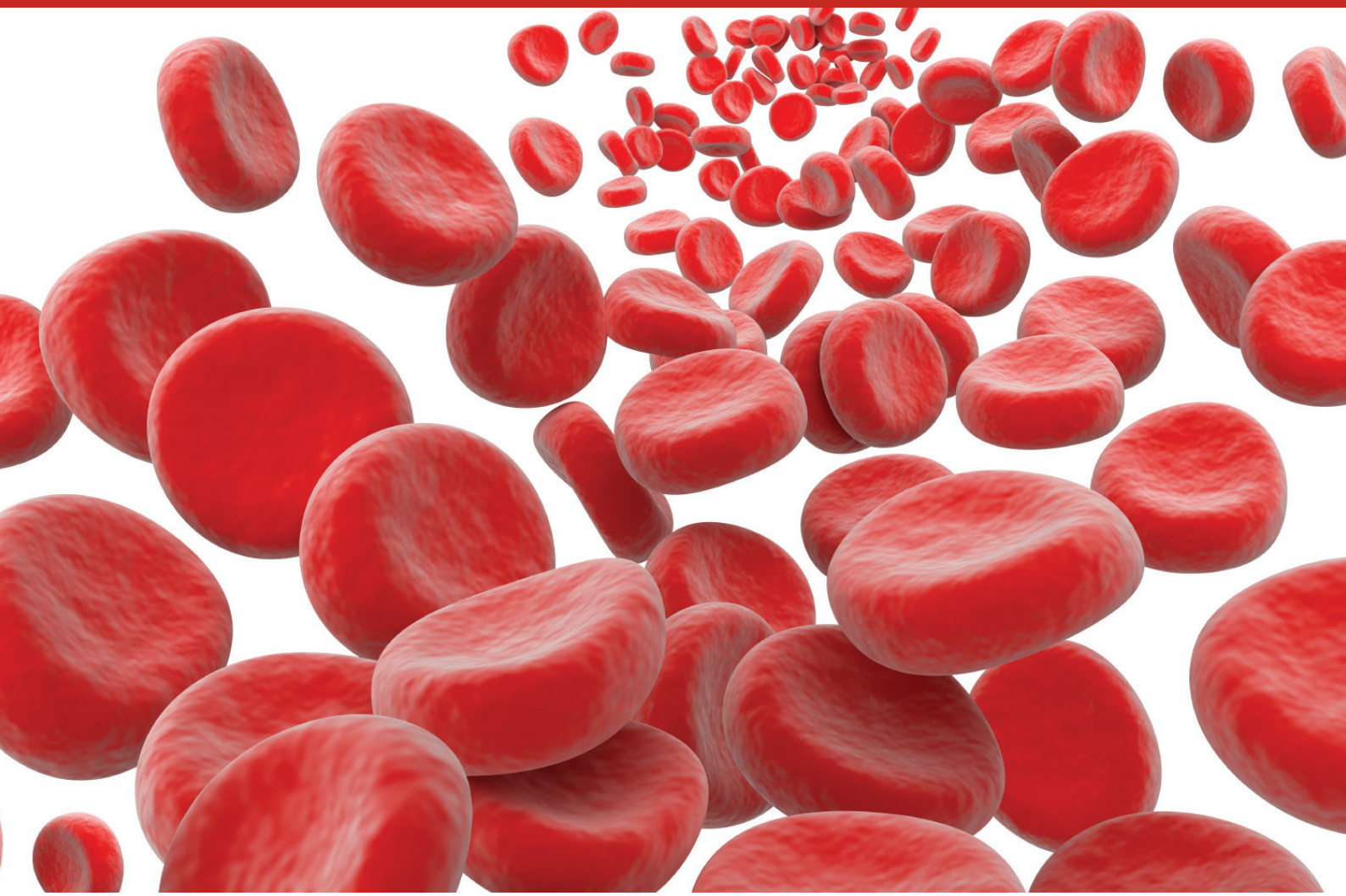
Clinical audit of elective red blood cell use in medical, surgical and obstetric adult patients – 2014

Blood Matters



Department of Health & Human Services

Australian Red Cross BLOOD SERVICE

State Government Victoria

Clinical audit of elective red blood cell use in medical, surgical and obstetric adult patients – 2014

Blood Matters

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Contents

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Blood Matters would like to thank everyone who contributed to this audit on the appropriate use of red blood cells.

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- Blood Matters team
- Dr Chris Hogan
- Dr Frank Hong
- Dr Marija Nedeljkovic
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- Ms Laurene Graham

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Abbreviations, acronyms and definitions

ACS: acute coronary syndrome

ACT: Australian Capital Territory

ASBT: Australiasian Society of Blood Transfusion

CIC: critical/intensive care

CRG: clinical/consumer reference group

Hb: haemoglobin

MTP: massive transfusion protocol

NBA: National Blood Authority

NHMRC: National Health and Medical Research Council

NT: Northern Territory

PBM: patient blood management

PP: practice point

PPH: postpartum haemorrhage

RBC: red blood cell

Definitions

Blood Matters: Victorian Government funded program run in collaboration with the Australian Red Cross Blood Service to measure and promote the quality, safety and appropriate use of blood and blood products.

Elective transfusion: a planned event or expected outcome, for example elective surgery, medical management of anaemia, thrombocytopenia or coagulation reversal.

Patient blood management (PBM): the management and preservation of patients' own blood to reduce or avoid the need for a blood transfusion (NBA 2012a,b,c).

Allogenic blood transfusion: a blood transfusion that involves collecting and infusing the blood of a compatible donor into a different person/patient.

Autologous blood transfusion: collection and re-infusion of the patient's own blood or blood components.

Limitations

This audit includes the following limitations:

- The auditors are not formally instructed to collect the data in a consistent way.
- Blood Matters relies on auditors to follow the audit tool instructions to ensure consistency of data.
- The definition of autologous blood collected was not defined as preoperative collection only, and as such auditors may have selected this option in line with reporting the use of cell salvage.
- Regarding documentation of cell salvage and units transfused, when the data was collected no distinction was made between transfusions of collected units via salvage, or if the units transfused were additional allogeneic units.

The transfusions reported were selected at the auditor's discretion, and may have been influenced by his or her knowledge and understanding of transfusion appropriateness, along with the documentation and reporting at the time of the transfusion.

Executive summary

The National Blood Authority (NBA) is developing six patient blood management (PBM) modules for Australian clinicians to improve patient outcomes and avoid risks associated with unnecessary exposure to blood and blood products.

Four modules have been released including:

- Module 1: Critical bleeding / massive transfusion
- Module 2: Perioperative
- Module 3: Medical
- Module 4: Critical care.

Module 5: Obstetrics and maternity was approved in November 2014 and released April 2015, and Module 6: Paediatrics is in development.

Process

In 2014, Blood Matters invited 147 health services in Victoria, Tasmania, Australian Capital Territory (ACT) and Northern Territory (NT) to participate in a red blood cell (RBC) appropriateness audit to examine alignment with NBA PBM modules 2, 3 and 4.

Health services were asked to audit up to 30 adult patients (≥ 16 years of age) admitted to medical, surgical, critical/intensive care and obstetrics clinical areas who had received an elective red cell transfusion during 2013.

Ninety-three health services (63 per cent) submitted data, with a total number of 2,170 transfusion episodes reported. Of these transfusion episodes, 98 (4.5 per cent) were excluded due to insufficient data or non-elective transfusion such as in critical bleeding or postpartum haemorrhage.

Data for 2,072 episodes was analysed and reported as it relates to each relevant PBM module. A total of 1,854 (89 per cent) red cell transfusion episodes were considered aligned by the use of a computerised algorithm or by medical review.

Module 2: Perioperative

There were 593 episodes (27 per cent) allocated as perioperative. Of these episodes, 558 (94 per cent) were deemed aligned.

Single unit transfusion guidelines were followed in 286 episodes (51 per cent).

Cell salvage was reported in 45 (8 per cent) of the perioperative episodes.

The use of preoperative autologous collection was reported in 20 episodes (3 per cent) although this practice is not recommended in the PBM guidelines.

Module 3: Medical

There were 1,315 episodes (63 per cent) allocated as medical. Of these episodes, 1,146 (87 per cent) were deemed aligned.

Single unit transfusion guidelines were followed in 501 episodes (38 per cent).

Iron deficiency was documented in 332 episodes (25 per cent).

Module 4: Critical care

There were 164 episodes (eight per cent) allocated as critical care. Of these episodes, 150 (91 per cent) were deemed aligned, with 114 (69 per cent) considered as following single unit transfusion guidelines.

Conclusion

While a significant proportion of the reported episodes do align with the current guidelines, much of the literature published since the release of the NBA PBM guidelines supports the use of lower transfusion thresholds in specific clinical scenarios (Hogshire and Carson 2013; Parker 2013; Goodnough and Murphy 2014; Shander et al. 2013).

As such, health services should continue to monitor the appropriateness of transfusion and strive for lower transfusion thresholds. Initiatives such as the implementation of clinical decision tools to assist appropriate prescription have shown to be beneficial (Goodnough and Murphy 2014).

Recommendations

Blood Matters recommends that health services:

- disseminate all the PBM guidelines widely
- provide targeted education for the appropriate clinical groups, highlighting PBM recommendations and practice points
- undertake regular reviews of appropriateness.

A full list of recommendations is outlined in the next section.

Tools and resources to support the implementation of guidelines are included in the report.

‘Better transfusion practice should not be viewed as an option, but a necessity to ensure clinicians are giving benefit and not doing harm to their patients’ (Shander et al. 2013).

‘Better transfusion practice also impacts on costs to health services with some studies outlining the significant cost benefits of restrictive transfusion practice and the use of bloodless surgery’ (Shander et al. 2010).

Summary of recommendations

General recommendations

- Disseminate PBM guidelines to all areas (perioperative, medical and critical care).
- Undertake targeted education highlighting PBM recommendations and practice points.
- Staff complete the BloodSafe eLearning patient blood management course.
- Consider implementing computerised ordering systems that include practice alerts based on PBM guidelines.
- Continue to monitor the appropriateness of prescription and administration of red blood cells.

Module 2: Perioperative recommendations

- Health services include timely identification, evaluation and management of preoperative anaemia into surgical care pathways, to allow sufficient lead time to implement appropriate therapy, including iron therapy, and reduce the need for RBC transfusion.
- Health services review the appropriateness of postoperative transfusions that occur when a patients' Hb is greater than 80 g/L and there are no documented signs or symptoms of anaemia.
- The single unit transfusion practice should be applied to stable, normovolaemic adult patients in an inpatient setting who do not have clinically significant bleeding.
- The practice of preoperative autologous donation should not occur except in the setting of rare blood types (for example, rare red cell phenotypes).

Module 3: Medical recommendations

- Improve documentation of indications for transfusion. For example, the medical record should contain documentation of a plan to transfuse RBCs, the pretransfusion Hb, and clinical assessment (that is, patient signs or symptoms, severity of anaemia, bleeding, et cetera). Consider staff education and the use of tools to assist in documentation.
- Where transfusion is indicated, transfuse a single unit of RBCs, and then clinically reassess the patient to determine if further transfusion is required.
- Where single unit transfusion practice is applied, encourage improved documentation of the post transfusion assessment.
- Include mechanisms for the timely identification, evaluation and management of iron deficiency anaemia, including the use of iron replacement therapy, regardless of whether a red cell transfusion is required.
- Staff education should include how to assess the requirement for iron replacement therapies.

