in the case notes.
- For patients with fractured neck of femur taking warfarin, clinical staff should aim for an INR of less than 1.5 on the day before or the day of surgery

Standards 6&7:**Patient Blood Management in theatre and recovery**

Clinical staff should attempt at least one (PBM standard 6) or all (PBM standard 7) appropriate patient blood management measures in patients who receive a transfusion during major blood loss surgery

Standard 8:**Post-operative transfusion indicated**

In patients who do not have active post-operative bleeding, clinical staff should only prescribe a transfusion if the Hb is less than the defined Hb threshold for transfusion²

Standard 9:**Post-operative transfusion - single unit approach**

For patients receiving a post-operative transfusion, clinical staff should prescribe one unit of red cells at a time and re-check Hb before prescribing a further unit unless the patient has active bleeding

Standards 10&11: Patient Blood Management in the post-operative period

Clinical staff should attempt at least one (PBM standard 10) or all (PBM standard 11) appropriate patient blood management measures in patients who receive a transfusion following major blood loss surgery

Analysis of compliance with standards was undertaken using a series of algorithms as shown in Appendix 1

Overall performance against standards

Algorithm	Standard MET	Standard NOT MET	EXCLUDED	INSUFFICIENT DATA	% standard MET*	YOUR HOSPITAL: % standard MET*
PBM1	1305	1531	1044	17	46%	67% (2/3)
PBM2	28	214	3529	126	12%	0% (0/2)
PBM3	3	129	3655	110	2%	0% (0/0)
PBM4	71	182	3529	115	28%	0% (0/2)
PBM5	340	201	3279	77	63%	0% (0/2)
PBM6	661	134	3027	75	83%	0% (0/0)
PBM7	133	675	3027	62	16%	0% (0/1)
PBM8	669	2088	996	144	24%	22% (4/18)
PBM9	920	1492	1358	127	38%	13% (2/16)
PBM10	1714	312	1748	123	85%	50% (2/4)
PBM11	175	1910	1748	64	8%	0% (0/4)

Patient Blood Management performance by type of procedure

	Primary unilateral total hip replacement	Primary bilateral total hip replacement	Primary unilateral total knee replacement	Primary bilateral total knee replacement	Unilateral revision hip replacement	Unilateral revision knee replacement	Colorectal resection for any indication
PBM1	57% (346/610)	50% (15/30)	63% (215/341)	70% (19/27)	50% (128/258)	52% (35/67)	27% (81/300)
PBM2	0% (0/14)	-	0% (0/1)	-	11% (1/9)	0% (0/2)	18% (7/40)
PBM3	0% (0/15)	-	0% (0/1)	-	0% (0/9)	0% (0/2)	2% (1/42)
PBM4	33% (5/15)	-	0% (0/1)	-	33% (3/9)	0% (0/2)	19% (8/42)
PBM5	67% (48/72)	25% (1/4)	68% (21/31)	-	47% (20/43)	70% (7/10)	74% (23/31)
PBM6	92% (68/74)	86% (6/7)	92% (12/13)	-	91% (77/85)	100% (10/10)	38% (42/110)
PBM7	34% (26/77)	14% (1/7)	42% (5/12)	0% (0/1)	9% (8/86)	0% (0/10)	3% (3/116)
PBM8	16% (79/487)	14% (3/22)	18% (51/279)	16% (4/25)	23% (37/163)	12% (7/57)	30% (45/151)
PBM9	31% (144/460)	29% (5/17)	27% (72/264)	39% (9/23)	46% (63/138)	21% (11/53)	34% (44/128)
PBM10	89% (435/491)	86% (19/22)	91% (262/287)	100% (25/25)	87% (146/167)	91% (53/58)	35% (53/153)
PBM11	0.4% (2/519)	18% (4/22)	1% (4/292)	16% (4/25)	17% (29/169)	13% (7/56)	0% (0/159)

	Open arterial surgery	Primary CABG	Valve replacement +/- CABG	Simple or complex hysterectomy	Cystectomy	Nephrectomy	# neck of femur (arthroplasty)
PBM1	32% (51/157)	29% (34/116)	43% (183/421)	38% (129/342)	38% (14/37)	42% (55/130)	-
PBM2	20% (2/10)	0% (0/1)	0% (0/2)	14% (4/29)	0% (0/3)	33% (4/12)	8% (10/118)
PBM3	10% (1/10)	0% (0/1)	0% (0/4)	3% (1/32)	0% (0/4)	0% (0/12)	-

PBM4	36% (4/11)	0% (0/1)	67% (2/3)	11% (3/28)	25% (1/4)	8% (1/12)	35% (44/124)
PBM5	68% (38/56)	78% (35/45)	61% (80/132)	58% (7/12)	0% (0/1)	72% (13/18)	55% (47/86)
PBM6	90% (55/61)	96% (43/45)	99% (182/184)	83% (90/108)	82% (9/11)	78% (54/69)	72% (13/18)
PBM7	5% (3/62)	22% (10/45)	28% (51/181)	8% (9/112)	8% (1/13)	4% (3/68)	72% (13/18)
PBM8	33% (28/85)	47% (42/90)	38% (110/292)	40% (83/209)	28% (7/25)	33% (21/64)	19% (151/798)
PBM9	47% (32/68)	87% (55/63)	83% (171/206)	24% (36/151)	24% (5/21)	41% (21/51)	32% (247/761)
PBM10	85% (73/86)	98% (89/91)	97% (292/300)	83% (165/198)	83% (20/24)	82% (50/61)	51% (32/63)
PBM11	1% (1/90)	23% (21/91)	22% (67/299)	0% (0/211)	8% (2/25)	3% (2/64)	51% (32/63)

METHODS

The audit was conducted on cases occurring during a 3 month period between February and April 2015.

Hospital selection and response

All hospitals/Trusts in England, Scotland, Wales, Northern Ireland and Republic of Ireland where transfusions are administered to adult surgical patients were invited to take part. Data were submitted by Trusts as a whole and by individual hospitals. The term hospital is used throughout this report to refer to the entity engaged in the audit process at each hospital

Case selection and quotas

Participating hospitals were asked to collect data on all consecutive cases of patients who had undergone any of the audit index operations and received transfusion pre-operatively and/or intra-operatively and/or up to 7 days post-operatively. Up to a maximum of 70 cases per hospital were collected from patients operated on during the period 1st Feb 2015 to 30th April 2015. The majority of procedures were elective and scheduled, however patients undergoing surgery for fractured neck of femur were also included to ensure that meaningful numbers of cases were collected for the audit.

A list of OPCS4 codes was provided for the index operations (table below) and hospitals were asked to liaise with their Informatics Department to collect a list of patients who had undergone one of these procedures. Transfused cases were identified with reference to laboratory data.

Procedure Descriptions	OPCS Codes
Primary unilateral total hip replacement	W37.1, W38.1, W39.1 with a Z94.2, Z94.3 or Z94.4
Primary bilateral total hip replacement	W37.1, W38.1, W39.1 with a Z94.1
Primary unilateral total knee replacement	W40.1, W41.1, W42.1 with a Z94.2, Z94.3 or Z94.4
Primary bilateral total knee replacement	W40.1, W41.1, W42.1 with a Z94.1
Unilateral revision hip replacement	W37.3, W37.4, W38.3, W38.4, W39.3 with a Z94.2, Z94.3, Z94.4
Unilateral revision knee replacement	W40.3, W40.4, W41.3, W41.4, W42.3 with a Z94.2, Z94.3, Z94.4
Colorectal resection for any indication (open or laparoscopic)	H29, H33 H048; H061; H062; H099; H103; H108; H41.1

Open arterial surgery e.g.: scheduled ((nonruptured) aortic aneurysm repair, infrainguinal, femoropopliteal or distal bypass)	L19.3 - L19.6, L21.3 - L21.6, L49, L51, L57, L59
Primary coronary artery bypass graft	K40 - K45 (excluding K44.2, K45.6) in any procedural position
Valve replacement +/- CABG	K25 - K29 (INCLUSIVE)
Simple or complex hysterectomy	Q07 - Q08 (INCLUSIVE)
Cystectomy	M34.3, M34.4, M35.9
Nephrectomy	M02.1, M02.3, M02.5, M03.1, M03.9
# neck of femur (arthroplasty)	W19.1, W24.1, W46.1 to W46.9, W47.1 to W47.9, W48.1 to W48.9

Data entry, cleaning and validation

The audit data from the transfusion episode was entered via a web-based audit tool specifically designed for the purpose although data could be collected on a paper proforma (see appendix 2). Submitted audit data was collated by the audit Programme Manager after the closing date for data entry. Because no patient identifiable data is recorded on the web-based audit tool, hospital auditors were advised to keep an audit linkage record to assist in review of cases and validation of data. Algorithms were developed to analyse whether the standards were met using the definitions outlined below (see appendix 1). There was some post-hoc analysis of the free text answers where indicated.

Definition of Patient Blood Management Measures

Pre-operative Anaemia optimisation

Patients with iron deficiency anaemia identified pre operatively and treated with oral or intravenous iron (anaemia defined as Hb less than 120g/L in females and less than 130g/L in males) at least 14 days before surgery; iron deficiency was defined as ferritin less than 30 µg/L, transferrin saturation less than 20% if no ferritin performed or MCV <78fl if no ferritin or transferrin saturation performed. There was no expectation for optimisation of other forms of anaemia or for optimisation of anaemia in patients with fractured neck of femur.

Pre-operative management of patients on anticoagulants and antiplatelet agents

Excluding those having surgery for fractured neck of femur, patients on oral anticoagulants (e.g. warfarin or novel oral anticoagulants as listed in the audit tool) must have the oral anticoagulant discontinued at least 5 days preoperatively. Patients on antiplatelet agents (dual antiplatelet therapy, clopidogrel, ticagrelor, prasugrel*) must have the drug(s) discontinued at least 5 days pre-operatively unless there are good clinical reasons for continuation, that is: coronary artery stent within last 12 months, active ischaemic heart disease in patients undergoing bypass surgery.

**It is acceptable to continue low dose aspirin therapy peri-operatively.*

For fractured neck of femur patients on warfarin: anticoagulation should be managed so that INR is <1.5 on day of or day before surgery.

Intra-operative cell salvage

In appropriate types of surgery, cell salvage should be set up and an attempt made to collect; standard is still met if not enough collected for return. Exceptions: active sepsis, malignancy, contaminated field.

Post-operative cell salvage

This is considered optional and can be washed red cells or reinfused shed blood.

Participation and sample size

A total of 3925 audit records were received, after extending the deadline for submission by an extra week. A total of 28 duplicate records were identified and removed from the dataset leaving 3897 cases for analysis, submitted by 190 hospitals (median of 18 cases per hospital, IQR 9-30, range 1-69). The list of participating hospitals is presented in Appendix 3.

The audit period specified for including operations was February to April 2015 inclusive, with 1783 cases in February, 1314 cases in March and 683 cases in April. Details were also received for a further 105 operations (from 46 hospitals) that fell outside the audit period; these were included in the analysis, with 72 cases in January, 30 cases in May, 2 in June and 1 in July. Also included were 12 operations for which the date of surgery was not stated.

NHS England/N Ireland/Scotland/Wales: 3628 cases from 155 hospitals, median 21, IQR 13-32, range 1-69.

Independent Hospitals: 165 cases from 28 hospitals, median 6, IQR 2-10, range 1-12.

Republic of Ireland: 104 cases from 7 hospitals, median 16, range 4-26.

Your hospital: 23 cases

The national results in this report are derived from all 3897 cases from 190 hospitals.

What are the characteristics of the patients audited?

Patient demographics

Of the 3897 cases, gender was known for 3873 and 65% (2519) were female and 35% were male (1354). The median age was 76 years (IQR 66-84). The breakdown by gender and age group for your hospital is shown in the tables below.

Gender

	National	Your hospital
Gender known	3873	
Female	65% (2519)	20
Male	35% (1354)	3

Patient age

	National	Your hospital
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Age known	3891	23
<55	12% (449)	
55-64	10% (403)	
65-74	23% (908)	
75-84	30% (1182)	
≥85	24% (949)	
Median (IQR)	76 (66-84)	Median: 80

The median age of patients undergoing the various procedures is shown in the table below (national figures). Note that the median age for patients with fractured neck of femur was 86 years (IQR 80-91) and these accounted for 27%

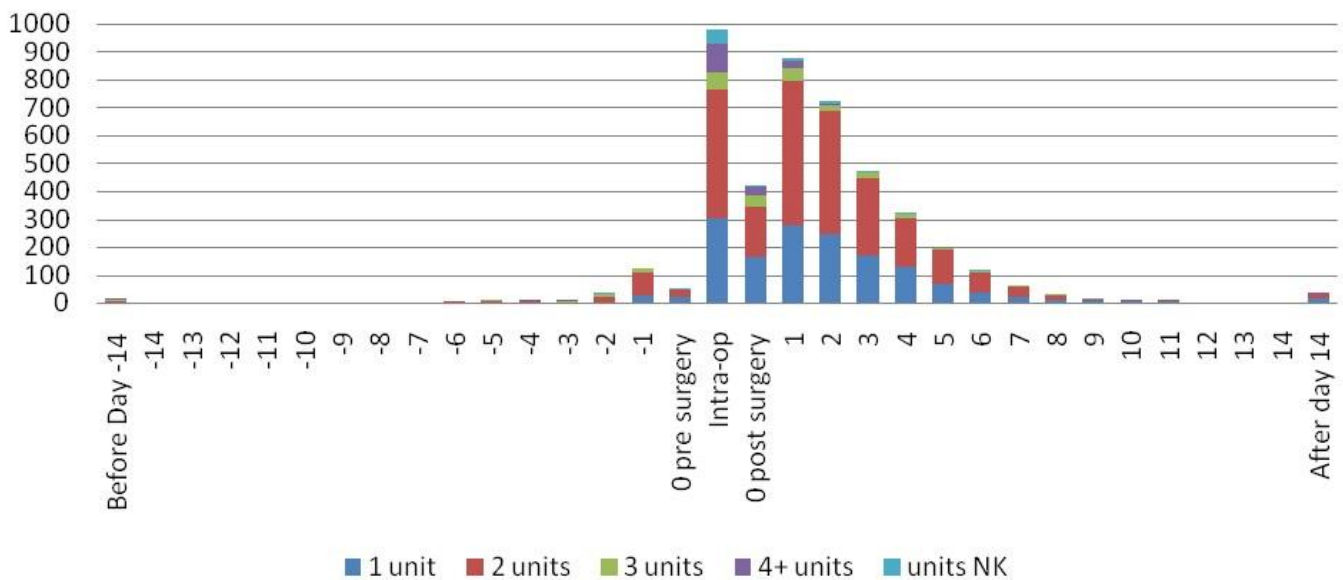
of the patients (1044). It is likely that the large number of fractured neck of femur patients accounts for the larger percentage of females.

TYPE OF PROCEDURE	Median (IQR) age
Primary unilateral total hip replacement	77 (67-83), n=608
Primary bilateral total hip replacement	74 (66-85), n=30
Primary unilateral total knee replacement	76 (68-82), n=339
Primary bilateral total knee replacement	71 (60-82), n=27
Unilateral revision hip replacement	75 (67-82), n=258
Unilateral revision knee replacement	73 (65-79), n=67
Colorectal resection for any indication	71 (61-79), n=300
Open arterial surgery	73 (65-78), n=157
Primary coronary artery bypass graft	69 (63-76), n=116
Valve replacement +/- CABG	73 (66-79), n=423
Simple or complex hysterectomy	51 (44-65), n=340
Cystectomy	68 (59-78), n=37
Nephrectomy	68 (57-74), n=130
# neck of femur (arthroplasty)	86 (80-91), n=1044
Procedure not stated	78 (73-86), n=15

When was blood transfused?

The majority of transfusions occurred during the postoperative period. See the chart and table below for national figures

Summary of pre-op, intra-op and post-op red blood cell transfusions (including number of units transferred)



	National
Pre-operative	277
Intra-operative	982
Post-operative	2878

Opportunities for PBM in the pre-operative period include pre-operative anaemia identification and optimisation and appropriate management of patients taking anticoagulants and antiplatelet therapy.

It is important that there is enough time for a full patient assessment and development of a management plan in advance of surgery so that the patient is optimised at the time of surgery.

The following section gives detailed information about the timings between listing and surgery and pre-operative assessment and surgery.

How many days between listing and date of surgery?

Excluding patients with fractured neck of femur, 94% (2678/2853) of patients had a listing date.

The median (IQR) time from listing to surgery was 42 days (13-93).