Module 4: Critical care recommendations

- Increase awareness and use of single unit transfusion policy and practice in critical care.

Introduction

There is increasing evidence of an association between blood transfusion and adverse patient outcomes. Patient blood management (PBM) aims to achieve improved patient outcomes by avoiding unnecessary exposure to blood products through effective conservation and management of a patient's own blood.

National PBM guidelines for Australian clinicians are currently in development. When complete, these will comprise six modules for different clinical settings: critical bleeding and massive transfusion; perioperative care; acute and chronic medical conditions; critical care; obstetrics; and paediatrics. The first four have been published.

The PBM guidelines replace the 2001 NHMRC/ASBT *Clinical practice guidelines for the use of blood components* (NHMRC/ASBT 2001).

The revision was needed because of (NBA 2012a):

- increasing evidence of transfusion-related adverse outcomes, leading to the emergence of new practices, including restrictive transfusion strategies and the increased use of alternatives to transfusion in the management of anaemia
- variable (and frequently poor) compliance with the recommendations of the 2001 guidelines, indicated by a high degree of variation in transfusion practices
- failure of the 2001 guidelines to address a range of clinical settings where blood management is commonly required, including critical bleeding and massive transfusion, chronic medical conditions, obstetrics and paediatrics.

The introduction of these national guidelines gives an increased emphasis to PBM, including strategies to reduce transfusion requirements.

Module 2: Perioperative and Module 4: Critical care promote the use of cell salvage in appropriate patients. Conversely, the use of pre-donated autologous blood to minimise perioperative allogeneic blood is no longer supported, unless there is an exceptional circumstance (for example, a patient with a rare blood group/red cell phenotype).

This audit was developed to focus on a number of practice points (PP) presented in the National Blood Authority (NBA) PBM guideline modules (Table 1). The PPs were developed by a clinical/consumer reference group, through consensus decision making, to guide appropriate transfusion.

Table 1: Practice points from Modules 2, 3 and 4

Practice points	Guidance recommendations
Module 3: PP1 Module 4: PP1	RBC transfusion should not be dictated by Hb concentration alone, but should also be based on assessment of the patient's clinical status.
Module 2: PP2	RBC transfusion should not be dictated by a Hb 'trigger' alone, but should be based on assessment of the patient's clinical status. In the absence of acute myocardial or cerebrovascular ischaemia, postoperative transfusion may be inappropriate for patients with a Hb level of > 80 g/L.
Module 3: PP2 Module 4: PP2	Where indicated, transfusion of a single unit of RBC, followed by clinical reassessment to determine the need for further transfusion is appropriate. The reassessment will also guide the decision on whether to retest Hb level.
Module 2: PP3	Perioperative patients should not receive a transfusion when the Hb level is ≥ 100 g/L. In postoperative patients with acute myocardial or cerebrovascular ischaemia and a Hb level of 70–100 g/L, transfusion of a single unit of RBC, followed by reassessment of clinical efficacy, is appropriate.
Module 3: PP3	Direct evidence is not available in general medical patients. Evidence from other patient groups and CRG consensus suggests that, with a: • Hb concentration < 70 g/L, RBC transfusion may be associated with reduced mortality and is likely to be appropriate. However, transfusion may not be required in well-compensated patients or where other specific therapy is available • Hb concentration of 70–100 g/L, RBC transfusion is not associated with reduced mortality. The decision to transfuse patients (with a single unit followed by reassessment) should be based on the need to relieve clinical signs and symptoms of anaemia, and the patient's response to previous transfusions. No evidence was found to warrant a different approach for patients who are elderly or who have respiratory or cerebrovascular disease • Hb concentration > 100 g/L, RBC transfusion is likely to be unnecessary and is usually inappropriate. Transfusion has been associated with increased mortality in patients with acute coronary syndrome.
Module 4: PP3	CRG consensus suggests that in critically ill patients, with a: • Hb concentration < 70 g/L, RBC transfusion is likely to be appropriate. However, transfusion may not be required in well-compensated patients or where other specific therapy is available • Hb concentration of 70–90 g/L, RBC transfusion is not associated with reduced mortality. The decision to transfuse patients (with a single unit followed by reassessment) should be based on the need to relieve clinical signs and symptoms of anaemia • Hb concentration > 90 g/L, RBC transfusion is generally unnecessary.

Note 1: The guidelines also provide practice points for patients with acute coronary syndrome (ACS). The current audit did not identify ACS and therefore could not be considered. For further information, see Module 3: PP5 and 6, and Module 4: PP4.

Note 2: Module 5: Obstetrics and Maternity was released in April 2015 and was not considered in this audit.

Method

In March 2014, 147 health services across Victoria, Tasmania, NT and ACT that transfuse blood or blood products were invited to participate in an audit of transfusion practice. Data was to be returned by 25 April 2014.

The audit consisted of two forms. The first covered general health service information collecting data about single unit transfusion practice, autologous blood collection and cell salvage usage. The second form collected retrospective data on elective transfusion episodes during the calendar year 2013 (Appendix 1).

Each invited health service was requested to audit up to 30 patients that had received an elective red cell transfusion during 2013. Adult patients (≥ 16 years of age) admitted into the clinical areas: medical, surgical, critical/intensive care and obstetrics. Patient exclusion criteria included patients within emergency areas and critical bleeding scenarios (including massive transfusion and post-partum haemorrhage (PPH), and paediatric patients under 16 years of age.

The auditors were not trained; however, the audit forms were accompanied with definitions and instructions for conducting the audit (Appendix 2). The Blood Matters secretariat was available to provide guidance and clarification throughout the audit. Auditors submitted data via an Excel spreadsheet which was imported into an audit-specific Access database. Summary data is included in Appendix 3.

After the audit, each participating health service was sent a summary of their data for verification and invited to correct any discrepancies or incomplete records.

Each transfusion episode submitted was allocated to the relevant module: perioperative, medical or critical care based on patient specialty, clinical area and whether an invasive procedure or surgery took place (Appendix 4). Obstetric episodes were classified and reviewed according to the perioperative, medical or critical care modules as described in Appendix 4 as Module 5 was not available at the time of the audit. These episodes will be discussed in each section.

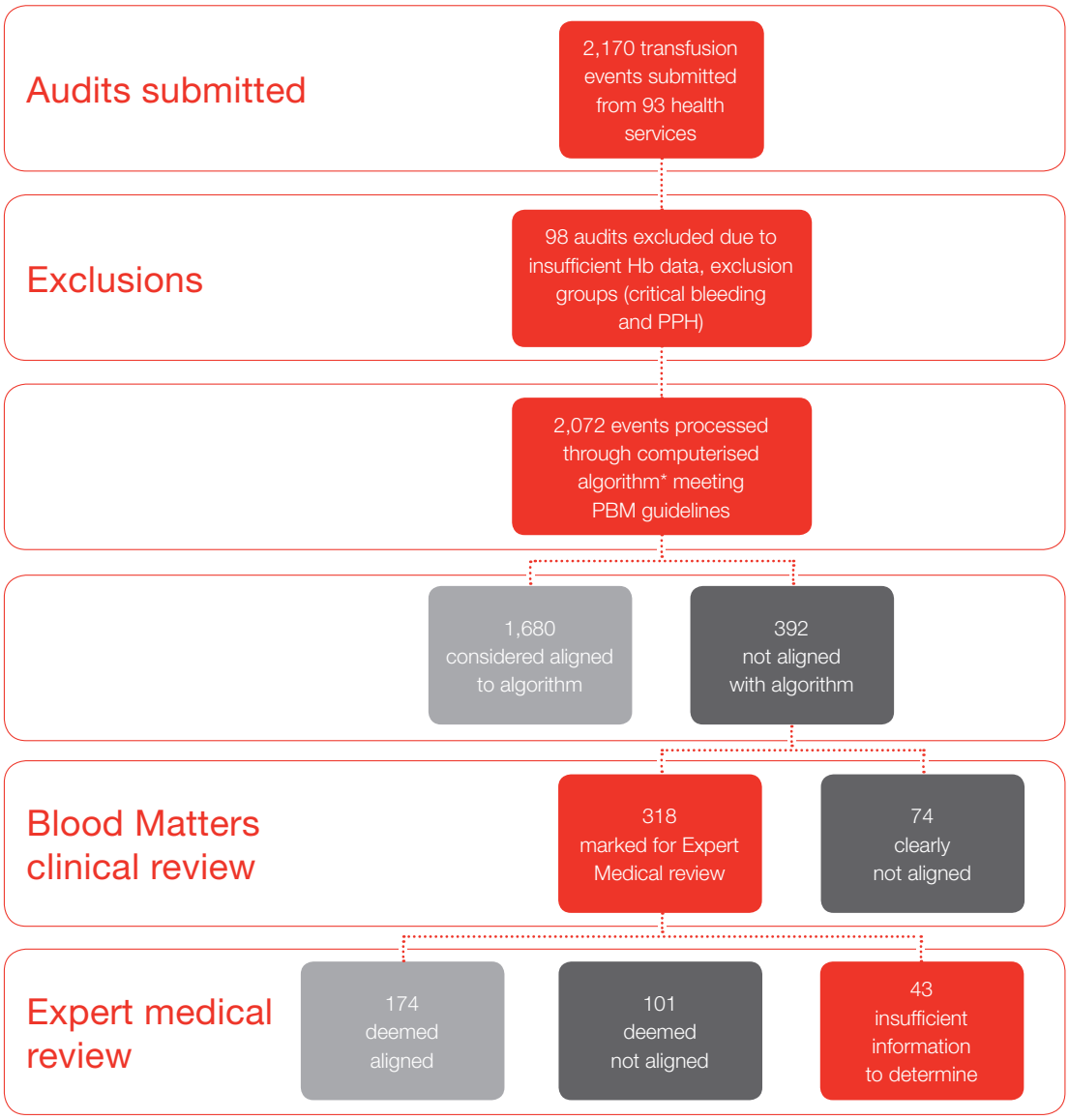
Once each transfusion episode had been allocated a module, it was assessed for alignment with the relevant NBA PBM guidelines. Practice points from the guidelines were considered and algorithms developed to determine transfusion alignment. The algorithms did not cover patients receiving transfusions for haematological disorder/bone marrow failure or obstetrics patients as explicit guidelines were not available. For the purpose of this audit, if the transfusion episode was determined to be not aligned, it was reviewed by an expert medical reviewer and the haematological disorder and/or obstetric nature was then taken into consideration.

Patients with haematological disorder or bone marrow failure are currently covered in Module 3: Medical; however, further research needs to be undertaken to determine the appropriate trigger for RBC transfusions in patients with haematological disorder or bone marrow failure. For patients with chronic transfusion requirements (for example, haematological disorder or bone marrow failure), prescribing more than one unit of RBC at a time may be appropriate. Such patients are usually managed as outpatients, and are often deliberately transfused to a higher level of Hb concentration than physiologically necessary, in an attempt to maximise the interval between transfusions (NBA 2012b, pp. 60, 72)

Any transfusion not meeting alignment based on the algorithm was reviewed by the Blood Matters secretariat and/or expert medical reviewer. Using this method, the algorithm determined that 81 per cent (n = 1,680) were aligned. The remaining 392 transfusion episodes were initially reviewed by the Blood Matters secretariat, where 74 episodes were determined to be clearly nonaligned

(for example, pre-transfusion Hb was greater than 100 g/L with no documented symptoms, recent/current bleeding or surgical/invasive procedure). The remaining 318 episodes were reviewed by an expert medical reviewer, with 25 per cent randomly selected for a second review to determine consensus (Figure 1). Further details on the algorithms are discussed in Appendix 4.

Figure 1: Process to determine alignment with PBM guidelines



In addition, each transfusion episode was assessed to see if:

- documentation implies that Hb and patient's clinical status were both considered in the decision to transfuse
- the single unit policy was followed
- there was indication for over-transfusion.

Results

Of the 147 health services invited to participate, 93 (response rate 63 per cent) submitted a total of 2,170 transfusion episodes. Ninety-eight episodes were excluded due to missing Hb results (n = 48), exclusion criteria such as PPH, (n = 47), other critical bleeding scenarios (n = 2), and one episode where intravenous immunoglobulin was the transfused product.

Demographics

Patient characteristics are described below as allocated into the relevant PBM modules.

Table 2: Patient characteristics

PBM module	Clinical area	Number	Age (years) average (range)	Pre-transfusion Hb (g/L) average (range)
Module 2: Surgical	Obstetrics with invasive procedure/ surgery	18	31 (22–40)	78 (61–104)
	Other invasive procedure/surgery	575	68 (16–99)	82 (48–156)
	Total	**593**	**67 (16–99)**	**82 (48–156)**
Module 3: Medical	Haematological disorder/bone marrow	429	70 (16–99)	78 (40–124)
	Non-haematological disorder/bone marrow (including obstetrics)	886	71 (17–99)	78 (22–145)
	Total	**1,315**	**71 (16–99)**	**78 (22–145)**
Module 4: Critical care	Surgical	100	68 (16–94)	78 (51–136)
	Medical	61	66 (17–95)	76 (41–95)
	Obstetrics	3	26 (25-26)	66 (48-75)
	Total	**164**	**66 (16–95)**	**77 (41–136)**

Module 2: Perioperative

Note: Data collected relating to the Module 2: Perioperative is referred to in this audit as Surgical, as this was the term used in the audit collection tool.

The perioperative module was released in March 2012 to support the introduction of PBM practices in the perioperative setting. A total of 22 recommendations are made in the module along with 20 practice points (PP). This audit collected specific data related to PP2 and PP3, however data was also collected regarding the documentation of iron deficiency; the use of autologous blood and cell salvage. This data will be discussed in relation to specific recommendations and PP.

Of the 2,072 transfusion episodes available for review, 593 (27 per cent) episodes were allocated to perioperative (surgical) based on the clinical area, patient speciality and whether invasive surgery occurred (see Appendix 4).

The audit excluded episodes of critical bleeding and postpartum haemorrhage. Even with this exclusion there were a small number (n = 7, one per cent) of episodes in the surgical group documented as receiving greater than five units of RBC.

An important component of PBM is the identification, evaluation and management of preoperative anaemia. This audit did not collect data to assess how well this is being addressed; however, the relevant recommendations and practice points are included below due to its importance (NBA 2012a).

Iron deficiency

RECOMMENDATIONS – red blood cell transfusion	
R2 GRADE C	In patients undergoing cardiac surgery, preoperative anaemia should be identified, evaluated and managed to minimise RBC transfusion, which may be associated with an increased risk of morbidity, mortality, ICU length of stay and hospital length of stay (Grade C).
R3 GRADE C	In patients undergoing noncardiac surgery, preoperative anaemia should be identified, evaluated and managed to minimise RBC transfusion, which may be associated with an increased risk of morbidity, mortality, ICU length of stay and hospital length of stay (Grade C).

PRACTICE POINTS – preoperative anaemia assessment	
PP1	To implement the above recommendations, a multimodal, multidisciplinary patient blood management program is required. All surgical patients should be evaluated as early as possible to coordinate scheduling of surgery with optimisation of the patient's haemoglobin and iron stores.
PP4	All surgical patients should be evaluated as early as possible to manage and optimise haemoglobin and iron stores
PP5	Elective surgery should be scheduled to allow optimisation of patients' haemoglobin and iron stores.

cont…

PRACTICE POINTS – preoperative anaemia assessment	
PP7	In patients with preoperative iron-deficiency anaemia or depleted iron stores, treatment should be with iron alone. In patients with anaemia of chronic disease (also known as anaemia of inflammation), ESAs may be indicated.

Auditors were asked to document if iron deficiency had been identified. In the surgical group, 64 episodes (11 per cent) were documented as having iron deficiency. Sixty-three (98 per cent) of these episodes were deemed to be aligned with guidelines. Average pre-transfusion Hb documented was 76 g/L (range 50–99 g/L). Following the completion of the prescribed number of RBCs, the average Hb was 99 g/L (range 72–130 g/L). A total number of 144 RBC were prescribed for this group, with 142 RBC units documented as transfused (average 2.2 RBC units per episode).

Data did not include when the iron deficiency was identified in relation to the timing of surgery, or if iron therapy had been considered or implemented. The guidelines support the early evaluation of all surgical patients to enable optimisation of the patient's Hb and iron stores.

There are a number of tools and resources currently available to support identification of iron deficiency and these are listed in the resources section.

Haemoglobin alone should not be used as a trigger for transfusion

PRACTICE POINTS – red blood cell transfusion	
PP2	RBC transfusion should not be dictated by a haemoglobin 'trigger' alone, but should be based on assessment of the patient's clinical status. In the absence of acute myocardial or cerebrovascular ischaemia, postoperative transfusion may be inappropriate for patients with a haemoglobin level of >80 g/L.

Of the 593 episodes in the surgical group, a total of 558 (94 per cent) were considered to be aligned with guidelines, either by computerised algorithm or medical review. Table 3 shows the alignment with regards to the documented pre-transfusion Hb. The majority of the aligned episodes (n = 277, 47 per cent) report a Hb of less than 80 g/L, and 259 (44 per cent) with a Hb of 80–99 g/L. Where the Hb is documented to be greater than or equal to 100 g/L there is less clarity regarding appropriateness with only 19 (38 per cent) deemed aligned.

Table 3: Alignment with pre-transfusion Hb

Aligned	Hb < 80 g/L	Hb 80 – 100g/L	Hb ≥ 100 g/L	Missing pre-transfusion Hb
	n = 277 (%)	n = 259 (%)	n = 50 (%)	n =7 (%)
Yes	277 (100)	259 (100)	19 (38)	3 (43)
No	0	0	11 (22)	2 (28)
Unsure*	0	0	20 (40)	2 (28)

*Unsure: medical reviewers were unable to determine due to lack of/or clarity of documented information.

The audit included questions regarding signs and symptoms of anaemia or hypoxia, recent or ongoing bleeding, and any other documentation to support the clinical decision to transfuse. This information was used by the medical reviewers to assist their designation of alignment. When a definitive decision could not be made because of insufficient information or lack of clarity, the category of 'unsure' was used. Where the pre-transfusion Hb was missing, alignment was based on the Hb reported after the first unit transfused, or at completion, where the expected incremental rise would suggest the pre-transfusion Hb would be within guidelines.

Guidelines for transfusion vary according to the perioperative period of the patient. Table 4 shows the perioperative period when the transfusion episode occurred, as reported by the auditors. The time of transfusion was reported as preoperative or intra/postoperative (with no distinction between intra and post-operative). The majority of episodes were reported as occurring intra/postoperatively (n = 407, 69 per cent) with 379 (93 per cent) of these deemed to be aligned.

Table 4: Alignment and Hb of transfusion episodes occurring pre or intra/post-operatively

	Transfusion pre-op and intra/post op n = 20 (%)		Transfusion pre-op only n = 82 (%)		Transfusion intra/post op only n = 407 (%)		No procedure reported n = 84 (%)	
	Aligned		Aligned		Aligned		Aligned	
	Yes	No	Yes	No	Yes	No	Yes	No
	20 (100)	0 (0)	79 (96)	3 (4)	379 (93)	28 (7)	80 (95)	4 (5)
Pre-transfusion Hb Average [range]	83 [56–101]		79 [50–113]	147 [144–149]	81 [48–147*]	124 [100–156]	81 [56–92]	128 [113–137]

* One episode documented 2,500 ml blood loss in theatre with a pre-transfusion Hb of 147 d/L with a post transfusion Hb of 125 g/L.

Clinical situations that may influence appropriateness such as documented signs and symptoms of anaemia/hypoxia and/or recent or ongoing bleeding are outlined in Table 5.

Table 5: Alignment with documented pre-transfusion Hb, anaemia/hypoxia and recent/ongoing bleeding

Alignment and documented Hb	Total	Anaemia/ hypoxia n (%)	Recent/ongoing bleeding n (%)	Both anaemia/ hypoxia and recent/ongoing bleeding n (%)	Neither anaemia/ hypoxia and recent/ongoing bleeding n (%)
Yes					
Hb < 80 g/L	277	174 (63)	178 (64)	121 (44)	46 (17)
Hb 80–99 g/L	259	118 (46)	147 (57)	83 (32)	77† (30)
Hb ≥ 100 g/L	19	10 (53)	15 (79)	9 (47)	3‡ (16)
missing Hb	3	2 (67)	3 (100)	2 (67)	0
No					
Hb < 80 g/L	0	0	0	0	0
Hb 80–99 g/L	0	0	0	0	0
Hb ≥ 100 g/L	11	0	2 (18)	0	9 (82)
missing Hb	2	0	0	0	2 (100)
Unsure*					
Hb < 80 g/L	0	0	0	0	0
Hb 80–99 g/L	0	0	0	0	0
Hb ≥ 100 g/L	20	2 (10)	20 (100)	2 (10)	0
missing Hb	2	1 (50)	2 (100)	1 (50)	0

* Unsure – medical reviewers were unable to determine due to lack of/or clarity of documented information.

† As per PBM PP3, perioperative patients should not receive a transfusion when the Hb level is ≥ 100 g/L, therefore episodes less than 100 g/L for the purposes of this audit were considered aligned.

‡ Two episodes documented post-transfusion Hb lower than pre-transfusion Hb, one episode had further appropriate documentation supporting use of transfusion.

For the purpose of this audit the signs and symptoms of anaemia or hypoxia included palpitations, breathlessness at rest/on minimal exertion, chest pain, postural hypotension or tachycardia. Recent/ongoing bleeding may include significant intraoperative blood loss, epistaxis or recent per rectum bleeding. Of the aligned episodes, a significant number reported either anaemia/hypoxia and/or recent/ongoing bleeding, with only 22 per cent (126 of 558) reporting neither.

Literature published since the release of the PBM guidelines (Hogshire and Carson 2013; Parker 2013) supports a restrictive transfusion practice for most patients, transfusing only when Hb concentration is 70–80 g/L and/or the patient is symptomatic. This practice is supported for most patients by clinical trials in many areas including surgery, critical care, and patients with gastrointestinal bleeding. Hogshire and Carson (2013), however, recommend the need for further clinical trials to establish thresholds for patients with acute coronary syndromes (ACS) and brain injury.