There was considerable variation between the different procedures. As expected, there was a longer time between listing and actual date of surgery for elective orthopaedic surgery compared to coronary artery bypass surgery or types of surgery associated with malignancy as shown for the national dataset in the table below

TYPE OF PROCEDURE	% (N) listed	Days between listing and surgery: Median (IQR)
☐ Primary unilateral total hip replacement	94% (572/610)	64 (20-115), n=571
☐ Primary bilateral total hip replacement	97% (29/30)	61 (13-99), n=28
☐ Primary unilateral total knee replacement	94% (322/341)	92 (50-144), n=322
☐ Primary bilateral total knee replacement	100% (27/27)	105 (36-137), n=27
☐ Unilateral revision hip replacement	95% (245/258)	48 (9-102), n=245
☐ Unilateral revision knee replacement	97% (65/67)	50 (19-102), n=65
☐ Colorectal resection for any indication	94% (281/300)	18 (8-36), n=280
☐ Open arterial surgery	94% (148/157)	23 (5-59), n=148
☐ Primary coronary artery bypass graft	89% (103/116)	12 (5-43), n=103
☐ Valve replacement +/- CABG	91% (384/423)	42 (12-90), n=384
☐ Simple or complex hysterectomy	96% (329/342)	28 (14-71), n=329
☐ Cystectomy	92% (34/37)	32 (14-53), n=34
☐ Nephrectomy	98% (127/130)	26 (12-42), n=127
☐ # neck of femur (arthroplasty)	0% (0/1044)	-
Procedure not stated	80% (12/15)	6 (0-64), n=12

How many days between pre-operative assessment and surgery?

Excluding patients with fractured neck of femur, 92% (2638/2853) of patients had a pre-operative assessment. In your hospital this was **50% (2/4)** .

The table below shows the national proportions of those having a pre-operative assessment.

TYPE OF PROCEDURE	NATIONAL % (N) with pre-operative assessment

<input type="checkbox"/>	Primary unilateral total hip replacement	90% (533/595)
<input type="checkbox"/>	Primary bilateral total hip replacement	83% (25/30)
<input type="checkbox"/>	Primary unilateral total knee replacement	98% (329/337)
<input type="checkbox"/>	Primary bilateral total knee replacement	100% (27/27)
<input type="checkbox"/>	Unilateral revision hip replacement	82% (211/257)
<input type="checkbox"/>	Unilateral revision knee replacement	88% (58/66)
<input type="checkbox"/>	Colorectal resection for any indication (open or laparoscopic)	82% (244/296)
<input type="checkbox"/>	Open arterial surgery	73% (114/156)
<input type="checkbox"/>	Primary coronary artery bypass graft	84% (97/115)
<input type="checkbox"/>	Valve replacement +/- CABG	80% (337/422)
<input type="checkbox"/>	Simple or complex hysterectomy	93% (315/340)
<input type="checkbox"/>	Cystectomy	80% (28/35)
<input type="checkbox"/>	Nephrectomy	91% (118/130)
<input type="checkbox"/>	# neck of femur (arthroplasty)	19% (192/1031)
	Procedure not stated	83% (10/12)

Days from pre-operative assessment to surgery

Nationally the median (IQR) time from assessment to surgery was 17 days (7-44) in the 2608 cases where the date was known.

In your hospital the median was **25 days** in the **2** cases where the date was known.

The table below shows the timings for pre-operative assessment for different types of surgery:

TYPE OF PROCEDURE	NATIONAL Days between assessment and surgery: Median (IQR)	
<input type="checkbox"/>	Primary unilateral total hip replacement	25 (13-59), n=529
<input type="checkbox"/>	Primary bilateral total hip replacement	32 (15-93), n=24
<input type="checkbox"/>	Primary unilateral total knee replacement	28 (15-76), n=325
<input type="checkbox"/>	Primary bilateral total knee replacement	26 (13-47), n=27
<input type="checkbox"/>	Unilateral revision hip replacement	22 (10-48), n=211
<input type="checkbox"/>	Unilateral revision knee replacement	20 (7-39), n=57
<input type="checkbox"/>	Colorectal resection for any indication (open or laparoscopic)	11 (6-21), n=240
<input type="checkbox"/>	Open arterial surgery e.g.: scheduled (nonruptured) aortic aneurysm repair, infrainguinal, femoropopliteal or distal bypass	19 (6-62), n=111
<input type="checkbox"/>	Primary coronary artery bypass graft	8 (1-42), n=95
<input type="checkbox"/>	Valve replacement +/- CABG	21 (7-61), n=333
<input type="checkbox"/>	Simple or complex hysterectomy	13 (7-28), n=313
<input type="checkbox"/>	Cystectomy	15 (9-26), n=28
<input type="checkbox"/>	Nephrectomy	13 (7-23), n=117
<input type="checkbox"/>	# neck of femur (arthroplasty)	0 (0-1), n=188
	Procedure not stated	9 (2-36), n=10

If the pre-operative assessment took place less than 28 days before surgery, what was the reason?

	National	Your hospital
Pre-operative assessment within 0-28 days before surgery:	66% (1711/2608)	100% (2/2)
Reason:*		
<input type="checkbox"/> Emergency Trauma	11% (188)	0
<input type="checkbox"/> Cancer surgery	11% (187)	0
<input type="checkbox"/> Other urgent	15% (260)	0
<input type="checkbox"/> Waiting list initiative	1% (11)	0
<input type="checkbox"/> Routine practice	19% (326)	0
<input type="checkbox"/> Other non-urgent	0.4% (6)	0
<input type="checkbox"/> No reason given/not known	43% (733)	2

Note that the reason was not known in 43% or was routine practice in 19% of cases nationally. There were good clinical reasons for a short time period in 37% of cases. More detail is given in the table below broken down by the different procedures at national level.

TYPE OF PROCEDURE	If pre-operative assessment took place < 28 days before surgery what was the reason? *							Total
	Emergency trauma	Cancer surgery	Other urgent	Waiting list initiative	Routine practice	Other nonurgent	No reason given/not known	
<input type="checkbox"/> Primary unilateral total hip replacement	7	4	28	5	101	-	149	294
<input type="checkbox"/> Primary bilateral total hip replacement	-	-	-	-	4	-	6	10
<input type="checkbox"/> Primary unilateral total knee replacement	-	1	3	3	49	1	108	165
<input type="checkbox"/> Primary bilateral total knee replacement	-	-	-	-	5	-	9	14
<input type="checkbox"/> Unilateral revision hip replacement	3	-	29	-	32	3	60	127
<input type="checkbox"/> Unilateral revision knee replacement	1	-	11	-	10	1	15	38
<input type="checkbox"/> Colorectal resection for any indication (open or laparoscopic)	-	74	30	-	20	-	71	195
<input type="checkbox"/> Open arterial surgery e.g.: scheduled (non-ruptured) aortic aneurysm repair, infrainguinal femoropopliteal or distal bypass	-	-	33	-	5	-	29	67
<input type="checkbox"/> Primary coronary artery bypass graft	-	-	43	-	2	-	23	68
<input type="checkbox"/> Valve replacement +/- CABG	-	1	43	1	36	1	102	184
<input type="checkbox"/> Simple or complex hysterectomy	-	67	23	2	45	-	104	241
<input type="checkbox"/> Cystectomy	-	7	2	-	8	-	6	23
<input type="checkbox"/> Nephrectomy	-	33	12	-	9	-	40	94
<input type="checkbox"/> # neck of femur (arthroplasty)	176	-	-	-	-	-	8	184
<input type="checkbox"/> Procedure not stated	1	-	3	-	-	-	3	7
Total	188	187	260	11	326	6	733	1711

*These categories were formed from free-text stated by auditors

How was pre-operative anaemia investigated and managed?

- The investigation and management of anaemia takes time. Timely Hb testing is thus necessary if patients are not to be:
 - Postponed unnecessarily, at best causing them inconvenience, often distress and sometimes harm OR;
 - Inappropriately transfused.
- When pre-operative anaemia is discovered during surgical work-up, it should not be seen as simply an abnormal laboratory value. Instead, it should be viewed as:

- A marker of potential undiagnosed serious disease, for example gastrointestinal cancer or renal failure.
- A modifiable risk factor for poor surgical outcome.
- Simply proceeding with planned surgery in the face of anaemia is therefore poor medicine.
- On the other hand, if anaemia is only detected close to the time of planned surgery, clinicians caring for the patient peri-operatively are in the invidious situation of having to choose between poor options: proceeding despite the above considerations, or cancelling surgery with its associated waste of resources and burden of morbidity to patients.
- Not detecting anaemia in a timely fashion and/or not managing it appropriately is thus a systemic failure.

Was there a haemoglobin (Hb) result at least 14 days before surgery and on/after the day of listing?

Excluding patients with fractured neck of femur, only 49% of cases (1407/2853) had an Hb result at least 14 days before surgery. Therefore it was not possible to optimise PBM in half of patients.

Nationally, the 1407 cases had Hb results a median (IQR) of 22 days (0-61 days) from listing and a median of 33 days (20-64 days) before surgery.

What were the results of Hb and other relevant investigations?

The median (IQR) Hb result taken at least 14 days before surgery was 124g/L. Further details are shown for the national dataset in the table below:

FBC results	Median	IQR	N
Hb result, g/L:	124	112-135	1407
MCH* result, picograms:	29.8	27.9-31.2	1302
MCV* result, femolitres	89	85-93	1377
Ferritin, µg/L:	68	27-140	205
Transferrin saturation % (TSAT)	20	12-31	48

Note that the MCV* (mean red cell volume) and MCH* (mean red cell Hb) were not given in all of the cases where the Hb result was known. Only a small proportion of cases had a ferritin measurement available and even fewer had the result of transferrin saturation

What about patients with anaemia?

Nationally, of those with an Hb result at least 14 days before surgery (1407), 46% of women and 48% of men were anaemic (defined as Hb less than 120g/L for women and less than 130g/L for men).

Nationally, of those with an Hb result at least 14 days before surgery, only 15% (205) of patients had a ferritin result available. The following table shows the full results of anaemia investigations nationally:

	National
Hb result, g/L:	
Female: median (IQR)	121 (111-130), n=896
Male: median (IQR)	131 (117-143), n=506
Females with Hb<120 g/L	46% (411/896)
Males with Hb<130 g/L	48% (244/506)

Of those with an Hb result:	
Also with a MCV result	93% (1308/1407)
Also with a Ferritin result	15% (205/1407)
Of those with an Hb result but with no Ferritin result: Also	
with a TSAT result	0.4% (5/1202)

The pre-operative anaemia standard only expects patients with anaemia to be investigated and treated for iron deficiency anaemia pre-operatively as other types of anaemia are more difficult to correct.

Did patients receive any treatment for anaemia pre-operatively?

The table below shows the treatments that were given to patients pre-operatively. This includes patients with fractured neck of femur. Only a very small proportion of patients had active treatment for anaemia, and in 279 cases, patients received a transfusion pre-operatively

	National
Known for	3793
<input type="checkbox"/> Oral iron	11% (399)
<input type="checkbox"/> IV iron	0.8% (29)
<input type="checkbox"/> Erythropoiesis-stimulating agent (ESA) therapy	0.3% (12)
<input type="checkbox"/> B12	2% (71)
<input type="checkbox"/> Folic acid	4% (151)
<input type="checkbox"/> Red cell transfusion	7% (279)
<input type="checkbox"/> None	79% (3009)

Pre-operative red cell transfusion

Pre-operative transfusion should not be seen as an alternative to good practice where there is an opportunity to ensure that pre-operative anaemia is proactively managed.

Transfusion should only be considered in patients with acute blood loss or where the anaemia is not correctable and the Hb is below the defined threshold. In the audit, transfusions to patients with fractured neck of femur were excluded from the analysis of compliance with standards 1 and 3 (see PBM algorithms in Appendix 1) since this clinical scenario is often associated with blood loss.

There is no consistent evidence of benefit for transfusing at higher haemoglobin thresholds (liberal practice), and some evidence of harm.¹⁴

The use of a restrictive transfusion strategy including a single unit approach is therefore recommended. This reduces unnecessary transfusion of red cells, thus reducing cost and improving outcomes for patients.

A higher transfusion threshold of 80g/L is recommended for those with acute coronary syndrome, given uncertainty about the levels of evidence for this subgroup.¹⁴

¹⁴Salpeter, S. R., Buckley, J. S., & Chatterjee, S. (2014). Impact of more restrictive blood transfusion strategies on clinical outcomes: a meta-analysis and systematic review. *American Journal of Medicine*, 127, 124-13

The table below shows the median (IQR) number of days from transfusion of the first unit of red cells to surgery, nationally; the majority were given either the day before surgery or the day of surgery but before transfer to theatre. Nationally, 46% (127/278) of pre-operative transfusions were given to patients with fractured neck of femur.

National	
Median (IQR)	1 (1-2), n=278
Same day as op	19% (53)
Day before op	45% (124)
2 Days before op	13% (37)
3-5 Days before op	11% (31)
6-14 Days before OP	6% (18)
Earlier	5% (15)

The median pre-transfusion Hb result (IQR) was 82g/L (76-89) nationally and **98g/L (n=2)** in your hospital.

Reasons for patients transfused at more liberal thresholds i.e. a pre-transfusion Hb of more than 70g/L (without acute coronary syndrome) or more than 80g/L (with acute coronary syndrome) are shown below for the national dataset; this was the case for the majority 81% (224/277) of pre-operative transfusions:*

National	
Reason known	147/224
<input type="checkbox"/> Acute blood loss	11% (16)
<input type="checkbox"/> Anticipated blood loss	11% (16)
<input type="checkbox"/> Anaemia	22% (32)
<input type="checkbox"/> Anti-platelet / Anti-coagulant	3% (5)
<input type="checkbox"/> Other cardiac history	16% (23)
<input type="checkbox"/> Infection	3% (4)
<input type="checkbox"/> COPD	1% (2)
<input type="checkbox"/> Renal disease	2% (3)
<input type="checkbox"/> Cancer	10% (14)
<input type="checkbox"/> Clinical decision - no other given for the clinical decision	6% (9)
<input type="checkbox"/> Hypotension	1% (1)
<input type="checkbox"/> Shortness Of Breath	1% (2)
<input type="checkbox"/> Optimisation	10% (15)
<input type="checkbox"/> Other	3% (5)

*These categories were formed from free-text stated by auditors

The median number of units transfused pre-operatively was 2 units.

National	
One	20% (56)
Two	61% (168)
Three	13% (35)
Four or more	6% (18)

The Hb result taken closest before date of surgery was available in 3685 / 3897 patients (95%). The median (IQR) Hb was 118g/L (105-131) and 58% (2136) were anaemic. Further details of national figures and for your hospital and shown here:

	National	Your hospital
Hb result, g/L:		
All patients: median (IQR)	118 (105-131), n=3685	Median: 121, n=23
Female: median (IQR)	116 (104-127), n=2371	Median: 122, n=20
Male: median (IQR)	122 (106-138), n=1291	Median: 121, n=3
Gender NK: median (IQR)	102 (95-126), n=23	
Females with Hb<120 g/L	57% (1355/2371)	N=10
Males with Hb<130 g/L	60% (781/1291)	N=3
Total anaemic (F<120, M<130)	58% (2136/3662)	
Days between pre-op Hb and surgery: median (IQR)	2 (1-13), N=3622	Median: 1, n=23

The percentage of patients found to be anaemic within the different surgical groups is shown in the table below:

TYPE OF PROCEDURE	Total anaemic (F<120, M<130)
<input type="checkbox"/> Primary unilateral total hip replacement	52% (287/557)
<input type="checkbox"/> Primary bilateral total hip replacement	54% (15/28)
<input type="checkbox"/> Primary unilateral total knee replacement	53% (167/313)
<input type="checkbox"/> Primary bilateral total knee replacement	33% (9/27)
<input type="checkbox"/> Unilateral revision hip replacement	49% (118/243)
<input type="checkbox"/> Unilateral revision knee replacement	69% (43/62)
<input type="checkbox"/> Colorectal resection for any indication (open or laparoscopic)	69% (192/279)
<input type="checkbox"/> Open arterial surgery e.g. scheduled (non-ruptured) aortic aneurysm repair, infrainguinal femoropopliteal or distal bypass	47% (68/144)
<input type="checkbox"/> Primary coronary artery bypass graft	34% (39/113)
<input type="checkbox"/> Valve replacement +/- CABG	37% (151/406)
<input type="checkbox"/> Simple or complex hysterectomy	53% (168/317)
<input type="checkbox"/> Cystectomy	50% (17/34)
<input type="checkbox"/> Nephrectomy	66% (84/127)
<input type="checkbox"/> # neck of femur (arthroplasty)	77% (768/999)
Procedure not stated	77% (10/13)
Total	58% (2136/3662)

How were patients taking anticoagulants or antiplatelet agents managed pre-operatively?