The reported use of clinical decision aids has been shown to improve clinical practice in various settings, with particular benefit in reducing inappropriate transfusion. Computerised ordering systems allow for 'practice alerts' to be introduced and provide mechanisms to capture the reason for transfusion (Goodnough 2014; Hibbs SP, Nielsen ND, Brunskill S et al. 2015).

PRACTICE POINTS – red blood cell transfusion	
PP3	Patients should not receive a transfusion when the haemoglobin level is ≥100 g/L. In postoperative patients with acute myocardial or cerebrovascular ischaemia and a haemoglobin level of 70–100 g/L, transfusion of a single unit of RBC, followed by reassessment of clinical efficacy, is appropriate.

Of the 593 surgical episodes, 50 (eight per cent) had a documented Hb greater than 100 g/L prior to receiving a transfusion. Following medical review, 19 (38 per cent) were deemed to be aligned with guidelines, 20 (40 per cent) unsure and 11 (22 per cent) deemed as not aligned. Of the 19 considered aligned by the medical reviewer, eight had documented stable or decreasing Hb post transfusion, an additional six had documented symptoms of hypoxia and recent/ongoing bleeding, three reported recent/ongoing bleeding, and two had documented symptoms of hypoxia.

Obstetric patients within the surgical group

Included in the surgical group were 18 obstetric episodes documented as having invasive or surgical procedures. The review of this patient group was undertaken in line with the perioperative module parameters as outlined in Table 6, as the Module 5 Obstetric and maternity PBM guidelines had not been released at the time of this audit.

Seventeen (94 per cent) were deemed aligned with one episode classified as unsure. Ten episodes reported Hb of less than 80 g/L (range 61–76 g/L). Iron deficiency was identified in five episodes (28 per cent). As mentioned previously, data did not include when the iron deficiency was identified in relation to the timing of surgery, or if iron therapy had been considered or implemented.

Table 6: Obstetric episodes with invasive procedure/surgical alignment with pre-transfusion Hb and iron deficiency

Aligned	Hb < 80 g/L	Hb 80–99 g/L	Hb ≥ 100 g/L	Missing pre-Tx Hb	Iron deficiency identified
	(n = 10)	(n = 6)	(n= 1)	(n = 1)	
Yes	10	6	1	0	5
No	0	0	0	0	0
Unsure*	0	0	0	1	0

*Unsure – medical reviewers were unable to determine due to lack of/or clarity of documented information.

Single unit policy

For the purpose of this audit, a single unit policy was considered to be followed if a transfusion episode demonstrated either in any combination or alone:

- prescribed units = 1, or
- units transfused = 1, or
- Hb taken after 1 unit, or
- clinical assessment performed after the first unit.

It would appear that some health services are beginning to implement the practice of single unit transfusion, with the data showing 286 of the reported episodes (48 per cent) had documentation suggesting that a single unit transfusion policy was being followed. Hb was tested after the first unit in 110 episodes (19 per cent) and 226 (38 per cent) documented that clinical assessment occurred after the first unit transfused. Of the single unit policy transfusions, 269 (94 per cent) were deemed as aligned, 12 unsure and five not aligned.

Single unit guidelines that include tools to assist with implementation are available on the NBA website (http://www.blood.gov.au/single-unit-transfusion) (NBA 2014).

Preoperative autologous donation

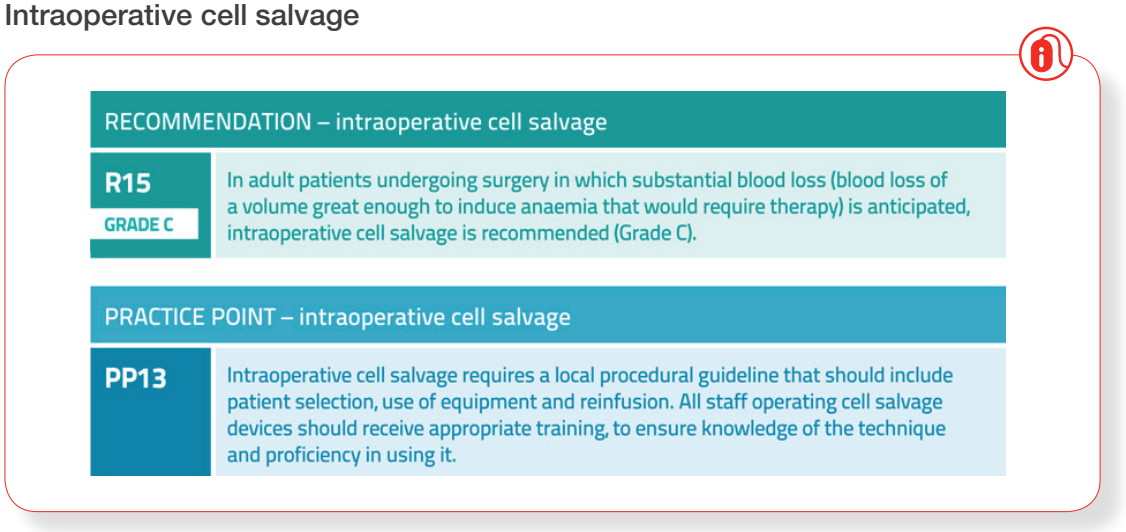
RECOMMENDATION – preoperative autologous donation

R11
GRADE C

The *routine* use of PAD is not recommended because, although it reduces the risk of allogeneic RBC transfusion, it increases the risk of receiving any RBC transfusion (allogeneic and autologous) (Grade C).

Ten health services (including seven private services) reported that autologous collection was practiced, predominately in the orthopaedic area. One health service stated the practice was across all specialties. Data indicated 23 episodes where autologous blood was transfused (5 per cent of surgical transfusions occurring during/after the invasive procedure/surgery. Fourteen of these episodes also reported intraoperative and postoperative cell salvage was used.

Intraoperative cell salvage



Where surgical episodes were reported, auditors were asked to document if cell salvage was used, and if so which type: intraoperative, postoperative or both.

The practice of cell salvage was reported by 38 (41 per cent) of the 93 reporting health services. In this audit, 14 health services (including eight private) reported on a total of 45 cell salvage episodes (10 per cent of surgical transfusions occurring during/after the invasive procedure/surgery). Intraoperative accounted for 29 episodes, postoperative 15, and one episode reported using both.

In this cohort, the number of RBC units transfused ranged from one to four units, with a total of 83 units reported as transfused (average 1.8 units per episode). In comparison, patients not receiving cell salvage (n = 548) received on average 2.1 units per episode (range one to nine units). The slightly lower average number of units transfused when using cell salvage in conjunction with RBC transfusion does not reflect the potential for minimising allogeneic RBC transfusion, as this audit did not consider the episodes where allogeneic transfusion was totally avoided due to the use of cell salvage. A Cochrane (2010) review found that the use of cell salvage reduced perioperative allogeneic RBC transfusion by 38 per cent.

While the numbers of documented episodes using cell salvage were small it is still encouraging to note its use and the lower average number of RBC units transfused per patient.

The NBA has developed a document *Guidance for the provision of intraoperative cell salvage* that may be useful for health services considering the implementation of the practice.

Other

Seven (one per cent) of the surgical episodes were reported as receiving more than five units of RBC (excluding those where critical bleeding / massive transfusion or PPH were documented).

Hb at pre-transfusion ranged from 48–119 g/L with a mean of 73 g/L. Only one episode reported a Hb of greater than 100 and was associated with ongoing bleeding. None of the episodes included had documented iron deficiency. All were deemed aligned.

Recommendations

- Include timely identification, evaluation and management of preoperative anaemia into surgical care pathways to allow sufficient lead time to implement appropriate therapy, including iron therapy, to reduce the need for RBC transfusion.
- Review the appropriateness of transfusions that occur when a patient's Hb is greater than 80 g/L and there are no documented signs or symptoms of anaemia.
- Single unit practice should be applied to stable, normovolaemic adult patients in an inpatient setting who do not have clinically significant bleeding.
- The practice of preoperative autologous donation should not occur except in the setting of rare blood types/red cell phenotypes.

Module 3: Medical

The medical module covers a range of specialities including haematology and oncology, renal, gastrointestinal and cardiac. Obstetric (with non-invasive procedures) episodes are also included as medical in this audit (Module 5 Obstetrics and maternity had not been released at the time of audit). There are eight recommendations and 24 practice points included in the guidelines. This audit assessed against practice points 1–3 of the guidelines.

A total of 1,315 transfusion events (including 60 obstetric episodes) were attributed as medical episodes. Of these episodes 427 (32 per cent) were documented as occurring in patients with haematological disorders or bone marrow failure. Three hundred and seventy-nine (30 per cent) documented recent or ongoing blood loss.

The audit collected information regarding whether a surgical or invasive procedure occurred. While auditors were not required to document the actual procedure, based on the patient clinical area and specialty, as well as optional additional information, patients were assigned to subgroups. Table 7 shows the medical episodes as defined by category as indicated by the auditors.

Table 7: Medical episodes as defined by category

Category	Number	Recent or ongoing bleeding n (%)	Documented signs/ symptoms of anaemia/ hypoxia n (%)	Both blood loss and anaemia identified n (%)	Iron deficiency identified n (%)	Procedure documented n (%)
Obstetrics	60	49 (82)	43 (72)	37 (62)	15 (25)	0 (0)
Documented haematological disorder / bone marrow failure	427	47 (11)	261 (61)	37 (9)	54 (13)	5 (1)
Other medical	828	283 (34)	547 (66)	206 (25)	263 (32)	62 (7)
All	**1,315**	**379 (29)**	**851 (65)**	**280 (21)**	**332 (25)**	**67 (5)**

To determine alignment, we ran the data through computerised algorithms based on the medical PBM guidelines. When a transfusion event was not aligned, the data was submitted for medical review (Appendix 4).

This allowed for a more specific review based on the individual patient history, especially for patients where the guidelines are less specific regarding the requirements for obstetric patients and those patients with documented haematological disorder/bone marrow failure.

Table 8 outlines alignment for each of the patient groups. Alignment was greatest in the haematological group (n = 424,100 per cent) and poorest in the medical group with no documented procedures with only 609 (80 per cent) aligned to guidelines.

Table 8: Alignment with guidelines according to medical category

Category	Number	Aligned n (%)	Nonaligned n (%)	Unsure n (%)
Obstetric	60	55 (92)	4 (7)	1 (2)
Haematological disorder / bone marrow failure	427	425 (99.5)	2 (0.5)	0 (0)
Other medical – procedure documented	62	57 (92)	4 (6)	1 (2)
Other medical – no procedure	766	609 (80)	144 (19)	13 (2)
Total	**1,315**	**1,146 (87)**	**154 (12)**	**15 (1)**

Haemoglobin alone should not be used as a trigger for transfusion

Hb alone should not be used as a trigger for transfusion, but should include the assessment of the patient's clinical status as outlined in PP1. This is further reinforced with PP3, which outlines situations for general medical patients where transfusion may be considered appropriate or less appropriate based on Hb and clinical status.

PP1	RBC transfusion should not be dictated by a Hb concentration alone, but should also be based on assessment of the patient's clinical status.
PP3	Direct evidence is not available in general medical patients.[a] Evidence from other patient groups and CRG consensus suggests that, with a: ▪ **Hb concentration <70 g/L**, RBC transfusion may be associated with reduced mortality and is likely to be appropriate. However, transfusion may not be required in well-compensated patients or where other specific therapy is available. ▪ **Hb concentration of 70 – 100 g/L**, RBC transfusion is not associated with reduced mortality. The decision to transfuse patients (with a single unit followed by reassessment) should be based on the need to relieve clinical signs and symptoms of anaemia, and the patient's response to previous transfusions. No evidence was found to warrant a different approach for patients who are elderly or who have respiratory or cerebrovascular disease.

cont…

- **Hb concentration >100 g/L**, RBC transfusion is likely to be unnecessary and is usually inappropriate. Transfusion has been associated with increased mortality in patients with ACS.

[a] Recommendations and practice points for medical patients in a critical care setting will be found in the *Patient Blood Management Guidelines: Module 4 – Critical Care*.[3] Recommendations and practice points for specific medical subgroups (ACS, CHF, cancer, acute upper gastrointestinal bleeding and chronically transfused) appear elsewhere in this module.

Of the total 1,315 medical episodes reported, 951 (72 per cent) episodes implied that the patient's clinical status was considered, through documentation of signs or symptoms of anaemia/hypoxia and/or evidence of recent or ongoing bleeding (Table 9).

Table 9: Number of medical episodes and alignment where bleeding and/or symptoms of anaemia/hypoxia reported

Category	Number	Aligned n (%)	Bleeding and/or symptoms of anaemia documented n (%)	Alignment where documented bleeding and/or symptoms of anaemia n (%)
Obstetric	60	55 (92)	56 (93)	55 (98)
Haematological disorder / bone marrow failure	427	425 (99)	271 (63)	271 (100)
Other medical – procedure documented	62	57 (92)	54 (87)	49 (90)
Other medical – no procedure	766	609 (80)	570 (74)	556 (97)
Total	**1,315**	**1,146 (87)**	**951 (72)**	**931 (98)**

The lack of patient clinical status in the documentation could indicate that either the transfusion has been based on Hb alone or that there is poor documentation of symptoms and signs of anaemia. In the medical cohort, 1,144 episodes (87 per cent) reported that the medical records indicated the reason for transfusion was documented, although on review of data by Blood Matters the reason was not always clear or justified.

The audit asked:

- pre-transfusion Hb level
- if the patient was experiencing signs/symptoms of anaemia/hypoxia
- if there was any other documentation that supported the clinical indication of the transfusion.

Often the other documentation included information related to disease process or cause (for example breast cancer), rather than evidence of signs and symptoms associated with the anaemia. These responses may support the transfusion, however they do not necessarily indicate the reason the patient required transfusion at that time.

Documented indications for transfusion such as 'Hb < 90 transfuse' do not take into consideration the patient's ability to tolerate anaemia, or indicate why they may not be able to tolerate a lower Hb level. There were several patients noted to have iron deficiency anaemia, but no indication of signs and symptoms of anaemia recorded.

The use of clinical decision aids has been shown to improve clinical practice in various settings, with particular benefit in reducing inappropriate transfusion. Computerised ordering systems allow for 'practice alerts' to be introduced and provide mechanisms to capture the reason for transfusion (Goodnough 2014).

Table 10 outlines alignment with guidelines including reported pre-transfusion Hb, documented signs and symptoms of anaemia/hypoxia or other clinical situation/condition.

Table 10: Alignment with guidelines including documented signs and symptoms and clinical condition

Hb g/L	Total 1,315	Aligned (%)	Not Aligned/ Unsure	Signs and symptoms of anaemia/ hypoxia 851 (%)	Recent or ongoing bleeding 379 (%)	Iron deficiency 332 (%)	Haematological disorder/bone marrow failure 429 (%)
Hb < 70	255	255 (100)	0	189 (74)	97 (38)	86 (34)	80 (31)
Hb 70–100	1,022	865 (85)	157 (15)	641 (63)	271 (27	239 (23)	336 (33)
Hb > 100	29	18 (62)	11 (38)	17 (59)	9 (31)	6 (21)	8 (27)
Missing Hb	9	8 (89)	1 (11)	4 (44)	2 (22)	1 (11)	5 (56)

While all episodes reported with Hb < 70 g/L were deemed aligned with guidelines, only 189 (74 per cent) had documented signs and symptoms of anaemia, and 97 (38 per cent) recent/ ongoing bleeding. The guidelines state that at Hb < 70 g/L RBC transfusion may be associated with reduced mortality and is likely to be appropriate. However, transfusion may not be required in well-compensated patients or where other specific therapy is available (NBA 2012b).

The majority of episodes report Hb in the 70–100 g/L range (1,022, 78 per cent). Of these 865 (85 per cent) were considered aligned to the guidelines with 157 (15 per cent) not aligned/unsure. For 22 nonaligned episodes, there was no adequate documentation of the reason for transfusion, with entries including such statements as 'Hb 80', 'anaemia secondary to malignancy'. Again these statements may support the need for transfusion, however they do not indicate the reason transfusion was required.

Twenty-nine (two per cent) received transfusions with an Hb > 100 g/L. Of these, 18 (62 per cent) were deemed aligned. Alignment was based on presence of haematological/bone marrow failure (n = 7), moderate anaemia with potential bleeding or symptoms of hypoxia (n = 10), or active bleeding (n = 1). Of the 11 episodes deemed not aligned, seven had no documented recent/ongoing bleeding or symptoms of hypoxia; although two episodes had documented recent/ongoing bleeding there was a high increment of Hb post transfusion, and two episodes had documented symptoms of hypoxia, however, the medical reviewer questioned if they were related to anaemia.

Of note the recording of signs and symptoms of anaemia reduced as the Hb increased, 189 (74 per cent) patients with Hb < 70 g/L had documentation of signs and symptoms of anaemia, while only 641 (63 per cent) patients with Hb 70–100 g/L and 17 (59 per cent) patients with Hb > 100 g/L had documentation.

Single unit policy

PP2	Where indicated, transfusion of a single unit of RBC, followed by clinical reassessment to determine the need for further transfusion, is appropriate. This reassessment will also guide the decision on whether to retest the Hb level.

Data for the medical group indicates 160 (12 per cent) episodes where a single unit was prescribed and transfused, with a further 30 (two per cent) episodes where more than one unit was prescribed but then, only one unit of RBC was transfused.

Some health services are implementing single unit transfusion policies with the data showing 501 of the reported episodes (38 per cent) had documentation suggesting that a single unit policy was being followed. Hb was tested after the first unit in 146 episodes (11 per cent) and 396 (30 per cent) documented that clinical assessment occurred after the first unit transfused. Table 11 outlines the number of episodes where only one unit prescribed and/or transfused, where Hb was taken after the first unit and/or clinical assessment was reported after the first unit indicating a single unit transfusion policy may be in place.

Table 11: Single unit transfusion

	Number (%)
Prescribed one unit	161 (12%)
Transfused one unit	190 (14%)
Hb taken after one unit	146 (11%)
Clinical assessment after one unit	396 (30%)
Number of episodes with at least one of the above attributes	485 (37%)

A further 27 episodes (two per cent) reported receiving fewer units than prescribed (but greater than one). This may indicate that assessment of patients between units is taking place and, where appropriate, no further units are being transfused. However, since there is no other documentation suggesting clinical assessment, or Hb testing after one unit, this may also be due to other reasons such as transfusion reactions.

Iron deficiency anaemia

PP4 In patients with iron deficiency anaemia, iron therapy is required to replenish iron stores regardless of whether a transfusion is indicated.

Three hundred and thirty-two (25 per cent) medical episodes documented that iron deficiency had been identified (Table 12). This compares with 64 (11 per cent) of perioperative episodes and 19 (12 per cent) of critical care. Of these 332 events, 291 (88 per cent) were found to be aligned with guidelines. The audit did not collect information regarding the use of iron replacement so it is uncertain how many, if any, received iron therapy alongside the transfusion.

From the reported data, it is not possible to determine if iron therapy alone could be considered an alternative strategy to transfusion for the nonaligned episodes, it should however be considered.

There are a number of tools and resources currently available to support identification and management of iron deficiency and these are listed in the resource section of the report.

Table 12: Transfusion episodes alignment with guidelines regarding transfusion in patients with and without identified iron deficiency

Iron deficiency identified	Alignment with guidelines			
	Yes (%)	No (%)	Unsure (%)	Total
Yes	291 (88)	39 (12)	2 (< 1)	332
No	729 (87)	98 (12)	11 (1)	838
Unknown	126 (87)	17 (12)	2 (1)	145

Haematological disorder/bone marrow failure

There were 427 (32 per cent) episodes where a haematological disorder or bone marrow failure is documented. Haematological disorder/bone marrow failure was also documented in 21 (13 per cent) critical care patients and 33 (six per cent) surgical patients.

Module 3 outlines that patients receiving chemotherapy and haematopoietic stem cell transplantation should follow the general guidelines for other medical patients; and transfusion should be based on the clinical need to relieve signs and symptoms of anaemia. PP8 outlines that for patients with cancer, anaemia is often due to a multiple factors, and these factors should be identified and treated.

The average pre-transfusion Hb for episodes reporting haematological disorder/bone marrow failure was the same as those without (78 g/L). There were also no significant differences in the number of units' transfused (average 2.3 units versus 2.2 units) and the post transfusion Hb (97 g/L versus 100 g/L).

In patients with cancer, there is evidence to suggest that tissue hypoxia in tumour cells decreases the effectiveness of radiotherapy and some forms of chemotherapy (Zhoa et al. 2006, Glaspy 2002). Transfusion alone is not the answer to hypoxia and underlying causes should be investigated and treated. This audit demonstrates that there was no significant difference in pre-transfusion Hb for patients with haematological disorder/bone marrow failure who might be receiving these treatments.

Obstetric patients within the medical group

There were 60 obstetric episodes reported, of which 55 (92 per cent) were found to be aligned with available (medical) guidelines. A significant proportion of these episodes were documented as having recent or ongoing bleeding (n = 49; 82 per cent) and 43 (72 per cent) had documentation of signs and symptoms of anaemia. Of this group, 15 (25 per cent), were documented with identified iron deficiency. Information regarding the use of iron replacement therapy was not included in the audit, however this should be considered for all patients with iron deficiency.

Recommendations

- Disseminate PBM guidelines Module 3 to medical areas within health services.
- Undertake targeted education for medical and nursing staff highlighting recommendations and practice points.
- Improve documentation stating the indications for transfusion. For example, the medical record should contain documentation of a plan to transfuse RBCs, the pre-transfusion Hb, and clinical assessment (that is, patient's signs or symptoms, severity of anaemia, bleeding, et cetera). Staff education and the use of tools to assist in documentation should be considered.
- Consider staff education and the use of tools to assist in documentation, for example using electronic ordering systems.
- Where indicated, transfuse a single unit of red blood cells, and then clinically reassess the patient to determine if further transfusion is required.
- Where single unit transfusion is applied, encourage improved documentation of the post transfusion assessment.
- Health services should include mechanisms for the timely identification, evaluation and management of iron deficiency anaemia, including the use of iron replacement therapy regardless of whether a red cell transfusion is required.
- Include the need for iron replacement therapies in staff education.
- Staff should complete the BloodSafe eLearning patient blood management course on iron deficiency anaemia.