Patients who do not have their oral anticoagulation or anti platelet medications withheld for at least 5 days before major elective surgery are likely to be at increased risk of bleeding during surgery (does not include aspirin).^{15,16}

To reduce the risk of bleeding, patients with fractured neck of femur on warfarin should have their anticoagulation actively managed so that their INR is 1.5 or less on the day before or the day of surgery.

The risk of bleeding versus the risk of thrombosis should be considered for each patient and an individualised management plan should be developed.^{15,16}

¹⁵Keeling, D., Baglin, T., Tait, C., Watson, H., Perry, D., Baglin, C., Kitchen, S., Makris, M. and British Committee for Standards in Haematology (2011), Guidelines on oral anticoagulation with warfarin – fourth edition. British Journal of Haematology, 154: 311–324.

¹⁶ A. D. Oprea & W. M. Popescu Perioperative management of antiplatelet therapy (2013) Br. J. Anaesth. 111 (suppl 1): i3-i17

Nationally, 710 patients had a record of receiving anticoagulant and / or antiplatelet agents (excluding aspirin) at any time in the month leading up to surgery

National	
Record	18% (710/3890)
Anticoagulant?	347
Antiplatelet agent?	349
Both	14

HOW WERE PATIENTS ON ORAL ANTICOAGULANTS MANAGED?

Patients on **oral anticoagulation** (e.g. warfarin, dabigatran, apixaban) should have the drug discontinued at least 5 days pre-op. The tables below show the number (%) of patients who discontinued therapy overall and by procedure (the latter shows national data only):

In the month leading up to surgery:	National	Your hospital
Patients on any oral anticoagulation	9% (361/3890)*	13% (3/23)
Stopped drug	87% (315/361) stopped	N=3
Stopped at least 5 days pre-op	48% (139/287)	n=0

* One patient was on two drugs (Dabigatran & warfarin) both stopped the day before surgery

TYPE OF PROCEDURE	On anti-coagulant	Stopped anticoagulant	Stopped at least 5 days before Op
<input type="checkbox"/> Primary unilateral total hip replacement	46	43	25/39
<input type="checkbox"/> Primary bilateral total hip replacement	3	3	0/2
<input type="checkbox"/> Primary unilateral total knee replacement	25	22	13/19
<input type="checkbox"/> Primary bilateral total knee replacement	-	-	-
<input type="checkbox"/> Unilateral revision hip replacement	31	29	13/27
<input type="checkbox"/> Unilateral revision knee replacement	7	7	5/7
<input type="checkbox"/> Colorectal resection for any indication	22	21	13/18
<input type="checkbox"/> Open arterial surgery	17	16	11/15

<input type="checkbox"/>	Primary coronary artery bypass graft	9	9	5/7
<input type="checkbox"/>	Valve replacement +/- CABG	79	65	42/56
<input type="checkbox"/>	Simple or complex hysterectomy	8	7	4/6
<input type="checkbox"/>	Cystectomy	2	2	0/1
<input type="checkbox"/>	Nephrectomy	9	7	5/7
<input type="checkbox"/>	# neck of femur (arthroplasty)	103	84	3/83
	Procedure not stated	-	-	-
Total		361	315	139/287

Nationally, 15 patients were on apixaban, 14 patients were on dabigatran, 38 patients were on rivaroxaban and 293 patients were on warfarin.

For those patients on warfarin, the median (IQR) INR result was 1.3 (1.1-1.5) (n=305) The more detailed breakdown for national data is shown in the table here:

National	
Patient on Warfarin pre-operatively	8.3% (318/3813)
INR result taken closest before surgery for those on Warfarin pre-operatively:	
<input type="checkbox"/> ≤1.0	49
<input type="checkbox"/> 1.1-1.4	164
<input type="checkbox"/> 1.5-1.9	50
<input type="checkbox"/> 2.0-2.4	17
<input type="checkbox"/> 2.5-2.9	6
<input type="checkbox"/> 3.0-3.4	7
<input type="checkbox"/> 3.5-4.4	8
<input type="checkbox"/> 4.5-5.9	2
<input type="checkbox"/> 6.0-7.9	-
<input type="checkbox"/> ≥8.0	2
Median (IQR) INR result	1.3 (1.1-1.5), n=305
Days between INR and surgery:	
<input type="checkbox"/> Same day as op	106
<input type="checkbox"/> Day before op	131
<input type="checkbox"/> Earlier	63
Median (IQR) days before op	1 (0-1), n=300

HOW WERE PATIENTS ON ANTIPLATELET AGENTS MANAGED?

Patients on **antiplatelet therapy** (e.g. clopidogrel, prasugrel, ticagrelor) should have the drug discontinued at least 5 days pre-operatively unless there is a good reason to continue it. Aspirin does not count towards this standard. The tables below show the number (%) of patients who discontinued therapy overall and by procedure (the latter shows national data only).

	National	Your hospital
Patients on any antiplatelet therapy*	9.3% (363/3890)	0% (0/23)

Stopped therapy	77% (279/363)	N=-
Stopped at least 5 days pre-op	57% (149/261)	N=23

** This count excludes aspirin. Note also that there were five of these patients who were on clopidogrel and ticagrelor. Two stopped clopidogrel within 5 days of surgery while three were not stopped. All five stopped ticagrelor, four at least 5 days before surgery. However only two stopped both drugs, which is what is counted here and none had both drugs stopped at least 5 days before surgery.*

TYPE OF PROCEDURE		On anti-platelet	Stopped antiplatelet	Stopped at least 5 days before Op
<input type="checkbox"/>	Primary unilateral total hip replacement	33	31	22/28
<input type="checkbox"/>	Primary bilateral total hip replacement	2	1	1/1
<input type="checkbox"/>	Primary unilateral total knee replacement	13	12	8/9
<input type="checkbox"/>	Primary bilateral total knee replacement	-	-	-
<input type="checkbox"/>	Unilateral revision hip replacement	15	14	7/13
<input type="checkbox"/>	Unilateral revision knee replacement	4	4	2/3
<input type="checkbox"/>	Colorectal resection for any indication	13	12	11/12
<input type="checkbox"/>	Open arterial surgery	42	23	17/23
<input type="checkbox"/>	Primary coronary artery bypass graft	42	34	25/32
<input type="checkbox"/>	Valve replacement +/- CABG	66	56	36/54
<input type="checkbox"/>	Simple or complex hysterectomy	6	4	3/3
<input type="checkbox"/>	Cystectomy	-	-	-
<input type="checkbox"/>	Nephrectomy	11	11	8/9
<input type="checkbox"/>	# neck of femur (arthroplasty)	114	75	7/72
	Procedure not stated	2	2	2/2
Total		363	281	149/261

Nationally, 337 patients were on clopidogrel, 2 patients were on prasugrel, 29 patients were on ticagrelor. 654 patients were on aspirin.

Of the 337 patients on clopidogrel, 82 patients continued on this drug: 10 because of acute coronary syndrome, 34 the reason was not recorded and 38 for other reasons including need for emergency surgery and patients with severe vascular disease.

Patient Blood Management whilst in theatre and recovery

PBM in the intra-operative period includes the use of antifibrinolytics such as tranexamic acid; there is accumulating evidence that tranexamic acid is safe and effective when used to reduce blood loss and minimise transfusion requirements in elective surgery; it is likely to be highly cost-effective.¹⁵

Other measures that should be attempted where appropriate include the use of cell salvage and haemostatic sealants.

Near patient testing of haemostasis is recommended for use particularly in cardiac surgery where studies have shown improved patient outcomes with the targeted management of coagulopathy¹⁸

When was tranexamic acid used?

Tranexamic acid was used in 1252/3805 cases (33%) nationally and in your hospital in **1/19 cases (5%)**. The majority of treatment was given intravenously and intra-operatively as shown in the table below:

	National	Your hospital
Tranexamic acid used	33% (1252/3805)	5% (1/19)
Oral, before surgery started	25	0
Oral, during surgery	1	0
Oral, after surgery	7	0
IV, before surgery started	368	0
IV, during surgery	912	1
IV, after surgery	66	0
Intra-articular, during surgery	1	0
Intra-articular, after surgery	-	-
Not known when TXA given known	18	0

Tranexamic acid was used most commonly in patients undergoing cardiac surgery, followed by those undergoing elective orthopaedic surgery. Further detail is shown here:

TYPE OF PROCEDURE	Tranexamic acid used
<input type="checkbox"/> Primary unilateral total hip replacement	47% (279/588)
<input type="checkbox"/> Primary bilateral total hip replacement	53% (16/30)
<input type="checkbox"/> Primary unilateral total knee replacement	38% (126/333)
<input type="checkbox"/> Primary bilateral total knee replacement	52% (14/27)
<input type="checkbox"/> Unilateral revision hip replacement	64% (162/255)
<input type="checkbox"/> Unilateral revision knee replacement	50% (33/66)

¹⁵ Ralley F. Tranexamic acid: When is enough (data) enough? Canadian Journal of Anesthesia 2015. doi:10.1007/s12630-015-0461-5. ¹⁸ Detecting, managing and monitoring haemostasis: viscoelastometric point-of-care testing (ROTEM, TEG and Sonoclot systems) (2014) <http://www.nice.org.uk/Guidance/DG13> accessed 20th Sept 2015

<input type="checkbox"/>	Colorectal resection for any indication	6% (16/287)
<input type="checkbox"/>	Open arterial surgery e.g.: scheduled	7% (10/152)
<input type="checkbox"/>	Primary coronary artery bypass graft	88% (101/115)
<input type="checkbox"/>	Valve replacement +/- CABG	73% (304/419)
<input type="checkbox"/>	Simple or complex hysterectomy	15% (51/332)
<input type="checkbox"/>	Cystectomy	12% (4/34)
<input type="checkbox"/>	Nephrectomy	10% (13/130)
<input type="checkbox"/>	# neck of femur (arthroplasty)	12% (120/1026)
	Procedure not stated	27% (3/11)
Total		33% (1252/3805)

Aprotinin was used in 32 cases (0.8%) nationally*

*Valve replacement +/- CABG (n=20), Primary coronary artery bypass graft (n=7), Primary unilateral total hip replacement (n=2), Open arterial surgery (n=2), Simple or complex hysterectomy (n=1)

Were topical haemostatic agents/sealants used?

Haemostatic agents were used in 200 cases (5.3%) nationally, although of these 59 should not have been recorded in this category. See the table here for further detail and for your hospital results:

	National	Your hospital
Haemostatic agents or sealants used	5.3% (200/3802)	0% (0/18)
What was used:*		
<input type="checkbox"/> Fibrin 7 thrombin sealants	72	
<input type="checkbox"/> Surgical adhesives & absorbable haemostatic dressings	61	
<input type="checkbox"/> Both the above	3	
<input type="checkbox"/> Others - i.e. not sealants and should not really be in this category	59	
<input type="checkbox"/> Not stated	5	

*These categories were formed from free-text stated by auditors

The sealants were mainly used in cardiac surgery and nephrectomy. Further details are shown here for the national dataset:

TYPE OF PROCEDURE	Haemostatic agents or sealants used
<input type="checkbox"/> Primary unilateral total hip replacement	1% (6/587)
<input type="checkbox"/> Primary bilateral total hip replacement	0% (0/30)
<input type="checkbox"/> Primary unilateral total knee replacement	2% (6/335)
<input type="checkbox"/> Primary bilateral total knee replacement	11% (3/27)
<input type="checkbox"/> Unilateral revision hip replacement	2% (6/256)

<input type="checkbox"/>	Unilateral revision knee replacement	0% (0/66)
<input type="checkbox"/>	Colorectal resection for any indication	4% (12/288)
<input type="checkbox"/>	Open arterial surgery e.g.: scheduled	7% (11/152)
<input type="checkbox"/>	Primary coronary artery bypass graft	24% (28/115)
<input type="checkbox"/>	Valve replacement +/- CABG	17% (69/418)
<input type="checkbox"/>	Simple or complex hysterectomy	10% (33/332)
<input type="checkbox"/>	Cystectomy	3% (1/32)
<input type="checkbox"/>	Nephrectomy	16% (21/129)
<input type="checkbox"/>	# neck of femur (arthroplasty)	0.4% (4/1024)
	Procedure not stated	0% (0/11)
Total		5% (200/3802)

Was intra-operative cell salvage utilised?

Collection for intra-operative cell salvage (IOCS) was commenced in 521 cases (14%). Of these, in 459 cases the red cells were reinfused. In 60 cases, the red cells were collected but not reinfused due to insufficient volume. The median (IQR) volume returned was 496 ml (303-714). Details for the national position and your hospital are shown below:

	National	Your hospital
Commenced	14% (521/3826)	0% (0/20)
Outcome of using IOCS:		
Collected but not reinfused due to insufficient volume	60	-
Collected and reinfused*	459	-
Not known	2	-
*Volume reinfused (ml): median (IQR)	496 (303-714), n=429	

The reasons that IOCS was not utilised are recorded in the table below (national data)

Why was cell salvage not commenced N=3305

	National
<input type="checkbox"/> IOCS was not available on the day of surgery	7% (229)
<input type="checkbox"/> Not worthwhile in this procedure as anticipated blood loss generally too low	40% (1320)
<input type="checkbox"/> Not considered in this procedure because of contaminated field	2% (76)
<input type="checkbox"/> Not considered in this procedure because of sepsis	1% (36)
<input type="checkbox"/> Not considered in this procedure because of malignancy	7% (237)
<input type="checkbox"/> Other reasons*	37% (1228)
<input type="checkbox"/> Cell salvage not available	374
<input type="checkbox"/> Miscellaneous clinical reasons	228

<input type="checkbox"/> Reason not recorded	626
<input type="checkbox"/> Not known	5% (179)

*These categories were formed from free-text stated by auditors

The types of procedure where IOCS was commenced is shown below

TYPE OF PROCEDURE	NATIONAL intra-operative cell salvage (IOCS) commenced
<input type="checkbox"/> Primary unilateral total hip replacement	4% (25/591)
<input type="checkbox"/> Primary bilateral total hip replacement	13% (4/30)
<input type="checkbox"/> Primary unilateral total knee replacement	8% (26/335)
<input type="checkbox"/> Primary bilateral total knee replacement	7% (2/27)
<input type="checkbox"/> Unilateral revision hip replacement	24% (62/256)
<input type="checkbox"/> Unilateral revision knee replacement	5% (3/66)
<input type="checkbox"/> Colorectal resection for any indication	0% (0/294)
<input type="checkbox"/> Open arterial surgery e.g.: scheduled	42% (64/154)
<input type="checkbox"/> Primary coronary artery bypass graft	63% (72/115)
<input type="checkbox"/> Valve replacement +/- CABG	55% (229/420)
<input type="checkbox"/> Simple or complex hysterectomy	4% (13/337)
<input type="checkbox"/> Cystectomy	6% (2/35)
<input type="checkbox"/> Nephrectomy	8% (10/130)
<input type="checkbox"/> # neck of femur (arthroplasty)	1% (6/1025)
Procedure not stated	27% (3/11)
Total	14% (521/3826)

Was near patient testing of haemostasis utilised?

Near patient testing of haemostasis was used in 579 cases (15%) of cases nationally. Activated clotting time was the most commonly performed test. The table here shows more detail for national and your hospital:

	National	Your site
Near patient testing of haemostasis undertaken	15% (579/3778)	-% (-/0)
Near patient testing options undertaken:	Known for 572	0
<input type="checkbox"/> TEG	35% (199)	-
<input type="checkbox"/> RoTEM	6% (36)	-
<input type="checkbox"/> Platelet function testing	2% (12)	-
<input type="checkbox"/> Activated Clotting Time	69% (396)	-

Other*

15% (85)

-

*other : consisted mainly of free text entries which largely consisted of blood gas analysis rather than near patient testing of haemostasis

The types of procedure where near patient testing of haemostasis was utilised is shown in the table for national data. These tests are most commonly used in cardiac surgery.

TYPE OF PROCEDURE		NATIONAL Near patient testing of haemostasis undertaken
<input type="checkbox"/>	Primary unilateral total hip replacement	2% (11/586)
<input type="checkbox"/>	Primary bilateral total hip replacement	3% (1/30)
<input type="checkbox"/>	Primary unilateral total knee replacement	1% (3/331)
<input type="checkbox"/>	Primary bilateral total knee replacement	4% (1/27)
<input type="checkbox"/>	Unilateral revision hip replacement	4% (10/254)
<input type="checkbox"/>	Unilateral revision knee replacement	0% (0/64)
<input type="checkbox"/>	Colorectal resection for any indication	3% (8/288)
<input type="checkbox"/>	Open arterial surgery	19% (28/151)
<input type="checkbox"/>	Primary coronary artery bypass graft	94% (108/115)
<input type="checkbox"/>	Valve replacement +/- CABG	88% (354/402)
<input type="checkbox"/>	Simple or complex hysterectomy	6% (21/334)
<input type="checkbox"/>	Cystectomy	9% (3/33)
<input type="checkbox"/>	Nephrectomy	9% (11/129)
<input type="checkbox"/>	# neck of femur (arthroplasty)	2% (18/1023)
	Procedure not stated	18% (2/11)
Total		15% (579/3778)

Intra-operative allogeneic red cell transfusion

Intra-operative transfusion is defined as any transfusion occurring during surgery or prior to departure from recovery using allogeneic red cells issued by the transfusion laboratory. This occurred in 25% (982/3851) of cases nationally and **4% (1/23)** in your hospital.