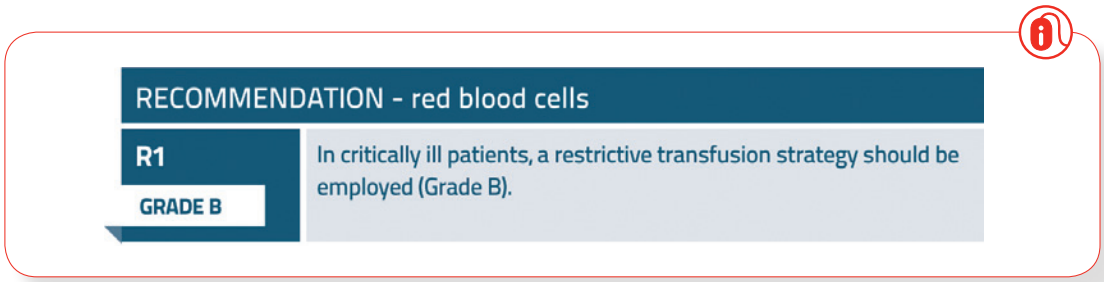
Module 4: Critical care

The NBA PBM guidelines Module 4: Critical care was released in 2013. A total of four recommendations are made in the module along with 15 practice points (PP). Data collected in the audit addresses recommendation 1 and PP 1–4 and the results are discussed as they relate to each relevant point.

Of the 2,072 episodes reported, 164 (eight per cent) were documented as occurring in critical care. One hundred and fifty (91 per cent) were deemed aligned with the guidelines, eight (five per cent) were non-aligned and six (four per cent) episodes classified as uncertain due to missing or insufficient information.

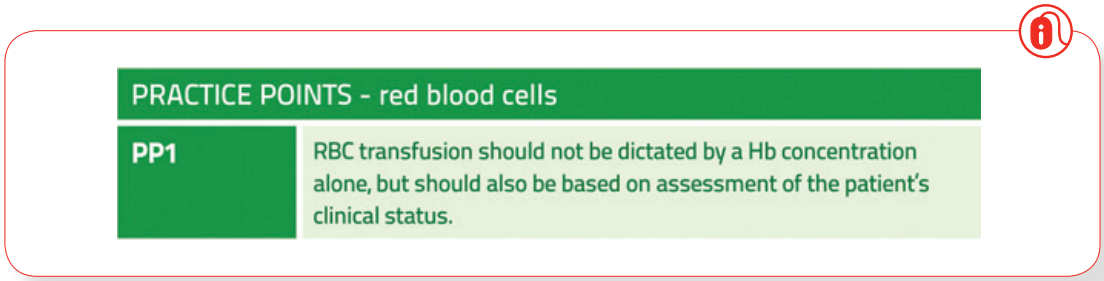
The 164 critical care episodes were considered according to the reported specialty groups, where surgical accounted for 100 (61 per cent), medical 61 (37 per cent) and obstetrics three (two per cent).

Module 4 Recommendation 1 advocates a restrictive transfusion strategy for critically ill patients (NBA 2012c).



Haemoglobin alone should not be used as a trigger for transfusion

Haemoglobin concentrations alone should not dictate the need for transfusion. Each case should be reviewed in line with clinical status as outlined in PP1 and PP3 (NBA 2012c).



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PP3

CRG consensus suggests that, with a:

- **Hb concentration <70 g/L,** RBC transfusion is likely to be appropriate; however, transfusion may not be required in well-compensated patients or where other specific therapy is available.
- **Hb concentration of 70–90 g/L,** RBC transfusion is not associated with reduced mortality. The decision to transfuse patients (with a single unit followed by reassessment) should be based on the need to relieve clinical signs and symptoms of anaemia.
- **Hb concentration >90 g/L,** RBC transfusion is generally unnecessary.

For patients undergoing cardiac surgery, refer to *Patient Blood Management Guidelines: Module 2 – Perioperative;*[5] for patients with active bleeding, refer to *Patient Blood Management Guidelines: Module 1 – Critical Bleeding/ Massive Transfusion.*[6]

The critical care episodes were considered aligned by a computerised algorithm (based on PP3) if Hb level (g/L) pre transfusion was less than 70 g/L, or if both of the following are met:

- Hb level (g/L) pre-transfusion was between 70 and 90 g/L, inclusive
- Patient was experiencing signs/symptoms of anaemia/hypoxia

Of the 164 critical care episodes reported, 113 (69 per cent) met the above criteria, and the 51 (31 per cent) that were deemed not aligned were submitted for medical review. Medical reviewers considered the information reported by the auditors for the 51 non-aligned episodes, and following review a further 37 (23 per cent) episodes were then classified as aligned.

Interestingly, there were nine (five per cent) episodes where the pre-transfusion Hb was > 90 g/L; and eight of those were classified as aligned and one as uncertain after medical review. This was based on clinical information provided with five episodes indicating recent or ongoing bleeding.

It is pleasing to note that the three obstetric critical care episodes reported were all aligned with the guidelines.

Ninety (90 per cent) of the 100 surgical episodes reported were deemed as aligned to guidelines, with six (six per cent) nonaligned and a further four (four per cent) where alignment was unsure. Of the six episodes that were nonaligned, five were reported as receiving single unit transfusions and one patient received two units of RBCs.

Of the 61 medical episodes in critical care, the majority (n = 57, 94 per cent) were deemed aligned. Two (three per cent) were nonaligned and a further two (three per cent) were classified as uncertain (Table 13).

Table 13: Alignment of reported critical care episodes

	Number 164	Aligned 150 (%)	Non-aligned 8 (%)	Unsure 6 (%)
Surgical	100	90 (90)	6 (6)	4 (4)
Medical	61	57 (94)	2 (3)	2 (3)
Obstetric	3	3 (100)	0	0

As shown in table 14, all nonaligned episodes had a pre transfusion Hb level of between 70 and 90 g/L, with no documented evidence of anaemia.

Table 14: Nonaligned critical care episodes

Specialty within critical care	Hb level g/L pre-Tx	Hb g/L level after transfusion of 1 RBC unit	Hb g/L after completion of transfusion episode	Number of units prescribed/ transfused	Signs and symptoms of anaemia*
Medical	73		99	2/2	N
Medical	77		82	2/2	U
Surgical	77		87	1/1	N
Surgical	78	89	89	1/1	N
Surgical	78		82	1/1	N
Surgical	85		116	2/2	N
Surgical	89		101	1/1	U
Surgical	90	96	96	1/1	U

*U = unknown

PP3 states that transfusing critically ill patients with a 'Hb of 70–90 g/L is not associated with reduced mortality and that the decision to transfuse patients (with a single unit followed by reassessment) should be based on the need to relieve clinical signs and symptoms of anaemia' (NBA 2012c).

Of the 164 transfusion episodes reported in critical care, 119 (73 per cent) had a pre-transfusion Hb of 70–90 g/L and 106 (89 per cent) of these were deemed aligned with guidelines. A further five (four per cent) of the reported episodes had insufficient information to determine alignment (Table 15).

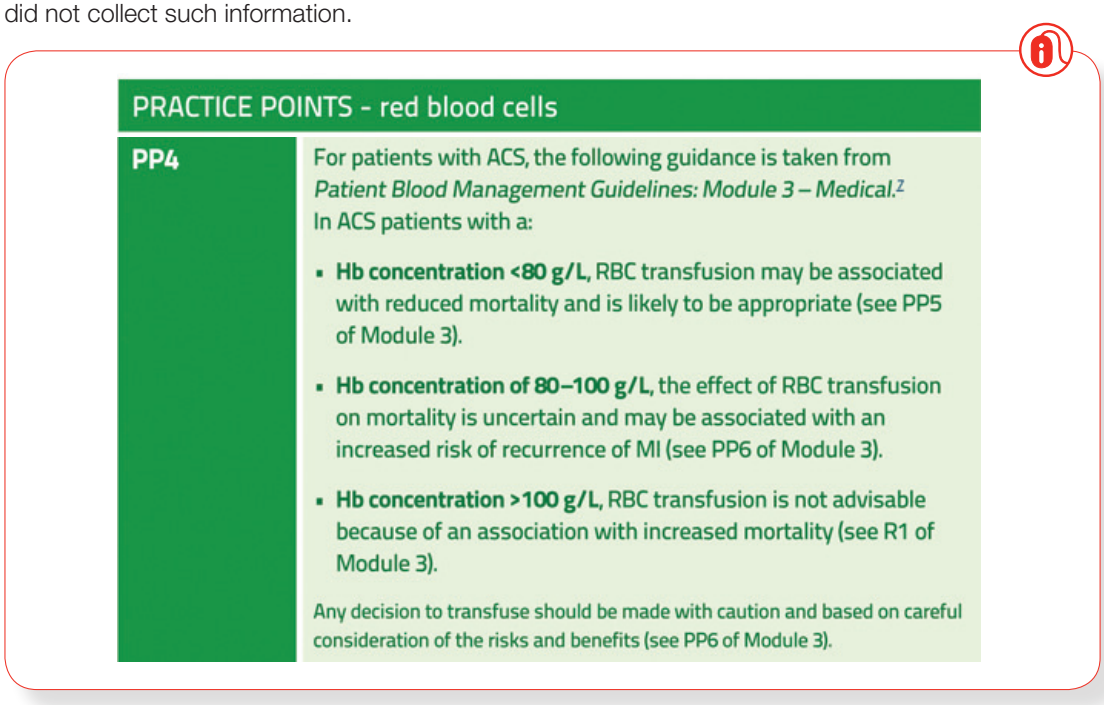
Table 15: Hb levels of patients prior to transfusion episode

Specialty within critical care	Transfusion aligned with guidelines	Hb Level prior to transfusion		
		< 70 g/L	70–90 g/L	> 90 g/L
Medical	No	0	2	0
Medical	Unsure	0	2	0
Medical	Yes	17	36	4
Obstetric	Yes	1	2	0
Surgical	No	0	6	0
Surgical	Unsure	0	3	1
Surgical	Yes	18	68	4
Totals (n = 164)		**36**	**119**	**9**

Herbert and Carson (2014) examined the 2012 Cochrane review of transfusion threshold and the results of four new trials involving critical care patients and state that 'a transfusion threshold of 7 g per decilitre should become the new normal, recommended in all critically ill patients, including those with severe sepsis and septic shock'. They do note that evidence for transfusion thresholds in patients with acute coronary syndrome (ACS) is weak as stated in the NBA PBM guidelines. This distinct group of patients may benefit from a higher Hb concentration (9 or 10 g per decilitre) (Herbert and Carson 2014).

This is further supported in another review of clinical trials in 2013 where they found pilot trials in ACS suggested that a more liberal transfusion approach may improve clinical outcomes for these patients however, larger trials are required (Hogshire and Carson 2013).

Module 4 PP4 sets out specific information relating to patients with ACS, however, this audit did not collect such information.



Single unit policy

PRACTICE POINTS - red blood cells	
PP2	Where indicated, transfusion of a single unit of RBC, followed by clinical reassessment to determine the need for further transfusion, is appropriate. This reassessment will also guide the decision on whether to retest the Hb level.

Of the 164 critical care episodes, 114 (70 per cent) indicated the use of single unit transfusions which supports awareness within critical care of the use of single unit transfusion (Table 16), as demonstrated by either:

- prescribed units = 1, or
- units transfused = 1, or
- Hb taken after 1 unit, or
- clinical assessment performed after first unit.