The Pre-transfusion Hb

The pre-transfusion Hb was checked within 1 hour before transfusing the first intra-operative unit in 631 cases (70%) nationally. The table here shows a breakdown of how the Hb was checked, both nationally and for your hospital:

	National	Your hospital
Pre-transfusion Hb checked	70% (631/898)	0% (0/1)
How was it checked:		
<input type="checkbox"/> Laboratory Hb from FBC sample	42	-

<input type="checkbox"/> Hb from blood gas analyser	405	-
<input type="checkbox"/> Hb from 'Masimo'	1	-
<input type="checkbox"/> Hb from Haemocue	165	-
<input type="checkbox"/> Other*	10	-
<input type="checkbox"/> Not known	8	-

Other* Method of check not documented

There were 604 cases nationally where the pre-transfusion Hb result was recorded. The median result from the national dataset and your hospital are shown here:

	National	Your hospital
Median Hb (IQR) g/L	83 (75-95), n=604	-%, n=0

Further details about the characteristics of the intra-operative transfusion episodes are shown here using the national dataset:

TYPE OF PROCEDURE	Any intra-operative transfusion with allogeneic red cells issued by the transfusion laboratory	Pre-transfusion Hb checked within 1 hour before transfusing the first unit	(if checked <1 hr) MEDIAN First intra-operative pre-transfusion Hb g/L
<input type="checkbox"/> Primary unilateral total hip replacement	13% (78/601)	59% (42/71)	86, n=40
<input type="checkbox"/> Primary bilateral total hip replacement	23% (7/30)	71% (5/7)	84, n=5
<input type="checkbox"/> Primary unilateral total knee replacement	4% (13/337)	75% (9/12)	94, n=9
<input type="checkbox"/> Primary bilateral total knee replacement	4% (1/27)	0% (0/1)	-
<input type="checkbox"/> Unilateral revision hip replacement	34% (86/254)	69% (55/80)	90, n=53
<input type="checkbox"/> Unilateral revision knee replacement	15% (10/67)	50% (4/8)	82, n=4
<input type="checkbox"/> Colorectal resection for any indication	39% (116/296)	64% (65/102)	83, n=63
<input type="checkbox"/> Open arterial surgery e.g.: scheduled (41% (62/152)	72% (43/60)	84, n=43
<input type="checkbox"/> Primary coronary artery bypass graft	39% (45/115)	93% (38/41)	76, n=36
<input type="checkbox"/> Valve replacement +/- CABG	44% (184/419)	89% (150/168)	79, n=146
<input type="checkbox"/> Simple or complex hysterectomy	34% (114/339)	59% (59/100)	83, n=56
<input type="checkbox"/> Cystectomy	36% (13/36)	80% (8/10)	84, n=8
<input type="checkbox"/> Nephrectomy	53% (69/130)	70% (46/66)	83, n=43
<input type="checkbox"/> # neck of femur (arthroplasty)	17% (180/1034)	62% (104/168)	82, n=95
Procedure not stated	29% (4/14)	75% (3/4)	77, n=3
Total	25% (982/3851)	70% (631/898)	83, n=604

THE REASON FOR TRANSFUSION

Active bleeding¹⁶ was given as the reason for intra-operative transfusion in 65% of cases (615/944). In 406 cases the estimated blood loss was given and the median (IQR) was 1184 (644-1940) ml. Further details including reasons transfusion was given in the absence of active bleeding are shown here both for the national dataset and your hospital:

THE NUMBER OF RED CELL UNITS TRANSFUSED AND THE POST-TRANSFUSION HB

Nationally, 82% of cases received 2 units or fewer intra-operatively. Further details for the national dataset and your hospital are shown here:

	National	Your hospital
Zero	0.5% (4)	
One	32% (288)	0
Two	50% (443)	1
Three	7% (63)	0
Four	6% (57)	0
Five to Nine	3% (30)	0
Ten or more	0.6% (5)	0

The Hb was checked on arrival in recovery in 35% (1306/3775) cases. Details of the median (IQR) Hb result for the national dataset and your hospital are shown here:

	National	Your hospital
Hb taken on arrival in recovery	35% (1306/3775)	13% (3/23)
Median (IQR)	97 (87-109), n=1277	Median: 89, n = 3

¹⁶ Active intra operative bleeding was defined as significant blood loss with haemodynamic instability in the audit protocol

	National	Your hospital
Patient had active bleeding	65% (615/944)	0% (0/1)
Estimated blood loss (EBL) in ml:		
Median (IQR)	1184 (644-1940), n=406	
If patient did not have active bleeding why were they transfused:*		
<input type="checkbox"/> Low BP or other hemodynamic reason	35	
<input type="checkbox"/> Hb drop	167	
<input type="checkbox"/> Blood loss - any volume recorded	16	
<input type="checkbox"/> Not known	111	

*These categories were formed from free-text stated by auditors

Patient Blood Management in the post-operative period

With the introduction of enhanced recovery pathways, the use of drains and therefore post-operative cell salvage is becoming less commonly used. In this audit, this procedure was considered optional¹⁹

There is very little evidence to support the use of post-operative iron; further research is required²⁰

¹⁹.Varandhan, KK, Lobo DN, Ljungqvist O, (2010) Enhanced Recovery After Surgery: The Future of Improving Surgical Care. Crit Care Clin. 26 :527-47

²⁰ Hogan, M; Klein, AA; Richards, T; (2015) The impact of anaemia and intravenous iron replacement therapy on outcomes in cardiac surgery. Eur J Cardiothorac Surg, 47 218-226.

Post-operative cell salvage

This was a relatively rare procedure occurring in 70 cases (1.9%) nationally; the technique usually used was reinfusion of shed blood. The table below shows more detail:

Post-operative cell salvage

	National	Your hospital
Post-operative cell salvage used*	1.9% (70/3782)	0% (0/20)
Which post-op cell salvage technique(s) was/were used:		
<input type="checkbox"/> Reinfused shed blood	51/67	
<input type="checkbox"/> Washed red cells	15/68	
<input type="checkbox"/> Other	1/68	
Total volume in ml of post-operative salvaged blood infused: median (IQR) <input type="checkbox"/>		
median (IQR)	300 (200-500), n=46	

*Primary unilateral total knee replacement (N=34), Valve replacement +/- CABG (N=12), Primary unilateral total hip replacement (N=8), Unilateral revision hip replacement (N=7), other procedures (N=9).

Post-operative Hb and use of post-operative iron

The first Hb result taken on day 1 (the next calendar day after surgery) was available in 3312 cases and the median (IQR) result was 91g/L (83-102) nationally and was available in **17** cases at your hospital with a median of **89g/L**.

Post-operative iron was given in 17% of cases (630/3782) nationally. Further details for the national dataset and for your hospital are given here:

	National	Your hospital
Patient given post-operative iron	17% (630/3782)	5% (1/20)
Given orally	609/619	1/1
Given as IV	10/619	-/1

The type of procedure where post-operative iron was given is shown here for the national dataset:

TYPE OF PROCEDURE	NATIONAL Post-operative iron
<input type="checkbox"/> Primary unilateral total hip replacement	17% (100/579)

<input type="checkbox"/>	Primary bilateral total hip replacement	13% (4/30)
<input type="checkbox"/>	Primary unilateral total knee replacement	15% (48/330)
<input type="checkbox"/>	Primary bilateral total knee replacement	22% (6/27)
<input type="checkbox"/>	Unilateral revision hip replacement	11% (28/252)
<input type="checkbox"/>	Unilateral revision knee replacement	21% (14/66)
<input type="checkbox"/>	Colorectal resection for any indication	12% (35/289)
<input type="checkbox"/>	Open arterial surgery e.g.: scheduled	11% (16/151)
<input type="checkbox"/>	Primary coronary artery bypass graft	11% (12/112)
<input type="checkbox"/>	Valve replacement +/- CABG	11% (46/417)
<input type="checkbox"/>	Simple or complex hysterectomy	39% (131/338)
<input type="checkbox"/>	Cystectomy	3% (1/35)
<input type="checkbox"/>	Nephrectomy	13% (17/129)
<input type="checkbox"/>	# neck of femur (arthroplasty)	17% (170/1016)
	Procedure not stated	18% (2/11)
Total		17% (630/3782)

Post-operative red cell transfusion

Nationally, 74% of patients (2878/3874) received at least one post-operative transfusion up to 7 days following surgery. 80% of these (2307) had a single transfusion episode. Further details from the national dataset and for your hospital are shown here:

Transfusion on any of the first seven post-operative days (*i.e. Day 1 to day 7*)

	National	Your hospital
Transfusion	74% (2878/3874)	78% (18/23)
How many episodes:* One	80% (2307)	
Two	13% (360)	
Three	2.2% (62)	
Four	0.3% (10)	
Five	<0.1% (2)	
Not known	4.8% (137)	

*A transfusion episode = any red cells transfused within a 24 hour period

Post-operative transfusion rates for the different procedures are shown here for national data:

TYPE OF PROCEDURE	Transfusion on any of the first seven post-operative days
-------------------	---

<input type="checkbox"/>	Primary unilateral total hip replacement	86% (520/607)
<input type="checkbox"/>	Primary bilateral total hip replacement	73% (22/30)
<input type="checkbox"/>	Primary unilateral total knee replacement	87% (293/336)
<input type="checkbox"/>	Primary bilateral total knee replacement	93% (25/27)
<input type="checkbox"/>	Unilateral revision hip replacement	67% (172/257)
<input type="checkbox"/>	Unilateral revision knee replacement	88% (59/67)
<input type="checkbox"/>	Colorectal resection for any indication	54% (161/297)
<input type="checkbox"/>	Open arterial surgery	59% (90/153)
<input type="checkbox"/>	Primary coronary artery bypass graft	80% (92/115)
<input type="checkbox"/>	Valve replacement +/- CABG	72% (302/421)
<input type="checkbox"/>	Simple or complex hysterectomy	62% (212/342)
<input type="checkbox"/>	Cystectomy	70% (26/37)
<input type="checkbox"/>	Nephrectomy	49% (64/130)
<input type="checkbox"/>	# neck of femur (arthroplasty)	80% (827/1040)
	Procedure not stated	87% (13/15)
Total		74% (2878/3874)

Characteristics of the first post-operative transfusion episode are shown here for the national dataset:

NATIONAL N=2868	
Days from surgery: median (IQR)	2 (1-3) N=2805
Who made the decision to transfuse: (These categories were formed by the auditors)	
<input type="checkbox"/>	Consultant- Anaesthetics & critical care 226
<input type="checkbox"/>	Consultant - Other specialty 332
<input type="checkbox"/>	Consultant - Specialty not known 259
<input type="checkbox"/>	Senior trainee - Anaesthetics & critical care 61
<input type="checkbox"/>	Senior trainee - Other specialty 242
<input type="checkbox"/>	Senior trainee - Specialty not known 142
<input type="checkbox"/>	Junior trainee - Anaesthetics & critical care 14
<input type="checkbox"/>	Junior trainee - Other specialty 225
<input type="checkbox"/>	Junior trainee - Specialty not known 469
<input type="checkbox"/>	Grade NK - Anaesthetics & critical care 149
<input type="checkbox"/>	Grade NK - Other specialty 205
<input type="checkbox"/>	Grade NK - Specialty not known 536
<input type="checkbox"/>	Nurse 8
Pre-transfusion Hb*, g/L: median (IQR)	79 (74-85) n=2717
Units of red cells given:	N=2842
<input type="checkbox"/>	One 31% (892)

<input type="checkbox"/> Two	61% (1729)
<input type="checkbox"/> Three	5% (149)
<input type="checkbox"/> Four or more	3% (72)
Hb recorded after each unit of red cells	29% (823/2818)
Patient had acute coronary ischaemia	6.0% (167/2794)
Reason for transfusion:	
<input type="checkbox"/> Active bleeding***	256
<input type="checkbox"/> An Hb <70 g/L without acute coronary syndrome	304
<input type="checkbox"/> An Hb <80 g/L with acute coronary syndrome	134
<input type="checkbox"/> Other****	2115
<input type="checkbox"/> Low BP or other hemodynamic reason	394
<input type="checkbox"/> Hb drop	1242
<input type="checkbox"/> Blood loss - any volume recorded	107
<input type="checkbox"/> Not known	372
<input type="checkbox"/> Not known	59

* within 12 hours of transfusion

*** Active post-operative bleeding defined as bleeding causing systolic Hb <90mmHg, and or heart rate >110bpm, and or return to theatre because of bleeding and or activation of major haemorrhage pathway.

****These categories were formed from free-text stated by auditors: FIRST transfusion only

What was the patient outcome post-operatively?

Information about whether there were complications of surgery was recorded in 3755 cases. The table here shows the breakdown of the type of complication for the national dataset and your hospital: Complications of surgery N=3755

	National	Your hospital
<input type="checkbox"/> No complications noted	78% (2938)	76% (16/21)
<input type="checkbox"/> Return to theatre	5.2% (195)	1
<input type="checkbox"/> VTE	0.5% (19)	0
<input type="checkbox"/> Wound infection	2.5% (92)	0
<input type="checkbox"/> Positive blood culture	0.5% (18)	0
Any of the above 4 complications	8.0% (301)	(1/21)
<input type="checkbox"/> Others	16% (603)	5

Complications by type of procedure are shown here for the national dataset:

TYPE OF PROCEDURE	Return to theatre	VTE	Wound infection	Positive Blood culture	Any of these 4 complications	Total cases
<input type="checkbox"/> Primary unilateral total hip replacement	7	4	11	1	3.4% (20)	581
<input type="checkbox"/> Primary bilateral total hip replacement	-	-	-	-	-	29

<input type="checkbox"/>	Primary unilateral total knee replacement	1	5	6	-	3.7% (12)	328
<input type="checkbox"/>	Primary bilateral total knee replacement	-	-	-	-	-	26
<input type="checkbox"/>	Unilateral revision hip replacement	6	1	11	1	6.5% (16)	245
<input type="checkbox"/>	Unilateral revision knee replacement	2	-	4	-	9.1% (6)	66
<input type="checkbox"/>	Colorectal resection	35	-	15	4	18% (53)	289
<input type="checkbox"/>	Open arterial surgery	20	-	8	2	18% (28)	152
<input type="checkbox"/>	Primary coronary artery bypass graft	13	-	4	2	16% (18)	112
<input type="checkbox"/>	Valve replacement +/- CABG	43	-	5	2	12% (48)	411
<input type="checkbox"/>	Simple or complex hysterectomy	42	-	6	-	14% (48)	332
<input type="checkbox"/>	Cystectomy	5	-	1	-	14% (5)	35
<input type="checkbox"/>	Nephrectomy	7	-	3	1	8.6% (11)	128
<input type="checkbox"/>	# neck of femur (arthroplasty)	14	9	18	5	3.6% (36)	1012
	Procedure not stated	-	-	-	-	-	9
	Total	195	19	92	18	8.0% (301)	3755

Transfusion reactions were reported rarely and details provided were sketchy.

National	
ANY adverse reaction	0.9% (23/2683)
Type of blood that caused the reaction: <input type="checkbox"/>	
Autologous	-
<input type="checkbox"/> Allogeneic	23
N=30 reactions from 23 cases	
Days from surgery: median (IQR)	2 (2-4), range 0-7, n=29

The commonest type of reaction was a mild febrile type, not considered severe enough for reporting to SHOT. There was one possible case of transfusion associated circulatory overload.

138(3.6%) patients died during the surgical admission. Further details are given here for the national dataset and your hospital:

	National	Your hospital
Patient died	3.6% (138/3874)	4% (1/23)
Days from surgery		
To date of death: median (IQR)	12 (6-24), n=138	Median: 4,n=1
To discharge: median (IQR)	8 (6-14), n=3670	Median: 13, n=22

DISCHARGE Hb

The median Hb (IQR) at discharge was 102g/L (94-109). Further details are given here for both the national dataset and your hospital.

Hb on or nearest to discharge/death (g/L)

	National	Your hospital
All patients: median (IQR)	102 (94-109), n=3764	Median: 109, n=23
Days from surgery to Hb: median (IQR)	7 (4-12), n=3703	

Limitations of the audit

There were a number of limitations to this audit. Only transfused patients were analysed; excluding who were not transfused may mean that we have missed the opportunity to identify those cases where excellent PBM practice was applied.

Patients with fractured neck of femur were included even though they were not elective cases in order to increase the number of cases in the audit. However, these patients accounted for 27% of the dataset and were significantly older and more likely to be female. This group was excluded from the analysis of pre-operative anaemia optimisation.

Restrictive transfusion thresholds were selected in line with the accumulating evidence. However there remains controversy about the transfusion threshold for patients undergoing cardiac surgery and those with coronary disease in general where a higher threshold may be appropriate, and in the audit a strict definition of acute coronary syndrome was the only allowance for a higher pre-transfusion Hb threshold of 80g/L

The audit can only assess what is recorded in clinical records and may not have been able to account for all aspects of clinical decision-making. However, good clinical record keeping is increasingly recognised as a core feature of sound and safe clinical practice.

Discussion

There has been an excellent participation rate by UK and Republic of Ireland hospitals and the number of cases represents the largest audit of PBM practice in surgical patients in the UK to date.

There is evidence of some excellent practice; for example, 85% of patients receiving a post-operative transfusion had at least one PBM measure applied.

There is room for improvement however against most of the audit standards, in particular the proactive management of pre-operative anaemia, the use of tranexamic acid and cell salvage during surgery and the adoption of a restrictive approach to transfusion in stable non-bleeding patients through the use of a lower Hb threshold than is current practice and a single unit policy.

The key and full findings reports clearly compare the results of individual hospitals against national data for each of the standards and a set of recommendations have been developed to support implementation of service improvement. This supplementary report provides further detailed information on the audit data which will also help hospitals target their activities appropriately.

The implementation of PBM will be further strengthened by the publication of the NICE Clinical Guideline on Transfusion and the Choosing Wisely campaign of the Academy of Medical Royal Colleges which will have 5 key messages about PBM.

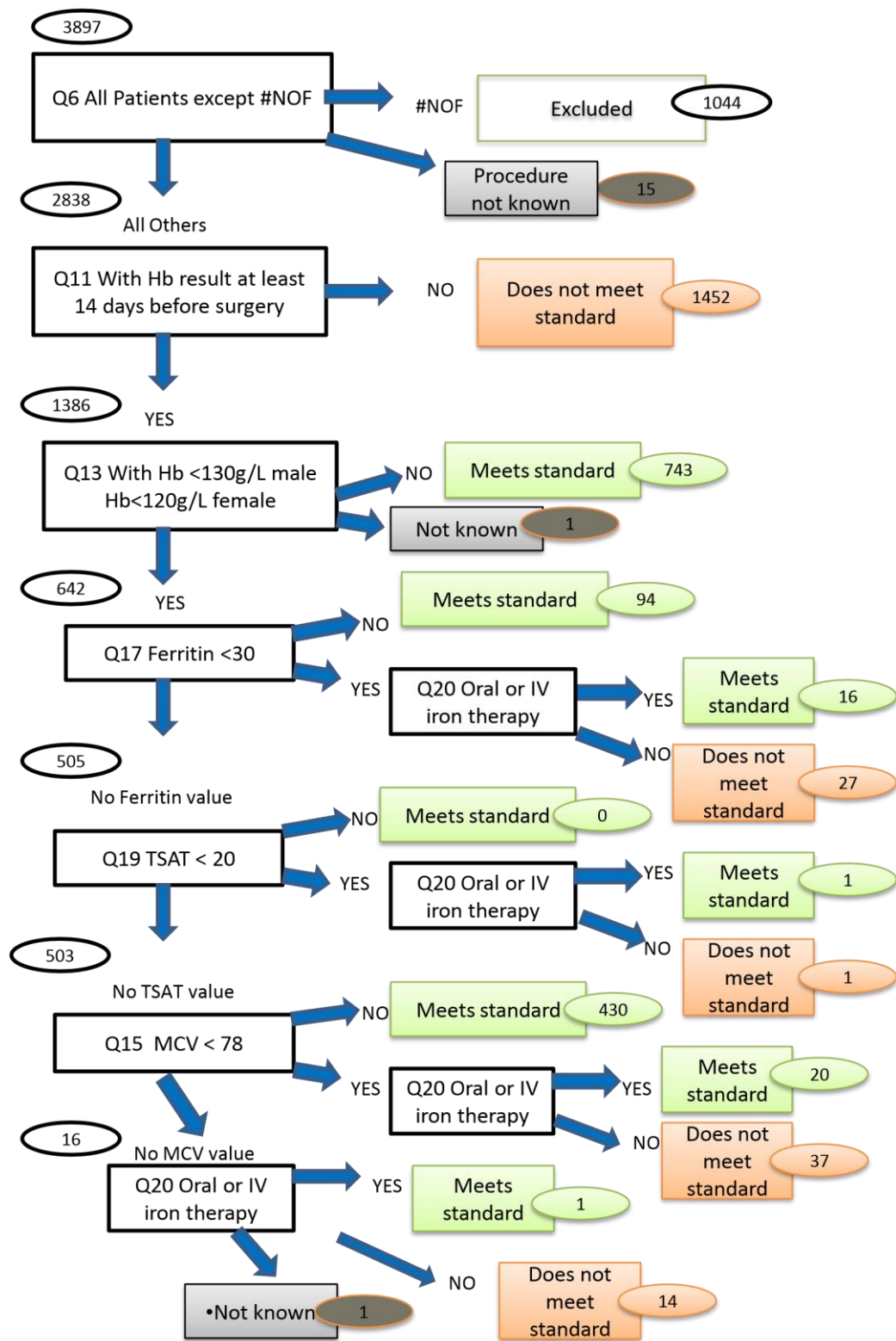
Abbreviations

BP	Blood pressure
CABG	Coronary artery bypass graft
Hb	Haemoglobin
INR	International normalised ratio
IOCS	Intra operative cell salvage
IQR	Inter quartile range
IV	Intra venous
MCH	Mean cell haemoglobin
MCV	Mean cell volume
NHSBT	NHS Blood and Transplant
OPCS4	OPCS Classification of Interventions and Procedures
PBM	Patient blood management
RoTEM	Rotational thromboelastometry
SHOT	Serious hazards of transfusion
TEG	Thromboelastography

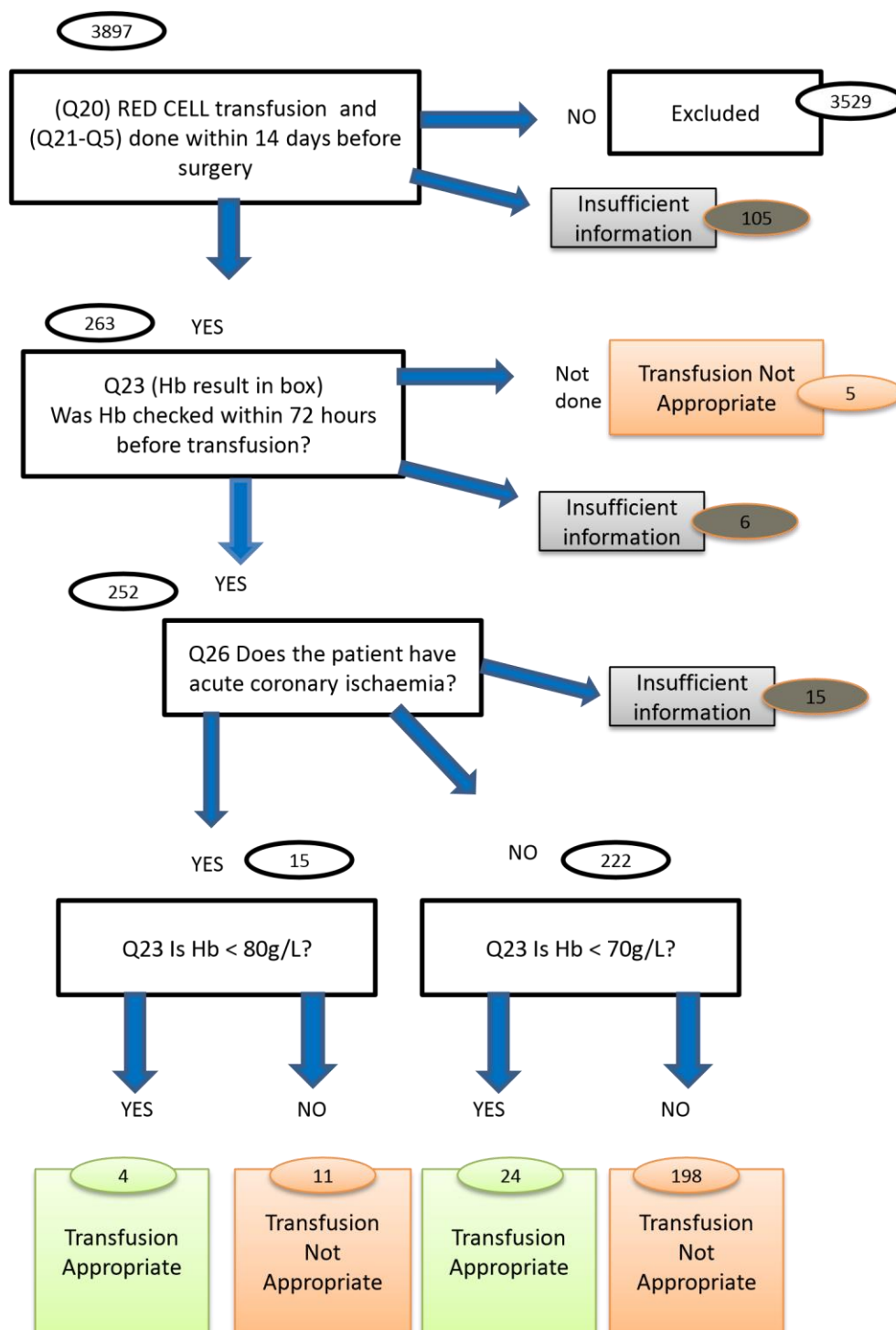
Appendix 1

PBM algorithms

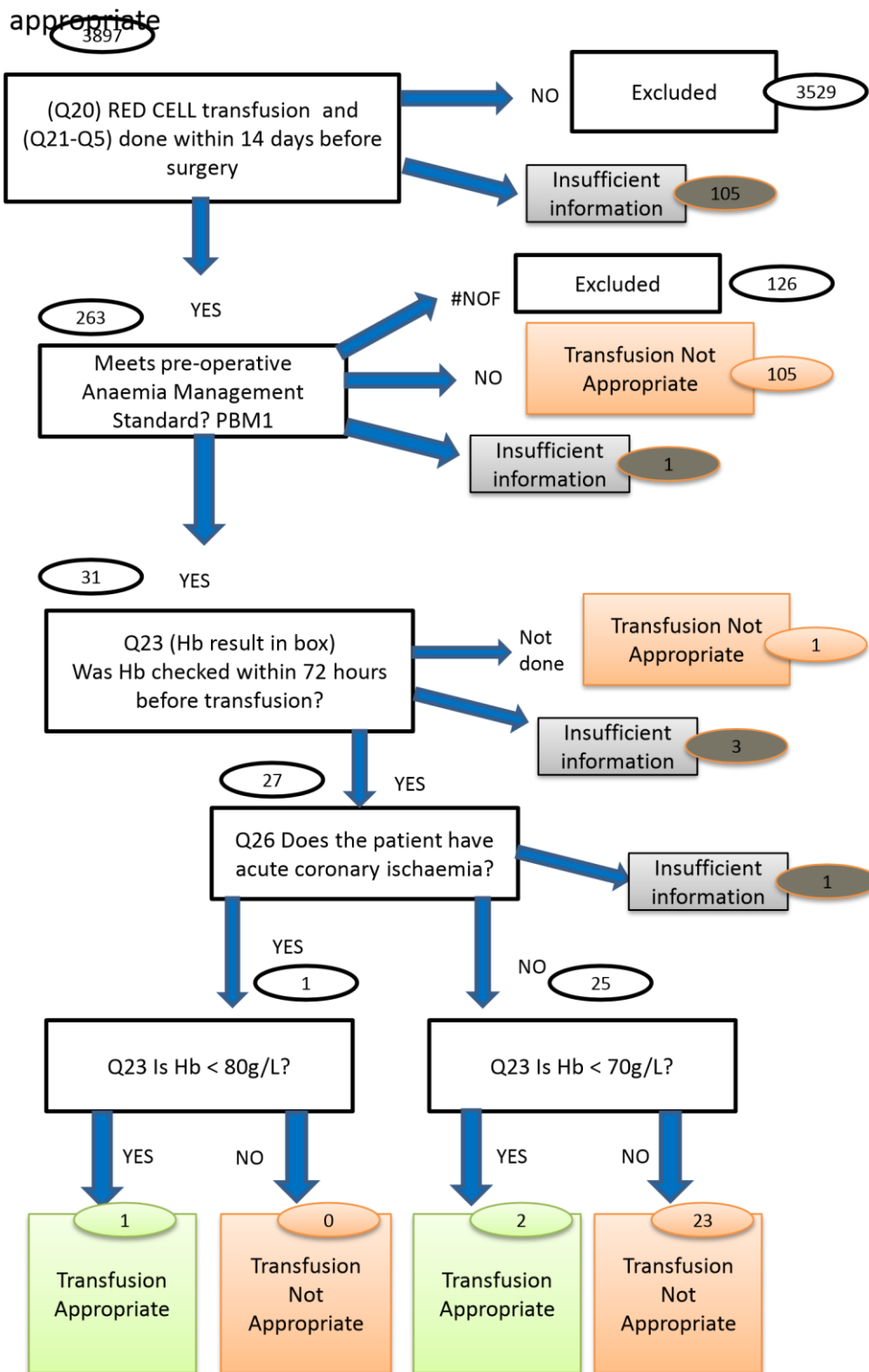
Algorithm for PBM standard 1 : Pre operative anaemia management



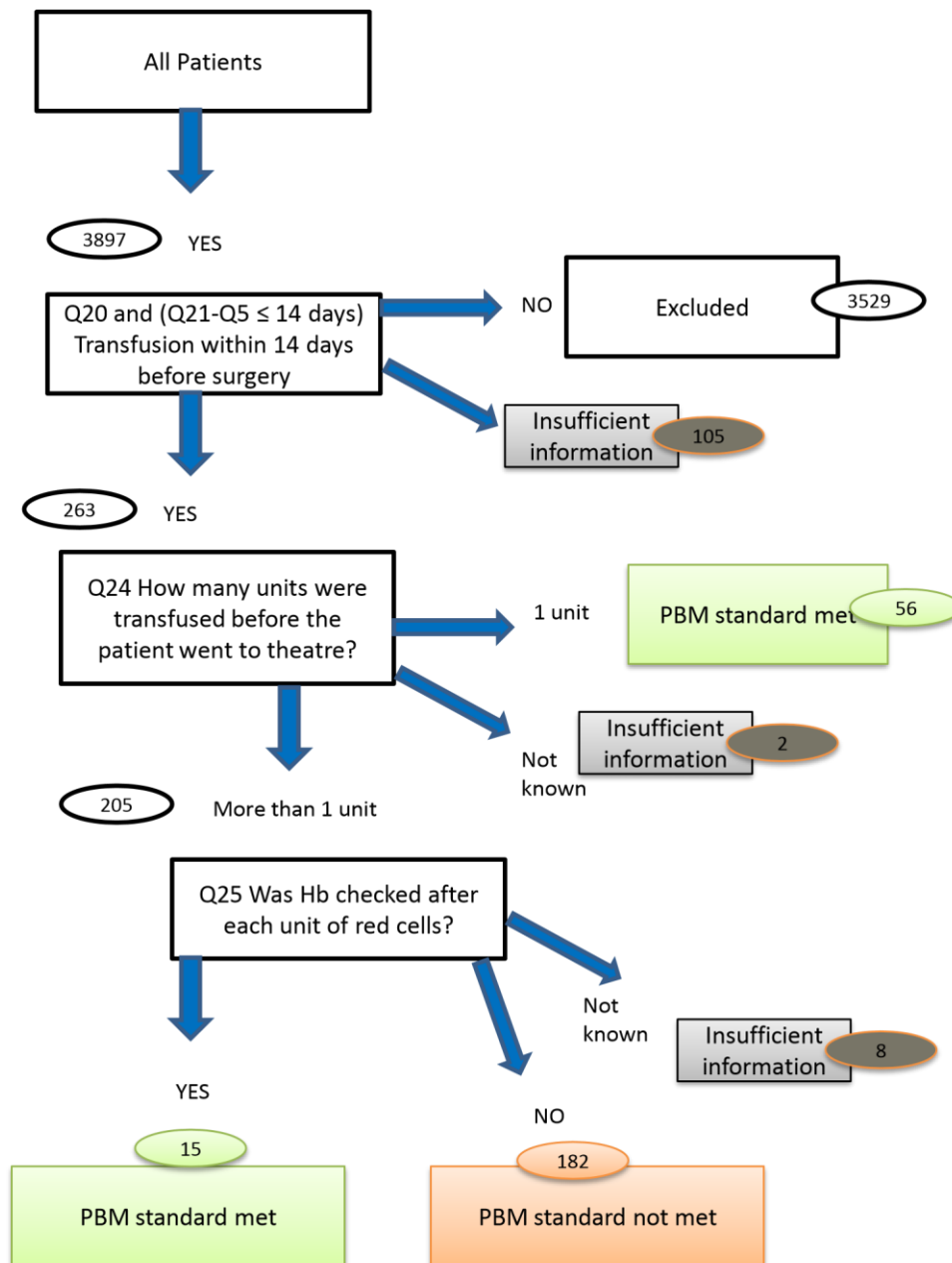
Algorithm for PBM standard 2 : Pre operative transfusion allowed