Table 16: Single unit transfusion policy – the number of episodes where only one unit prescribed and/or transfused and other variables indicating when a single unit transfusion policy may be in place

	Number (%)
Prescribed one unit	63 (38%)
Transfused one unit	71 (43%)
Hb taken after one unit	53 (32%)
Clinical assessment after one unit	77 (47%)
Number of episodes with at least one of the above attributes	114 (70%)

Haemoglobin was tested after the first unit in 53 episodes (32 per cent) and 77 (47 per cent) documented that clinical assessment occurred after the first unit transfused.

Table 17 shows the clinical specialties where single unit transfusion was reported in critical care, and their alignment to Module 4. Of the 114 single unit episodes, 104 (91 per cent) were deemed aligned.

Table17: Use of single unit transfusion in critical care with alignment to guidelines

Specialty within critical care	Transfusion aligned with guidelines (%)			Number of Transfusion episodes that were single unit transfusions (%)		
	Yes	No	Unsure	Yes	No	Unsure
Medical	57 (93)	2 (4)	2 (4)	38 (67)	1 (50)	1 (50)
Surgical	90 (90)	6 (6)	4 (4)	64 (71)	5 (83)	3 (75)
Obstetric	3 (100)	–	–	2 (67)	–	–
	150 (91)	**8 (5)**	**6 (4)**	**104 (69)**	**6 (75)**	**4 (67)**

The overall alignment rate of 91 per cent (n=150) within the reported episodes from critical care is encouraging and indicates an understanding of and adherence to PBM guidelines.

The NBA has tools to support the implementation of single unit guideline as outlined in the resource section (NBA 2014).

Recommendations

- Disseminate PBM guidelines Module 4 to critical care units.
- Education should target critical care medical and nursing staff, highlighting recommendations and practice points.
- Staff should complete BloodSafe eLearning patient blood management course.
- Increase awareness of and use of single unit guidelines in critical care.

Over-transfusion

The audit also attempted to determine if over-transfusion was occurring. For the purposes of this audit over transfusion was defined as a Hb level greater than 115 g/L at the completion of all transfused units. Six per cent of all episodes were considered to be over-transfusions in this audit. Table 18 shows the over-transfusion rates for each of the modules.

Table 18: Over transfusion rates

Module Allocated	Alignment with guidelines			
	Yes n = 1,854	No n = 175	Unknown n = 43	All transfusions n = 2072
Critical care	4 (3%)	1 (13%)	0 (0%)	5 (3%)
Medical	46 (4%)	14 (9%)	4 (27%)	64 (5%)
Surgical	42 (8%)	4 (0%)	5 (23%)	51 (9%)
All patient groups	92 (5%)	19 (11%)	9 (21%)	120 (6%)

Episodes that were determined as not aligned to the guidelines were also more likely to fit with the definition of over-transfusion. A smaller percentage of aligned transfusions could be considered over-transfusion, while nearly a quarter of all episodes with unsure alignment fit the over-transfusion criteria. This may indicate that many of these unsure alignment episodes would, if more information was available, not be aligned.

Resources

Patient blood management

Bloodsafe eLearning – PBM module
https://www.bloodsafelearning.org.au/

Iron deficiency

National Blood Authority – preop anaemia optimisation template
http://www.blood.gov.au/search/gss/iron%20deficiency

National Blood Authority tools – iron product choice
http://www.blood.gov.au/system/files/documents/iron-product-choice-dose-calc-paediatric.pdf

NBA preoperative bleeding risk assessment will be available soon on
www.blood.gov.au

Bloodsafe eLearning – IDA module
https://www.bloodsafelearning.org.au/

Blood Matters – anaemia
http://www.health.vic.gov.au/bloodmatters/management/

BloodSafe – Iron deficiency anaemia app
https://www.bloodsafelearning.org.au/node/71

Anaemia management tools

South Australian Health BloodSafe
http://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/clinical+resources/clinical+programs/blood+products+and+programs/bloodsafe/anaemia+management

Cell salvage

Guidance for the Provision of Intraoperative Cell Salvage
http://www.blood.gov.au/ics

Single unit guidelines

Single unit guide
http://www.blood.gov.au/single-unit-transfusion

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Appendix 1: Audit tool

blood matters

Australian Red Cross BLOOD SERVICE

State Government Victoria

Health Service Information

Clinical audit of elective red blood cell use in medical, surgical and obstetric adult patients

The aim of this audit is to improve the quality of care provided to adult patients (≥ 16 years of age) by ensuring the appropriate use of elective red cell transfusion and patient blood management practices.

Contact email address:	
Health service name:	
Do any of the clinical specialties at your health service demonstrate a single unit practice?	
If yes, name the specialties (free text, can be more than one specialty, if health service wide write 'all specialties')	
Do any of the clinical specialties at your health service practice autologous blood collection?	
If yes, name the specialties (free text, can be more than one specialty, if health service wide write 'all specialties')	
Do any of the clinical specialties at your health service practice intra- or post- operative cell salvage?	
If yes, name the specialties (free text, can be more than one specialty, if health service wide write 'all specialties')	
Any other comments?	

blood matters

Australian Red Cross BLOOD SERVICE

State Government Victoria

Health Service Data

Clinical audit of elective red blood cell use in medical, surgical and obstetric adult patients

Legend: **Clinical area/Patient specialty:** (S) surgical, (M) medical, (O) obstetrics, (CIC) critical/intensive care **Yes/No responses:** (Y) yes, (N) no, (U) unknown

Health service name:					
Audit number	1	2	3	4	5
Patient age in years (≥ 16years)					
Did the transfusion occur between 1 January - 31 December 2013?					
Time of transfusion (24 hour clock HH:MM)					
Clinical Area					
Patient specialty					
Medical record information					
Is there evidence of medical documentation indicating reason for transfusion?					
What is Hb level (g/L) pre-transfusion?					
Is iron deficiency identified?					
Is there a haematological disorder/ bone marrow failure present?					
Is there recent or ongoing bleeding present?					
Is the patient experiencing signs/symptoms of anaemia/hypoxia?					
Is there any other documentation that supports the clinical indication of this transfusion?					
If yes, what reason is documented? Free text limited to 50 characters					
Number of units prescribed					
Number of units transfused					
Clinical assessment was performed after the first unit of transfusion					
Hb (g/L) level after transfusion of one unit (leave blank if not taken)					
Hb (g/L) after completion of whole transfusion ordered (leave blank if not taken)					
surgical/ invasive procedure patients only:					
Invasive procedure/surgery - transfusion before					
Invasive procedure/surgery - transfusion during / after					
Autologous blood collected					
Autologous blood transfused					
If cell salvage used,what type?					
optional comments: limited to 50 characters					

Appendix 2: Audit instructions

Clinical audit of elective red blood cell use in medical, surgical and obstetric adult patients.

Audit Aims

To improve the quality of care provided to adult patients (≥ 16 years of age) by ensuring the appropriate use of elective red blood cell transfusion and patient blood management practices.

Objectives

To determine if/that:

- Elective red blood cell (RBC) transfusion and patient blood management practice is aligned to the National Blood Authority's (NBA) Patient Blood Management (PBM) Guidelines Module 2, 3 & 4.
- Haemoglobin (Hb) alone is not the only trigger for transfusion but also based on assessment of the patient's clinical status.
- A single unit of RBC is followed by clinical reassessment to determine the need for further transfusion.
- Over transfusion occurs in elective RBC use.

Data Set for Transfusion

Transfusion committees (or their equivalent) are asked to take this opportunity to ensure that elective red cell transfusion is aligned with PBM practice points.

Practice points from NBA PBM Guidelines Modules 2, 3, &4:

Practice point	Guidance recommendation
4.4.1 PP1 3.4.1 PP1 3.4.5 PP1	RBC transfusion should not be dictated by a Hb concentration alone, but should also be based on assessment of the patient's clinical status.
4.4.1 PP2 3.4.1 PP2 3.4.5 PP2	Where indicated, transfusion of a single unit of RBC, followed by clinical reassessment to determine the need for further transfusion is appropriate. The reassessment will also guide the decision on whether to retest Hb level.
2.4.4 PP2	RBC transfusion should not be dictated by a haemoglobin 'trigger' alone, but should be based on assessment of the patient's clinical status. In the absence of acute myocardial or cerebrovascular ischaemia, postoperative transfusion may be inappropriate for patients with a haemoglobin level of >80 g/L.
2.4.4 PP3	Patients should not receive a transfusion when the haemoglobin level is ≥100 g/L. In postoperative patients with acute myocardial or cerebrovascular ischaemia and a haemoglobin level of 70–100 g/L, transfusion of a single unit of RBC, followed by reassessment of clinical efficacy, is appropriate.
3.4.1 PP3 3.4.5 PP3 3.4.7 PP3 4.4.1 PP3	Direct evidence is not available in general medical patients. Evidence from other patient groups and Clinical/Consumer Reference Group consensus suggests that, with a: Hb concentration <70 g/L, RBC transfusion may be

	associated with reduced mortality and is likely to be appropriate. However, transfusion may not be required in well-compensated patients or where other specific therapy is available. Hb concentration of 70 – 100 g/L, RBC transfusion is not associated with reduced mortality. The decision to transfuse patients (with a single unit followed by reassessment) should be based on the need to relieve clinical signs and symptoms of anaemia, and the patient's response to previous transfusions. No evidence was found to warrant a different approach for patients who are elderly or who have respiratory or cerebrovascular disease. Hb concentration >100 g/L, RBC transfusion is likely to be unnecessary and is usually inappropriate. Transfusion has been associated with increased mortality in patients with acute coronary syndrome.

Inclusions

- Clinical areas to include: medical, surgical, critical/intensive care and obstetrics. Patient speciality within those clinical areas is categorised into medical, surgical and obstetric adult patients (≥ 16 years of age).
- If participants wish to collect across different clinical areas, to provide data that is meaningful we suggest auditing 3 areas and provide 10 audits per area.

Exclusions

- Emergency areas and critical bleeding scenarios (including massive transfusion and post-partum haemorrhage).
- Paediatric patients under 16 years of age have been excluded as currently there are no clinical guidelines to measure appropriateness against. Paediatric areas are still encouraged to participate in this audit by including only patients that are 16 years or older.

Methodology

- Each invited health service is requested to audit up to 30 patients that have received an elective red cell transfusion during 2013.

Definitions

- Elective transfusion – a planned event or expected outcome, for example elective surgery, medical management of anaemia/ thrombocytopenia/coagulation reversal
- Patient blood management (PBM) is the management and preservation of patients' own blood to reduce or avoid the need for a blood transfusion.[1]

[1]National Blood Authority. http://www.blood.gov.au/patient-blood-management#guidelines-implementation

Instructions to download, complete and submit the audit tool.

Click the "RBC Audit Excel Form" on the Blood Matters webpage and "save as" to any location on your computer (preferably, to a directory where it can be easily found again). On opening the Excel document, there will be a number of worksheet tabs along the bottom-left of the spreadsheet: Health Service Details, and Data.

Health Service details

Open 'health service details' tab and enter your health services information.

- Please ensure the email address of a contact person is provided should Blood Matters need to clarify any information you provide. This will be the person who receives a draft individual report to review when they are prepared ahead of the final report.
  Your health service should be listed in the drop box for you to choose.

- Single unit practice: please indicate if any clinical specialty at your health service undertakes a single unit policy.
  Please choose response from dropdown box yes (Y), no (N) or unknown (U).
  If you answer yes, please type the name of the clinical speciality/ies, if health service wide, write 'All specialities'. Your response can be up to 250 characters.