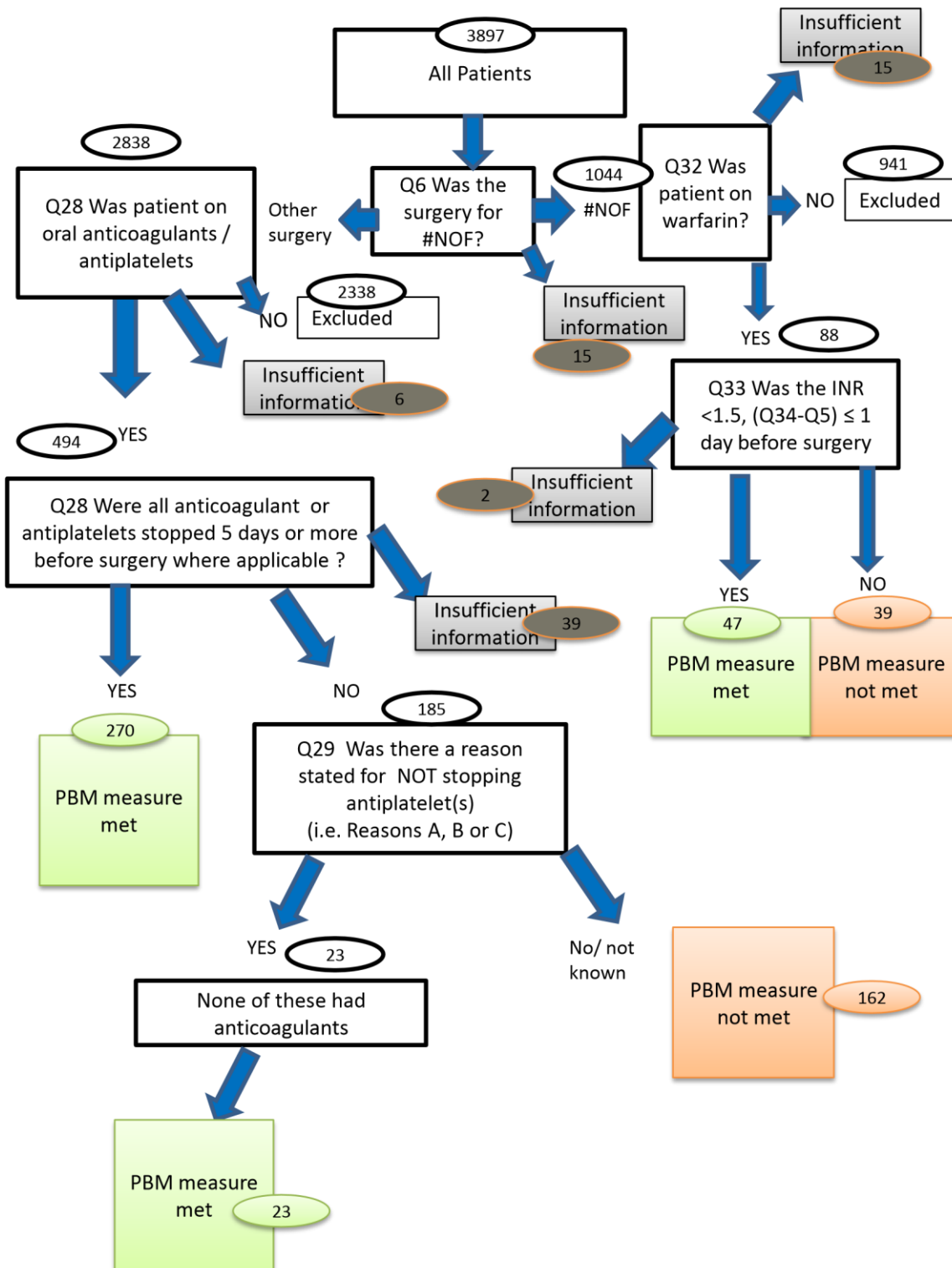
Algorithm for PBM standard 3 : Pre operative transfusion allowed only if preoperative anaemia optimisation has been attempted where



Algorithm for PBM standard 4 : Pre operative transfusion – single unit transfusion policy

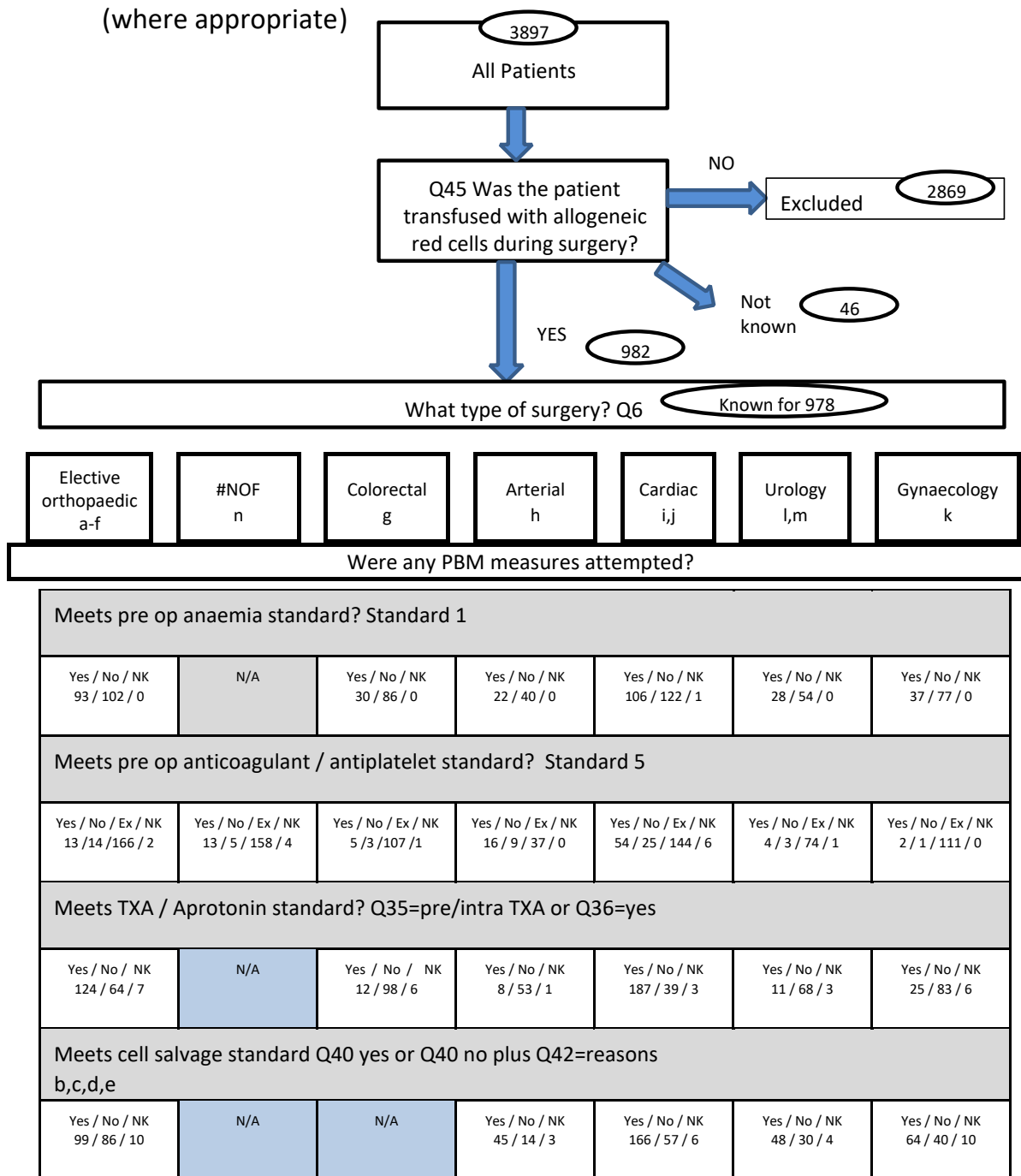


Algorithm for PBM standard 5 : Pre operative anticoagulant and antiplatelet management



Algorithm for PBM standard 6 : Patients having Intra operative transfusion in whom at least one PBM measure has been attempted

(where appropriate)

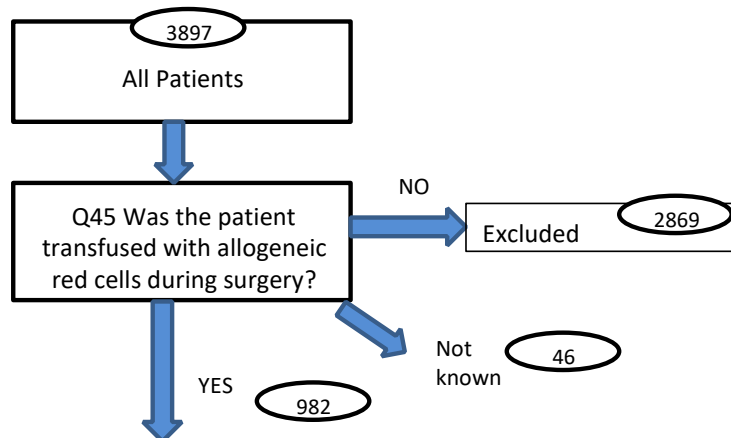


If yes to any (where applicable) standard is met

If no to all (where applicable) standard is not met

Algorithm for PBM standard 7 : Patients having Intra operative transfusion in whom all PBM measures has been attempted (where appropriate)

Revision /
bilateral
ortho
b,d,e,f



Q6 What type of surgery? Known for 978

Primary ortho a,c	#NOF n	Colorecta l g	Arterial h	Cardiac i,j	Urology l,m	Gynaecology k
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Were any PBM measures attempted?

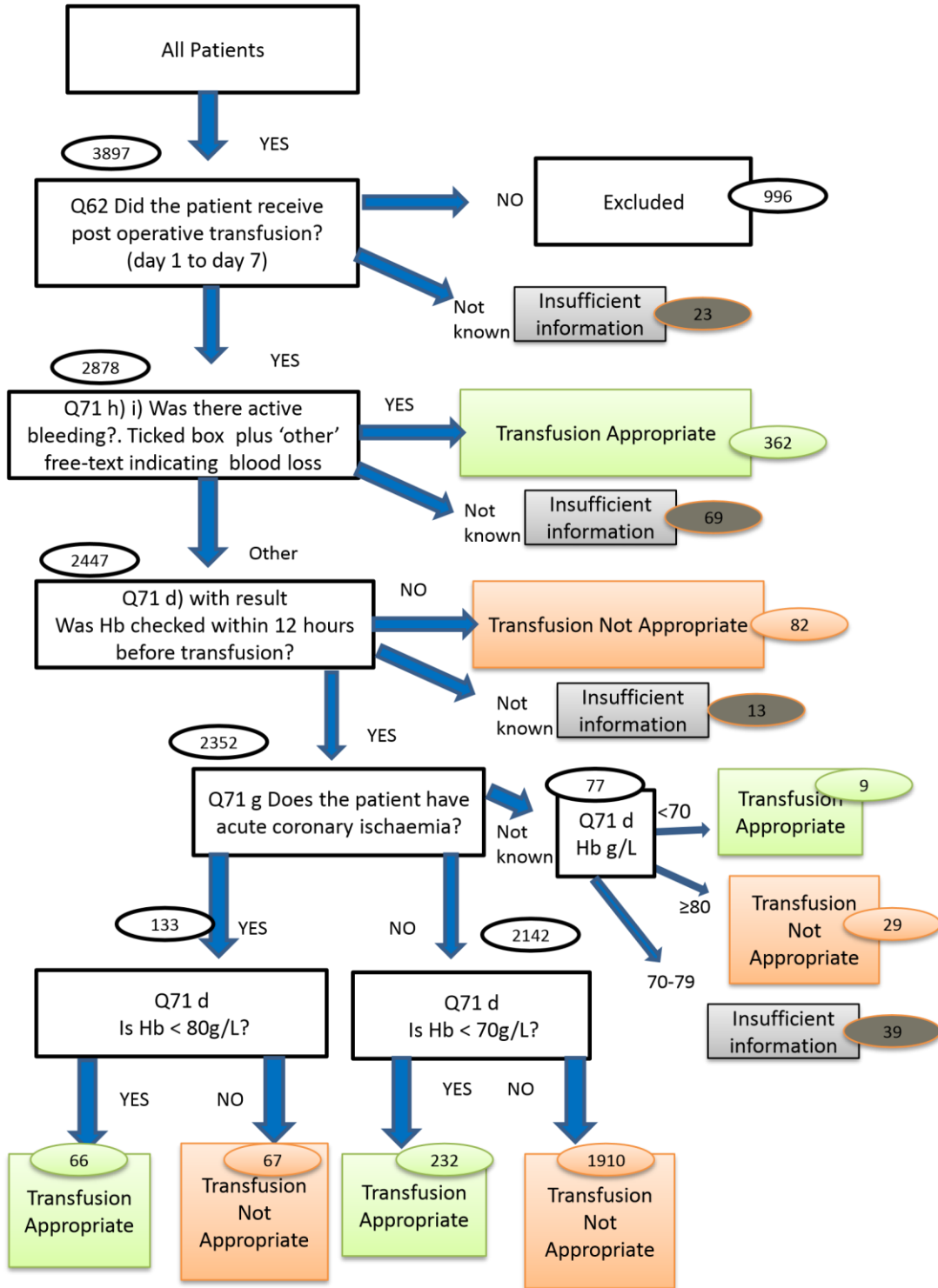
Meets pre op anaemia standard? Standard 1							
Yes /No/ NK 49 / 42 / 0	Yes /No/ NK 44 / 60 / 0	N/A	Yes / No / NK 30 / 86 / 0	Yes / No / NK 22 / 40 / 0	Yes / No / NK 106 / 122 / 1	Yes / No / NK 28 / 54 / 0	Yes / No / NK 37 / 77 / 0
Meets pre op anticoagulant / antiplatelet standard? Standard 5							
Yes/No/Ex/NK 6 / 2 / 83 / 0	Yes/No/Ex/NK 7 / 12 / 83 / 2	Yes/No/Ex/NK 13 / 5 / 158 / 4	Yes/No/Ex/NK 5 / 3 / 107 / 1	Yes/No/Ex/NK 16 / 9 / 37 / 0	Yes/No/Ex/NK 54 / 25 / 144 / 6	Yes/No/Ex/NK 4 / 3 / 74 / 1	Yes/No/Ex/NK 2 / 1 / 111 / 0
Meets TXA / Aprotinin standard? Q35=pre/intra TXA or Q36 = yes							
Yes /No / NK 57 / 30 / 4	Yes /No / NK 67 / 34 / 3	N/A	Yes / No / NK 12 / 98 / 6	Yes / No / NK 8 / 53 / 1	Yes / No / NK 187 / 39 / 3	Yes / No / NK 11 / 68 / 3	Yes / No / NK 25 / 83 / 6

Meets cell salvage standard Q40 yes or Q40 no plus Q42=reasons b,c,d,e							
N/A	Yes / No / NK 47 / 54 / 3	N/A	N/A	Yes / No / NK 45 / 14 / 3	Yes / No / NK 166 / 57 / 6	N/A	N/A

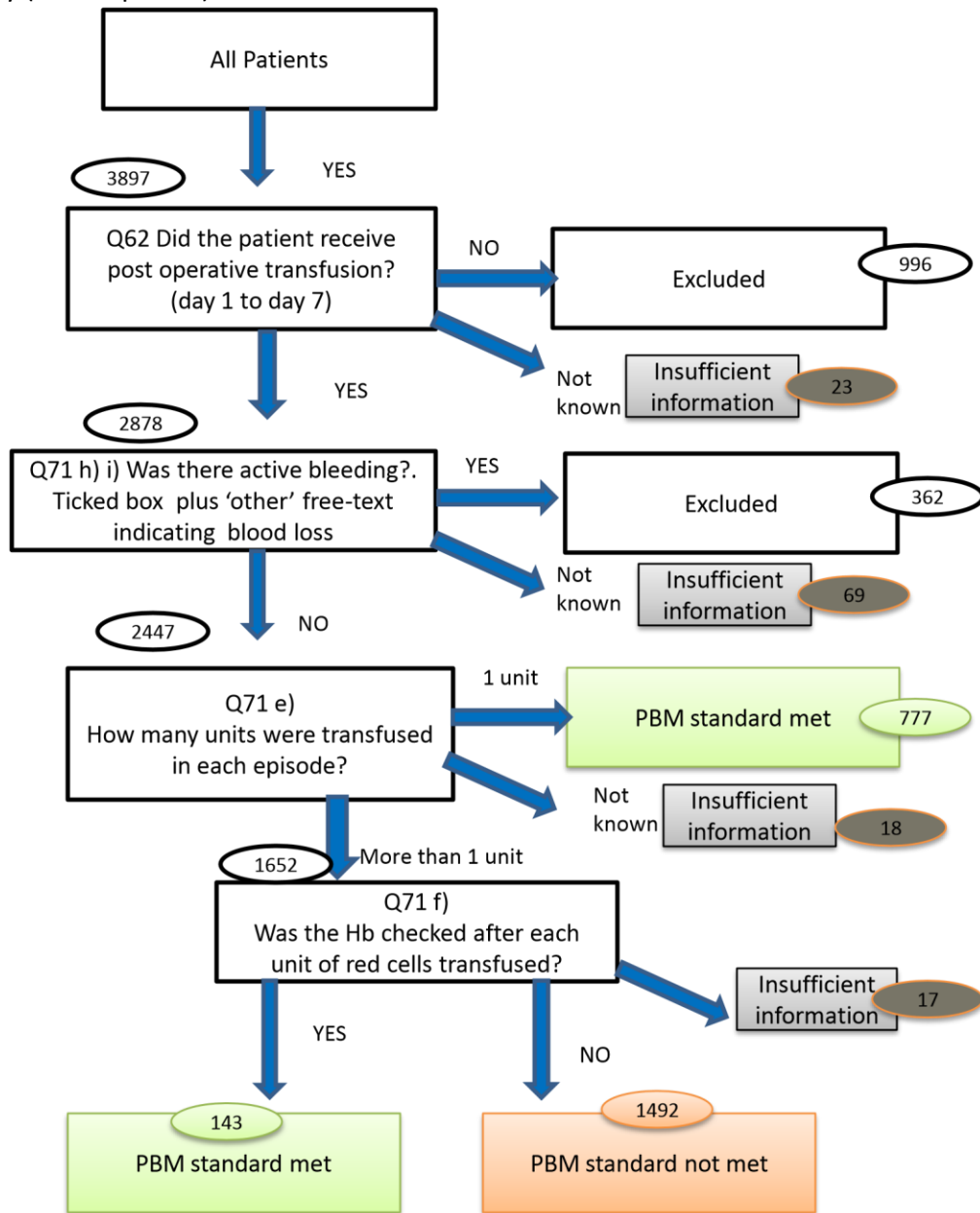
If yes to all (where applicable) standard is met

If no to any (where applicable) standard is not met

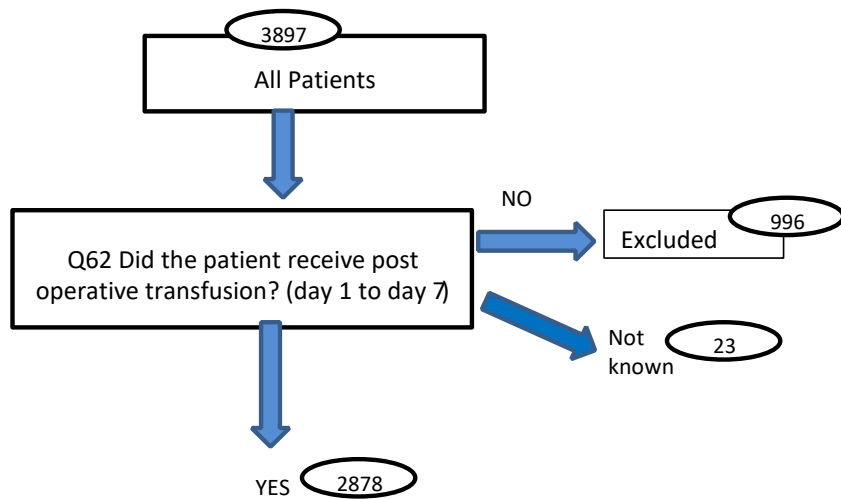
Algorithm for PBM standard 8 : Post operative transfusion allowed (whether or not PBM measures attempted) – FIRST transfusion episode



Algorithm for PBM standard 9 : Post operative transfusion following the single unit policy (FIRST episode)?



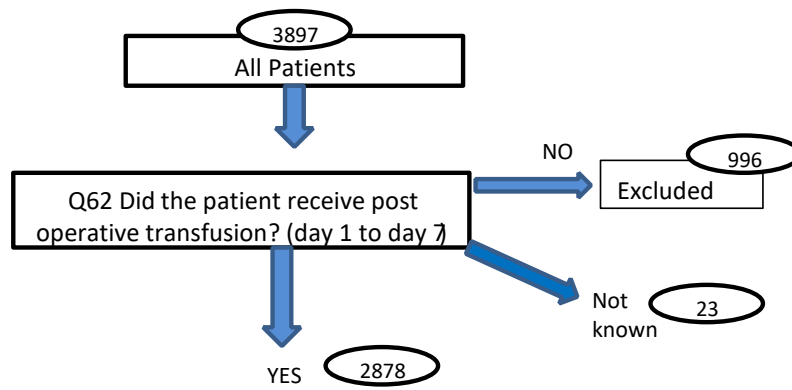
Algorithm for PBM standard 10 : Patients having post operative transfusion in whom at least one PBM measure has been attempted (where appropriate) (FIRST EPISODE)



What type of surgery? Known for 2865						
Elective orthopaedic a-f	#NOF n	Colorectal g	Arterial h	Cardiac i,j	Urology l,m	Gynaecology k
Were any PBM measures attempted?						
Meets pre op anaemia standard? Standard 1						
Yes/No/ NK 621 / 470 / 0	NA	Yes/No/ NK 43 / 118 / 0	Yes/No/ NK 30 / 60 / 0	Yes/No/ NK 151 / 241 / 2	Yes/No/ NK 39 / 51 / 0	Yes/No/ NK 83 / 129 / 0
Meets pre op anticoagulant / antiplatelet standard? Standard 5						
Yes/No/Ex/NK 76 / 50 / 947 / 18	Yes/No/Ex/NK 32 / 31 / 752 / 12	Yes/No/Ex/NK 11 / 4 / 143 / 3	Yes/No/Ex/NK 23 / 9 / 57 / 1	Yes/No/Ex/NK 81 / 49 / 251 / 13	Yes/No/Ex/NK 10 / 3 / 76 / 1	Yes/No/Ex/NK 5 / 5 / 200 / 2
Meets TXA / Aprotinin standard? Q35 =yes or Q36 = yes						
Yes/No/ NK 475 / 583 / 33	N/A	Yes/No/ NK 3 / 148 / 10	Yes/No/ NK 7 / 80 / 3	Yes/No/ NK 312 / 80 / 2	Yes/No/ NK 8 / 80 / 2	Yes/No/ NK 29 / 175 / 8
Meets cell salvage standard Q40 yes or Q40 no plus Q42=reasons b,c,d,e						
Yes/No/ NK 578 / 437 / 76	N/A	N/A	Yes/No/ NK 56 / 27 / 7	Yes/No/ NK 289 / 94 / 11	Yes/No/ NK 57 / 23 / 10	Yes/No/ NK 116 / 74 / 22
Meets post op cell salvage standard Q55=yes						
Yes/No/ NK 37 / 1021 / 33	N/A	N/A	N/A	Yes/No/ NK 11 / 376 / 7	N/A	N/A

If yes to any (where applicable) standard is met

If no to all (where applicable) standard is not met **Algorithm for PBM standard 11 :**
 Patients having post operative transfusion in whom all PBM measures have been attempted (where appropriate) (FIRST EPISODE)



What type of surgery? Known for 2865

Primary ortho a,c	Revision / bilateral ortho b,d,e,f	#NOF n	Colorectal g	Arterial h	Cardiac i,j	Urology l,m	Gynaecology k
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Were any PBM measures attempted?

Meets pre op anaemia standard? Standard 1							
Yes /No / NK 481 / 332 / 0	Yes /No / NK 140 / 138 / 0	N/A	Yes /No / NK 43 / 118 / 0	Yes /No / NK 30 / 60 / 0	Yes /No / NK 151 / 241 / 2	Yes /No / NK 39 / 51 / 0	Yes /No / NK 83 / 129 / 0
Meets pre op anticoagulant / antiplatelet standard? Standard 5							
Yes/No/Ex/NK 56/28/716/13	Yes/No/Ex/NK 20/22/231/5	Yes/No/Ex/NK 32/31/752/12	Yes/No/Ex/NK 11/4/143/3	Yes/No/Ex/NK 23/9/57/1	Yes/No/Ex/NK 81/49/251/13	Yes/No/Ex/NK 10/3/76/1	Yes/No/Ex/NK 5/5/200/2
Meets TXA / Aprotinin standard? Q35 =yes or Q36 = yes							
Yes /No / NK 325 / 459 / 29	Yes /No / NK 150 / 124 / 4	N/A	Yes /No / NK 3 / 148 / 10	Yes /No / NK 7 / 80 / 3	Yes /No / NK 312 / 80 / 2	Yes /No / NK 8 / 80 / 2	Yes /No / NK 29 / 175 / 8
Meets cell salvage standard Q40 yes or Q40 no plus Q42=reasons b,c,d,e							
N/A	Yes /No / NK 142 / 119 / 17	N/A	N/A	Yes /No / NK 56 / 27 / 7	Yes /No / NK 289 / 94 / 11	N/A	N/A
Meets post op cell salvage standard Q55=yes							
Yes /No / NK 28 / 760 / 25	N/A	N/A	N/A	Yes /No / NK 1 / 86 / 3	N/A	N/A	Yes /No / NK 0 / 206 / 6

If yes to all (where applicable) standard is met

If no to any (where applicable) standard is not met

Audit tool



**National Comparative Audit
of Blood Transfusion**



¹⁷ Audit of Patient Blood Management in Adults undergoing Scheduled Surgery

PATIENT AUDIT BOOKLET

Audited patient number

Auditor (s) job title

A. Patient demographics

Q1. What was the patient's year of birth?

Q2. Was the patient Male?

Female?

.....
B. Patient Blood Management in the period from listing for surgery to going to theatre

Q3. On what date was the patient listed for surgery? *ddmmyy*

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Q4. For what date was the surgery scheduled?

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Q5. What was the actual date of surgery?

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Q6. What was the type of procedure? *(Tick one option)*

- Primary unilateral total hip replacement
- Primary bilateral total hip replacement
- Primary unilateral total knee replacement
- Primary bilateral total knee replacement
- Unilateral revision hip replacement
- Unilateral revision knee replacement
- Colorectal resection for any indication (open or laparoscopic)

- Open arterial surgery e.g.: scheduled (non-ruptured) aortic aneurysm repair, infrainguinal femoropopliteal or distal bypass
- Primary coronary artery bypass graft
- Valve replacement +/- CABG
- Simple or complex hysterectomy
- Cystectomy
- Nephrectomy
- # neck of femur (arthroplasty)

Q7. Did the patient have a pre-operative assessment?

- Yes **Now go to Q8** No **Now go to Q11**

Q8. On what date did the patient have their first pre-operative assessment?

Q9. Who is responsible for reviewing the results of investigations taken at the pre-operative assessment?

-
- Not known
 Nurse

- Doctor – discipline and rank

Q10. If the pre-operative assessment took place less than 4 weeks before surgery what was the reason?

Q11. Were FBC results available in the time between listing for surgery and up to 14 days before surgery?

- Yes **Now go to Q12** No **Now go to Q20**

Q12. On what date during the time between listing for surgery and up to 14 days before surgery were the FBC results first available?

Q13. What was the Hb result? g/L

Q14. What was the MCH result? picograms **OR** Not available

Q15. What was the MCV result? femolitres **OR** Not available

Q16. Was ferritin checked? Yes **Now go to Q17** No **Now go to Q18** Q17. If yes, what was the ferritin result?
(State unit of measurement as well as value, and include reference range) **THEN GO TO Q18**

Value	Unit of measurement	Reference range
Q18. Was a transferrin saturation done?		

Yes **Now go to Q19** No **Now go to Q20**

Q19. What was the transferrin saturation? %

Q20. Was the patient on any of the following treatments before they had their operation?

None

Oral iron

IV iron

Erythrocytosis-stimulating agent (ESA) therapy

B12

Folic acid

Red cell transfusion - *Ticking this means the patient had a red cell transfusion before they went to theatre. Now go to Q21 to record details of that transfusion episode. Details of allogeneic red cell transfusion in theatre are recorded at Q45.*

NB: If you did not tick Red cell transfusion DO NOT complete this section. Go to Q28. Q21.

What was the date and time of transfusion of the first unit?

Date ddmmyy Time hh:mm

Q22. Who made the decision to transfuse? (Please state job title and, if doctor, give discipline and rank if possible)

Q23. What was the pre-transfusion Hb in g/L? (up to 72 hours before first unit transfused)

g/L **OR** Not done

Q24. How many units of red cells were given in all before the patient went to theatre?

Q25. Was the Hb recorded after each unit of red cells?

 Yes No

Q26. Did the patient have acute coronary ischaemia*?

 Yes No

(*definition of acute coronary ischaemia: STEMI (ST segment elevated myocardial infarction); NSTEMI (Non ST segment elevation myocardial infarction); Unstable angina within last 14 days)

Q27. If the patient was transfused at a pre-transfusion Hb of >70g/L (without acute coronary syndrome) or >80g/L (with acute coronary syndrome), please state reason for transfusion:

Q28 Was the patient on any of the following medications at any time in the month leading up to surgery (that is up until the time of Nil by Mouth), and if so were they stopped? If they were, give the date they were stopped. If they were not on any of them, tick "None/ No record" and go to Q30.

	Tick if patient on drug	Tick if stopped prior to surgery / or there is a note that patient was asked to stop	On what date was it stopped /or was the patient asked to stop?
Apixaban			
Dabigatran			
Rivaroxaban			
Warfarin			
Other oral anticoagulant (please state)			

Clopidogrel			
Prasugrel			
Ticagrelor			
Other antiplatelet agent (please state)			

None / No record of any of the above medication prior to surgery

Q29. If the patient was on clopidogrel, prasugrel or ticagrelor or other antiplatelet agent **and it was not stopped**, give details of the documented clinical reason for continuing it:

<i>Use a code to tell us the reason for continuing: A = coronary artery stent within last 12 months, B = acute coronary syndrome, C = other, D= don't know. If you use code C, please provide brief details</i>	
Clopidogrel	
Prasugrel	
Ticagrelor	
Other antiplatelet agent	

Q30. What was the pre-operative Hb taken closest before the date of surgery?

g/L **Now go to Q31** or Not done **Now go to Q32**

Q31. What was the date of that Hb check?

Q32. Was the patient on Warfarin pre-operatively?

Yes **Now go to Q33** No **Now go to Q35**

Q33. What was the INR result taken closest before the date of surgery?

Q34. What was the date of that INR check?

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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C: Patient Blood Management while in theatre and recovery

Q35. Was tranexamic acid used for this patient?

Yes **Complete the table below, then go to Q36** No **Now go to Q36**

<i>If used, write dose in relevant box</i>	Before surgery started	During surgery	After surgery
Oral			
IV			
Intra-articular			

Q36. Was aprotinin used for this patient?

Yes **Now go to Q37** No **Now go to Q38**

Q37. What was the dose used? (Please state in mls and not KIU) Dose

Q38. Were haemostatic agents or sealants used for this patient?

Yes **Now go to Q39** No **Now go to Q40**

Q39. Which agents or sealants were used?

Q40. Was collection for intra-operative cell salvage (IOCS) commenced?

Yes **Now go to Q41** No **Now go to Q42**

Q41. Which of these describes the outcome of using IOCS?

Collected but not reinfused due to insufficient volume

Collected and reinfused – (state volume reinfused)

mls

Q42. Why was cell salvage not commenced?

- IOCS was not available on the day of surgery
- Not worthwhile in this procedure as anticipated blood loss generally too low
- Not considered in this procedure because of contaminated field
- Not considered in this procedure because of sepsis
- Not considered in this procedure because of malignancy
- Other, please state:

Q43. Was near patient testing of haemostasis undertaken?