- Autologous blood collection:
  Please choose response from dropdown box yes (Y), no (N) or unknown (U).
  If you answer yes, please type the name of the clinical speciality/ies. Your response can be up to 250 characters.

- Cell salvage:
  Please choose response from dropdown box yes (Y), no (N) or unknown (U).
  If you answer yes, please type the name of the clinical speciality/ies. Your response can be up to 250 characters.

- A further comments area has been provided should you wish to provide any further information or comment regarding this audit and your hospitals information.

Data

Enter up to 30 responses via the 'data' tab.

- The audit response numbers are indicated on the top line.
- Age should be 16 or more whole years. Part years will not be accepted.
- Did transfusion occur between 1 January – 31 December 2013: the dropdown box offers a yes (Y) or no (N) response. The transfusion must have occurred during 2013 to be included in this audit.
- Time of transfusion: format 00:00 (24hr clock).
- Clinical area: the area the patient was located at time of transfusion.
  The dropdown box offers alternatives: medical (M), surgical (S), critical/intensive care (CIC) and obstetrics (O). For example, an oncology patient may be admitted to a surgical ward due to bed shortages on an oncology/medical ward, so for the purposes of this audit will be recorded as "surgical". Choose the appropriate clinical area from the dropdown box.
- Patient speciality: generally determined by the specialty of the physician in charge of the patient for which the patient was admitted.
  The dropdown box offers alternatives: medical (M), surgical (S) and obstetric (O). For example, an oncology patient would be recorded as "medical". However, if the oncology patient was admitted for colorectal surgery, they would be recorded as "surgical". Choose the appropriate speciality from the dropdown box.

Medical record information

Please complete all cells in this section.
If any questions are left unanswered when they are required, the response will default to "Unknown"

- Is there evidence of medical documentation indicating reason for transfusion? This question should be answered “yes” if the reason for transfusion has been recorded in the patient’s progress notes, prescription form or as per your hospital’s expectation.
- Haemoglobin (Hb) is recorded in g/L. Therefore, if your hospital receives results in g/dL, please convert to g/L by multiplying the amount by 10.
- Is iron deficiency identified: This question should be answered “yes” if iron deficiency noted in medical notes or via pathology results.
  Please choose response from dropdown box yes (Y), no (N) or unknown (U).
- Does the patient have an underlying haematological disorder or bone marrow failure? For example: lymphoma, leukaemia, and myeloma.
  Please choose response from dropdown box yes (Y), no (N) or unknown (U).
- Is there ongoing or recent blood loss? This may include significant recent intraoperative blood loss, epistaxis or recent per rectum bleeding.
  Please choose response from drop box yes (Y), no (N) or unknown (U).
- Signs/symptoms of anaemia/hypoxia can include palpitations, breathlessness at rest /on minimal exertion, chest pain, postural hypotension or tachycardia.
  Please choose response from dropdown box yes (Y), no (N) or unknown (U).
- Is there any other documentation that supports the clinical indication of this transfusion? Please answer this if there is a reason documented in the notes why the patient required a transfusion that does not fit into the other reasons listed for transfusion.
  Please choose response from dropdown box yes (Y), no (N) or unknown (U).
  If the response is yes, complete the free text box (limited to 50 characters) to state the reason. This response box will remain highlighted yellow if left unanswered.
- Clinical assessment was performed after the first unit of transfusion: This box becomes highlighted yellow if number of units prescribed is higher than the number of units transfused. Please choose response from dropdown box yes (Y), no (N) or unknown (U).
- Hb (g/L) level after transfusion of one unit: Please express in g/L what the Hb level was after one unit, if levels were taken
- Hb (g/L) after completion of whole transfusion ordered (leave blank if not taken) : Please express in g/L what the Hb level was after completion of total transfusion, if levels were taken

Surgical/ invasive procedure patients only

- Invasive procedure/surgery - transfusion before: if appropriate to the transfusion event, answer via dropdown box selection of yes (Y) or no (N), if the patient received a transfusion before surgery or an invasive procedure.
- Invasive procedure/surgery - transfusion during / after: if appropriate to the transfusion event answer via dropdown box selection of yes (Y) or no (N) If the patient received a transfusion during or after surgery or an invasive procedure..
- Autologous blood collected: answer via dropdown box selection of yes (Y) or no (N), if appropriate to the transfusion event.
- Autologous blood transfused: answer via dropdown box selection of yes (Y) or no (N), if appropriate to the transfusion event.
- If cell salvage used what type: answer via dropdown box selection of intra-operative, post-operative or both.

Optional comments: free text limited to 50 characters if needed for each audit entry.

The workbook will need to be saved to your drive, which will provide you with your own copy and then emailed to bloodmatters@redcrossblood.org.au

We will acknowledge receipt of your data by return email.

The Transfusion Committee or equivalent should designate a member of staff to record the information requested on the excel workbook downloaded from Blood Matters website. The designated data collector in participating health service will review the patient case notes and using the excel workbook, collect the relevant data and forward the tool to Blood Matters secretariat via email to bloodmatters@redcrossblood.org.au

If there are any data queries please contact Blood Matters on 9694 0102.

All data collection forms comply with The Information Privacy Act 2000 and the Health Records Act 2001.

Time Frame

The Blood Matters secretariat are co-ordinating the audit, and responsible for the distribution of audit collection tools, data processing and analysis.
Data collection will commence 12 March 2014 and close 25 April 2014. Data will be validated and the report will follow. Blood Matters will disseminate individual results to the participating health services with the final report.

Completed audit forms are to be returned via email to:
bloodmatters@redcrossblood.org.au

If further information is required please contact
- Blood Matters on Tel: 9694 0102 or email: bloodmatters@redcrossblood.org.au

References

The National Blood Authority's Patient Blood Management Guideline:
Module 2 – Perioperative
Module 3 – Medical
Module 4 – Critical care

Summary of red blood cell transfusion appropriateness by Patient Blood Management Guideline modules.

	Surgical		Medical		Critical Care	
Inclusion criteria / Basic information						
Number submitted occuring between Jan-Dec 2013?	593		1315		164	
Patient age in years (≥ 16years) (average, range)	66.8, 16-99		70.6, 16-99		66.5, 16-95	
Number Tx occurring within hours (8am - 8pm)	488	82.3%	1148	87.3%	110	67.1%
Number Tx occurring outside hours (8pm - 8am)	99	16.7%	162	12.3%	53	32.3%
Medical record information:						
Is there evidence of medical documentation indicating reason for transfusion?	477	80.4%	1144	87.0%	145	88.4%
Hb level g/L pre-transfusion (average, range)	82.3, 48-156		78.1, 22-145		77.3, 41-136	
Is iron deficiency identified	64	10.8%	332	25.2%	19	11.6%
Haematological disorder bone marrow failure present	33	5.6%	429	32.6%	21	12.8%
Recent or ongoing bleeding present	367	61.9%	379	28.8%	99	60.4%
Signs/symptoms of anaemia/hypoxia	307	51.8%	851	64.7%	110	67.1%
Other documentation supporting transfusion	266	44.9%	603	45.9%	76	46.3%
Number of units prescribed (average, range)	2.2, 0-9		2.3, 1-12		1.9, 1-8	
Number of units transfused (average, range)	2.1, 0-9		2.2, 1-12		1.8, 1-8	
Clinical assessment performed after 1st unit of Tx	230	38.8%	396	30.1%	77	47.0%
Hb g/L level after transfusion of 1 unit (average, range)	93.9, 65-127		91.4, 59-123		87.0, 66-108	
Hb g/L after completion of whole Tx ordered (average, range)	101.2, 68-146		99.2, 10-159		91.0, 10-118	

Abbreviations: Tx - transfusions, Hb - haemoglobin

	Surgical		Medical		Critical Care	
Surgical/invasive procedure patients:						
Invasive procedure/surgery - Tx before	102	17.2%	29	2.2%	24	14.6%
Invasive procedure/surgery - Tx during / after	427	72.0%	44	3.3%	80	48.8%
Autologous blood collected	20	3.4%	0	0.0%	2	1.2%
Autologous blood transfused	23	3.9%	1	0.1%	2	1.2%
Cell salvage used:						
Postoperative	15	2.5%	1	0.1%	1	0.6%
Intraoperative	29	4.9%	0	0.0%	10	6.1%
Medical review:						
as best assessed by the limited information requested and provided						
Cases aligned to PBM guidelines	558	94.1%	1146	87.1%	150	91.5%
Documentation implies that Hb and patient's clinical status BOTH considered in decision to transfuse	501	84.5%	1060	80.6%	147	89.6%
Single unit transfusion guide followed	286	48.2%	501	38.1%	114	69.5%
Indication of overtransfusion	51	8.6%	64	4.9%	5	3.0%

Abbreviations: Tx - transfusions, Hb - haemoglobin

Appendix 4: Determining alignment by algorithm

All patient episodes were allocated the most appropriate PBM Guideline module to which they should be aligned to based on the information provided of patient specialty, clinical area and whether an invasive procedure or surgery took place (See Table 19).

Table19: Algorithm to allocate patient a module

Module	Criteria	Numbers
Module 4: Critical care	If [clinical area] = "Critical care" THEN "CRITICAL CARE"	**Breakdown: total 164** 100 pt specialty = surgical; 61 pt specialty = medical; 3 pt specialty = obstetrics
Module 2: Surgical	If [patient specialty] = "surgical" OR If [patient specialty] = "obstetrics" AND [Invasive procedure/surgery – Transfusion before] = "yes" or [Invasive procedure/surgery – Transfusion during/after] = "yes"; THEN "SURGICAL"	**Breakdown: total 593** 575 pt specialty = surgical; 18 pt specialty = obstetrics AND procedure
Module 3: Medical	If [patient specialty] = "Medical" THEN "MEDICAL"	**Breakdown: total 1,315** 1193 pt specialty = medical; 62 pt specialty = medical AND procedure 60 pt specialty = obstetrics AND no procedure

After determining the most appropriate module, a series of algorithms were run for each patient group, as detailed in Table 20. The PBM guidelines and practice points were considered and used as a basis to develop criteria for alignment and translated into clinical algorithms

Anything considered "not aligned" by algorithm was reviewed by Blood Matters, and if required, reviewed by an expert medical reviewer.

Table 20: Computerised algorithm to determine positive alignment

1. **If patient identified as 'critical care'**

   The transfusion event will be considered appropriate if:

   a. **Hb level (g/L) pre-transfusion** is less than 70 g/L,

   or, if both are met:

   a. **Hb level (g/L) pre-transfusion** is between 70 and 90 g/L, inclusive, and

   b. **patient experiencing signs/symptoms of anaemia/hypoxia** is marked as 'yes'.

2. **If patient identified as 'surgical'**

The transfusion event will be considered appropriate if:

   a. **Hb level (g/L) pre-transfusion** is 100g/L or less, inclusive.

3. **If patient identified as 'medical'**

The transfusion event will be considered appropriate if:

   a. **Hb level (g/L) pre-transfusion** is less than 70g/L,

Or, if both are met:

   b. **Hb level (g/L) pre-transfusion** is between 70 and 100g/L, inclusive, and

   c. **Patient experiencing signs/symptoms of anaemia/hypoxia** is marked as 'yes'.