- Yes **Now go to Q44**
- No **Now go to Q45**

Q44. Which of these near patient testing options were undertaken? (tick as many as apply)

TEG

- RoTEM
- Platelet function testing
- Activated Clotting Time

Other, please state:

*Questions 45 to 52 ask about allogeneic blood that was transfused in theatre or recovery, in other words intra-operative transfusion. If allogeneic blood **was** used, answer Yes to Q45 and continue through to Q52. If allogeneic blood **was not** used, answer No to Q45 and go to Q53.*

We ask you to give details of post-op cell salvage and post-op allogeneic transfusion in Section D

Q45. Was there any intra-operative transfusion with allogeneic red cells issued by the transfusion laboratory?

Yes **Now go to Q46** No **Now go to Q53**

Q46. Who made the decision to transfuse? (*Please state job title and, if doctor, give discipline and rank if possible*)

Q47. Was the pre-transfusion Hb checked within 1 hour before transfusing the first unit?

Yes **Now go to Q48** No **Now go to Q50**

Q48. How was the pre-transfusion Hb checked?

- Laboratory Hb from FBC sample
- Hb from blood gas analyser
- Hb from 'Masimo'
- Hb from Haemocue
- Other, please state

Q49. What was the first intra-operative pre-transfusion Hb?

--	--	--

 g/L or Not done

Reason for intra-operative transfusion:

Q50. Did the patient have active bleeding?

Yes **Now complete the boxes below, then go to Q52** No **Now go to Q51**

Please state how the active bleeding was recorded in the notes: give estimated blood loss (EBL) and / or change in physiological parameters:

EBL (mls)	Change in parameters
-----------	----------------------

Q51. The patient did not have active bleeding, so why were they transfused?

Q52. How many units of red cells were transfused intra-operatively?

On arrival in recovery:

Q53. Was an Hb taken on arrival in recovery?

- Yes **Now go to Q54** No **Now go to Q55**

Q54. What was the Hb taken on arrival in recovery? g/L

D: Post-operative Patient Blood Management (when the patient had returned to the ward or had gone to HDU or similar)

Q55. Was post-operative cell salvage used?

- Yes **Now go to Q56** No **Now go to Q58**

Q56. Which post-op cell salvage technique(s) was/were used:

- Reinfused shed blood
 Washed red cells
 Other (You do not need to give us details of other techniques)

Q57. What was the total volume in mls of post-operative salvaged blood infused?

Q58. What was the first Hb taken on day 1? g/L or Not done
(Day 1 is the next calendar day after surgery)

Q59. Did any of these complications of surgery occur? (Tick as many as apply)

- No complications noted
- Return to theatre VTE Wound infection
 Positive blood culture Other, please state:

Q60. Was the patient given post-operative iron?

- Yes **Now go to Q61** No **Now go to Q62**

Q61. Was it given orally IV (Tick one or both as applicable)

This is where you tell us about any allogeneic red cells that were transfused once the patient had left recovery. A transfusion episode is all units of red cells given against one prescription.

Q62. Was there transfusion on any of the first seven post-operative days? (i.e. Day 1 to day 7)

Yes **Now go to Q63** No **Now go to Q66**

Q63. How many post-operative transfusion episodes were there?
(A transfusion episode = any red cells transfused within a 24 hour period)

- 1
- 2
- 3
- 4
- 5

If there were more than 5 episodes of post-operative allogeneic red cell transfusion in the 7 post-operative days, please contact us for advice on how to proceed.

Q64. Did the patient have an adverse reaction to ANY transfusion?

Yes **Now go to Q65** No **Now go to Q66**

Q65. What type of blood caused the reaction? Autologous Allogeneic

Q65a. Please supply details:

Date	Was the transfusion Pre-op, Intra-op or Post-op?	SHOT category

Q66. Did the patient die during this admission?

Yes **Now go to Q67** No **Now go to Q68**

Q67. What was the date of death?

Q68. What was the date of discharge?

Q69. What was the Hb on or nearest to discharge / death? g/L **Now go to Q70**

or Not done **Go to Episode 1 if there was post-operative transfusion with allogeneic blood**

Q70. What was the date of the Hb test?

Please record details of each post-operative transfusion episode:

Episode 1

a) Date of transfusion

b) Time of transfusion

c) Who made the decision to transfuse?

d) What was the pre transfusion Hb (within 12 hours of transfusion)? g/L

e) How many units of red cells were given?

f) Was the Hb recorded after each unit of red cells? Yes No

g) Did the patient have acute coronary ischaemia? Yes No

****Definition of acute coronary ischaemia: STEMI (ST segment elevated myocardial infarction), NSTEMI (Non ST segment elevation myocardial infarction) unstable angina) within last 14 days.**

h) What was the reason for transfusion?

Active bleeding

***Active post-operative bleeding defined as bleeding causing systolic Hb <90mmHg, and or heart rate >110bpm, and or return to theatre because of bleeding and or activation of major haemorrhage pathway.**

An Hb <70 g/L without acute coronary syndrome

An Hb <80 g/L with acute coronary syndrome

Other, please state

Episode 2

--	--	--	--	--	--

i) Date of transfusion

--	--	--	--

j) Time of transfusion

k) Who made the decision to transfuse?

--

l) What was the pre transfusion Hb (within 12 hours of transfusion)?

--	--	--

 g/L

m) How many units of red cells were given?

--	--

n) Was the Hb recorded after each unit of red cells?

Yes No

o) Did the patient have acute coronary ischaemia? Yes No

***Definition of acute coronary ischaemia: STEMI (ST segment elevated myocardial infarction), NSTEMI (Non ST segment elevation myocardial infarction) unstable angina) within last 14 days.*

p) What was the reason for transfusion?

Active bleeding

**Active post-operative bleeding defined as bleeding causing systolic Hb <90mmHg, and or heart rate >110bpm, and or return to theatre because of bleeding and or activation of major haemorrhage pathway.*

An Hb <70 g/L without acute coronary syndrome

An Hb <80 g/L with acute coronary syndrome

Other, please state

--

Episode 3

q) Date of transfusion

r) Time of transfusion

s) Who made the decision to transfuse?

t) What was the pre transfusion Hb (within 12 hours of transfusion)? g/L

u) How many units of red cells were given?

v) Was the Hb recorded after each unit of red cells? Yes No

w) Did the patient have acute coronary ischaemia? Yes No

***Definition of acute coronary ischaemia: STEMI (ST segment elevated myocardial infarction), NSTEMI (Non ST segment elevation myocardial infarction) unstable angina) within last 14 days.*

x) What was the reason for transfusion?

Active bleeding

**Active post-operative bleeding defined as bleeding causing systolic Hb <90mmHg, and or heart rate >110bpm, and or return to theatre because of bleeding and or activation of major haemorrhage pathway.*

An Hb <70 g/L without acute coronary syndrome

An Hb <80 g/L with acute coronary syndrome

Other, please state

Episode 4

y) Date of transfusion

z) Time of transfusion

aa) Who made the decision to transfuse?

ab) What was the pre transfusion Hb (within 12 hours of transfusion)? g/L

ac) How many units of red cells were given?

ad) Was the Hb recorded after each unit of red cells?

Yes No

ae) Did the patient have acute coronary ischaemia? Yes No

***Definition of acute coronary ischaemia: STEMI (ST segment elevated myocardial infarction), NSTEMI (Non ST segment elevation myocardial infarction) unstable angina) within last 14 days.*

af) What was the reason for transfusion?

Active bleeding

**Active post-operative bleeding defined as bleeding causing systolic Hb <90mmHg, and or heart rate >110bpm, and or return to theatre because of bleeding and or activation of major haemorrhage pathway.*

An Hb <70 g/L without acute coronary syndrome

An Hb <80 g/L with acute coronary syndrome

Other, please state

Episode 5

ag) Date of transfusion

ah) Time of transfusion

ai) Who made the decision to transfuse?

--

aj) What was the pre transfusion Hb (within 12 hours of transfusion)?

--	--	--

 g/L

ak) How many units of red cells were given?

--	--

al) Was the Hb recorded after each unit of red cells? Yes No

am) Did the patient have acute coronary ischaemia? Yes No

***Definition of acute coronary ischaemia: STEMI (ST segment elevated myocardial infarction), NSTEMI (Non ST segment elevation myocardial infarction) unstable angina) within last 14 days.*

an) What was the reason for transfusion?

Active bleeding

**Active post-operative bleeding defined as bleeding causing systolic Hb <90mmHg, and or heart rate >110 bpm, and or return to theatre because of bleeding and or activation of major haemorrhage pathway.*

An Hb <70 g/L without acute coronary syndrome

An Hb <80 g/L with acute coronary syndrome

Other, please state

--

If there were more than 5 episodes of post-operative allogeneic red cell transfusion in the 7 postoperative days, please contact us for advice on how to proceed.

END

Appendix 3

List of participating sites

Airedale NHS Foundation Trust	Dorset County Hospital NHS Foundation Trust
Altnagelvin Area Hospital	East and North Hertfordshire NHS Trust
Ashford and St Peters Hospitals NHS Foundation Trust	East Lancashire Hospitals NHS Trust
Barnet Hospital	Eastbourne Hospital
Barnsley Hospital NHS Foundation Trust	Forth Valley Royal Hospital
Barts Health NHS Trust	Frimley Park Hospital
Basildon and Thurrock University Hospitals NHS Foundation Trust	Furness General Hospital
Beaumont Hospital	Galway Clinic
Belfast Health and Social Care Trust	Galway University Hospital
Betsi Cadwaladr University Health Board	Gateshead Health NHS Foundation Trust
Birmingham Heartlands Hospital	George Eliot Hospital NHS Trust
Birmingham Women's NHS Foundation Trust	Gloucestershire Hospitals NHS Foundation Trust
Blackpool Victoria Hospital	Great Western Hospitals NHS Foundation Trust
Bon Secours Hospital Cork	Guys and St Thomas' NHS Foundation Trust
Borders General Hospital	Hammersmith Hospital
Bradford Teaching Hospitals NHS Foundation Trust	Hampshire Hospitals NHS Foundation Trust
Brighton and Sussex University Hospitals NHS Trust	Harrogate and District NHS Foundation Trust
Calderdale and Huddersfield NHS Foundation Trust	HCA International Group Hospitals
Central Manchester University Hospitals NHS Foundation Trust	Hinchingbrooke Hospital
Chase Farm Hospital	Homerton University Hospital NHS Foundation Trust
Chelsea and Westminster Hospital NHS Foundation Trust	Hospital of St John & St Elizabeth
Chesterfield Royal Hospital NHS Foundation Trust	Hull Royal Infirmary
Colchester Hospital University NHS Foundation Trust	James Paget University Hospital
Conquest Hospital	Kent & Canterbury Hospital
County Hospital (Stafford)	Kettering General Hospital NHS Foundation Trust
Craigavon Area Hospital	King Edward VII's Hospital Sister Agnes
Croydon Health Services NHS Trust	King's College Hospital NHS Foundation Trust
Darent Valley Hospital	King's Mill Hospital
Darlington Memorial Hospital	Kingston Hospital
Derby Hospitals NHS Foundation Trust	Lancashire Teaching Hospitals NHS Foundation Trust
Derriford Hospital	Liverpool Heart & Chest Hospital
Doncaster and Bassetlaw Hospitals NHS Foundation Trust	Liverpool Women's NHS Foundation Trust
Doncaster and Bassetlaw Hospitals NHS Foundation Trust	London North West Healthcare NHS Trust
Doncaster and Bassetlaw Hospitals NHS Foundation Trust	Maidstone Hospital
	Medway Maritime Hospital
	Mid Cheshire Hospitals NHS Foundation Trust
	Mid Essex Hospital Services NHS Trust

Milton Keynes NHS Foundation Trust
Nevill Hall Hospital
NHS Lothian
Norfolk & Norwich University Hospital
North Bristol NHS Trust
North Cumbria University Hospitals NHS Trust
North Middlesex University Hospital
North Tees and Hartlepool NHS Foundation Trust
Northern Devon Healthcare NHS Trust
Northern Lincolnshire and Goole Hospitals NHS Foundation Trust
Northumbria Healthcare NHS Foundation Trust
Nottingham University Hospitals NHS Trust
Nuffield Cheltenham Hospital
Nuffield Orthopaedic Centre (NHSI)
Oswestry Orthopaedic Hospital
Our Lady's Hospital Navan
Oxford University Hospitals NHS Trust
Papworth Hospital NHS Foundation Trust
Peterborough and Stamford Hospitals NHS Foundation Trust
Poole Hospital
Portsmouth Hospitals NHS Trust
Princess Alexandra Hospital
Queen Elizabeth Hospital Woolwich
Queen Elizabeth The Queen Mother Hospital
Queen's Hospital Burton
Queen's Hospital Romford
Ramsay Ashtead Hospital
Ramsay Duchy
Ramsay Euxton Hall Hospital
Ramsay Fitzwilliam Hospital
Ramsay Oaklands Hospital
Ramsay Park Hill Hospital
Ramsay Springfield Hospital
Ramsay West Midlands
Royal Berkshire Hospital
Royal Bolton Hospital
Royal Brompton and Harefield NHS Foundation Trust
Royal Devon & Exeter Hospital
Royal Free Hospital
Royal Gwent Hospital
Royal Lancaster Infirmary
Royal National Orthopaedic Hospital NHS Trust
Royal Surrey Country Hospital
Royal United Hospital
Salford Royal NHS Foundation Trust
Salisbury NHS Foundation Trust
Sandwell and West Birmingham Hospitals NHS Trust
Scarborough General Hospital
Sheffield Teaching Hospitals NHS Foundation Trust
Torbay and South Devon NHS Foundation Trust
South Infirmary Victoria University Hospital Cork
South Tees Hospitals NHS Foundation Trust
South Tyneside NHS Foundation Trust
South Warwickshire NHS Foundation Trust
South West London Elective Orthopaedic Centre
Southampton General Hospital
Southend University Hospital
Southport and Ormskirk Hospital NHS Trust
Spire Alexandra Hospital
Spire Bristol Hospital
Spire Cambridge Lea
Spire Clare Park Hospital
Spire Gatwick Park Hospital
Spire Harpenden Hospital
Spire Hull & East Riding Hospital
Spire Leicester Hospital
Spire Little Aston Hospital
Spire Murrayfield Hospital Wirral
Spire Parkway Hospital
Spire South Bank Hospital - Hospital
Spire St Anthony's Hospital
Spire Thames Valley Hospital
Spire Washington Hospital
Spire Wellesley Hospital
Spire Yale Hospital
St Mary's Hospital, Paddington
St. George's University Hospitals NHS Foundation Trust

St. Vincent's University Hospital
 St. Woolos Hospital
 Stockport NHS Foundation Trust
 Sunderland Royal Hospital
 Surrey and Sussex Healthcare NHS Trust
 Tameside Hospital NHS Foundation Trust
 Taunton & Somerset Hospital
 The Dudley Group of Hospitals NHS Foundation Trust
 The Hillingdon Hospitals NHS Foundation Trust
 The Ipswich Hospital NHS Trust
 The Leeds Teaching Hospitals NHS Trust
 The Mid Yorkshire Hospitals NHS Trust
 The Montefiore Hospital
 The Newcastle upon Tyne Hospitals NHS Foundation Trust
 The Pennine Acute Hospitals NHS Trust
 The Queen Elizabeth Hospital King's Lynn NHS Foundation Trust
 The Rotherham NHS Foundation Trust
 The Royal Bournemouth & Christchurch Hospitals NHS Foundation Trust
 The Royal Liverpool and Broadgreen University Hospitals NHS Trust
 The Royal Marsden NHS Foundation Trust
 The Royal Orthopaedic Hospital Birmingham
 The Royal Wolverhampton Hospitals NHS Trust
 The Shrewsbury and Telford Hospital NHS Trust
 The Ulster Hospital
 The York Hospital
 United Lincolnshire Hospitals NHS Trust
 University College London Hospitals NHS Foundation Trust

 University Hospital Aintree
 University Hospital Coventry
 University Hospital Lewisham
 University Hospital Limerick
 University Hospital of North Durham
 University Hospital of South Manchester NHS F. Trust
 University Hospitals Birmingham NHS Foundation Trust
 University Hospitals Bristol NHS Foundation 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 NHS Trust
 West Suffolk NHS Foundation Trust
 Western Sussex Hospitals NHS Foundation Trust
 Westmorland General Hospital
 Weston Area Health NHS Trust
 Wexham Park Hospital
 Whiston Hospital
 William Harvey Hospital
 Worcestershire Acute Hospitals NHS Trust
 Wrightington, Wigan and Leigh NHS Foundation Trust
 Wye Valley NHS Trust
 Yeovil District Hospital NHS Foundation Trust