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ORIGINAL PAPER

Assessing transfusion practice in elective surgical patients: a baseline audit

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Background Externally generated hospital benchmarking data indicated that the blood transfusion rate within elective surgical orthopaedic and gastrointestinal patients at a metropolitan, tertiary healthcare facility was higher than comparable Australian hospitals. An investigation of transfusion practices was undertaken with the aim of understanding the reasons contributing to this higher incidence.

Study Methods A chart audit was undertaken of every major, elective, surgical orthopaedic and gastrointestinal patient who received a blood transfusion between July and December 2017. The audit aimed to ascertain whether patients were screened and treated for preoperative anaemia and measure the clinical appropriateness of transfusions according to the National Blood Authority (NBA) Perioperative Patient Blood Management (PBM) recommendations. The key recommendations include the utilisation of restrictive transfusion thresholds (in conjunction with clinical assessment) and the administration of a single unit followed by clinical reassessment.

Results Forty-five patients had 72 transfusion episodes; 40% of episodes were considered inappropriate (n = 29). Of these, 76% (n = 22) did not have evidence of decompensation, and of the remaining that did (24%, n = 7), there was no evidence of clinical reassessment after transfusion. 42% (n = 19) of patients were anaemic preoperatively, of which only 21% (n = 4) had iron studies, and only one patient received intravenous iron preoperatively.

Conclusion Opportunities exist to improve the preoperative anaemia screening processes and clinical decision-making in transfusion practice. The baseline results of this audit will inform an improvement plan to develop interventions to enhance practice.

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Introduction

Contemporary research demonstrates causation between blood transfusions and a range of adverse outcomes including coagulopathies, immunomodulation and haemolysis [1–3]. It is, therefore, necessary to ensure that steps are taken to reduce the risk of unnecessary transfusions, and account for the benefit a patient may receive in the face of any risks posed by the transfusions [4]. The

Patient Blood Management (PBM) guidelines outline strategies to reduce the risk of unnecessary blood transfusion, and contain recommendations to guide practice, should a patient require a transfusion. To minimise blood transfusions, elective surgical patients should be screened and, where appropriate, treated for anaemia preoperatively [5]. In non-urgent circumstances, surgery should be delayed until any identified anaemia can be corrected [5]. Should a patient require a transfusion, the PBM guidelines recommend clinicians use haemoglobin levels in conjunction with a clinical assessment of the patient to guide transfusion decision-making and the transfusion of a single unit of blood, followed by reassessment of the patient (in stable non-bleeding patients) [5]. Haemoglobin levels should be considered in the context of restrictive transfusion thresholds where there is no evidence of respiratory or haemodynamic decompensation secondary to anaemia [5]. The restrictive thresholds suggest that a non-bleeding patient should not be transfused with a haemoglobin level above 70 g/l, with the exception of patients who have cardiac comorbidities and who should not be transfused with a haemoglobin level above 80 g/l [5]. Assessment of transfusion efficacy should occur after individual units are transfused and should consider the patients' physical status, in addition to any available blood results.

Globally, up to 30% of the elective surgical population are anaemic on admission [6]. The incidence in Australia is similar, with one South Australian study published in 2014 finding 28% of elective surgical patients to be anaemic preoperatively [7]. Patients within the major elective surgery population are also known to be at higher risk of requiring transfusion due to the increased risk of blood loss >500 mls. These risks can be mitigated using the PBM guidelines, with evidence demonstrating a substantial decrease in blood utilisation [[8–10]]. Despite the existence of the PBM guidelines, the frequency of inappropriate blood transfusions remains high, with evidence to suggest that between 18 and 57% of all transfusion episodes may be unwarranted or inappropriate [11]. Reasons for such practice vary widely, but there is evidence that a concerted, multi-modal approach to enhance clinical decision-making supports improvement [12].

The hospital in which the audit was conducted is a 500-bed, tertiary, metropolitan campus that services both public and privately insured patients. At this facility, activities have been undertaken in an attempt to ensure clinically appropriate transfusion practice, but according to unpublished clinical outcome benchmarking data, transfusions occurring in major, elective, orthopaedic and gastrointestinal surgical patients were identified as being double the rate of those occurring in similar Australian health services. The unpublished data showed that hospitals of comparable size were transfusing approximately 4% of patients in this population, while this facility was transfusing approximately 8% of the same patient demographic.

We sought to understand why transfusions were occurring at a higher rate by determining the clinical appropriateness of transfusion episodes and analysing current preoperative anaemia screening practices. An audit was undertaken of every patient included in the benchmarking report scheduled for elective orthopaedic and gastrointestinal surgery who received a blood transfusion over a 6-month period (July–December 2017).

Methods

Setting and context

There are three campuses within the health service under study, one metropolitan and two community campuses. The health service provides major surgical services but does not accept trauma cases. This audit was conducted in the metropolitan, tertiary referral campus that services both public and privately insured patients in a wide range of specialities, and performs approximately 1500 major, elective orthopaedic and gastrointestinal procedures annually. The public service undertakes approximately 400 orthopaedic and 100 gastrointestinal procedures, and the private service undertakes approximately 600 orthopaedic and 400 gastrointestinal procedures yearly. This hospital has evidence-based policies, procedures and clinical pathways in place that support clinically appropriate decision-making in accordance with Patient Blood Management (PBM) guidelines, which are complemented by executive-driven memos, a Blood Management Committee and quality co-ordinators employed specifically for blood management. However, it is yet to adopt a uniform preoperative anaemia screening process for both public and private patients.

Ethics

An ethics approval waiver (#Project 42846–HREC/18/MHS/111) was granted from the hospital Human Research Ethics Committee (HREC) as the data were collected for auditing and quality improvement.

Sample

The sample comprised all adult (≥18 years) patients undergoing major, elective, orthopaedic and gastrointestinal surgery, who received a blood transfusion (n = 45) over six months (July–December 2017). This included patients from both the private (n = 24) and public (n = 21) metropolitan campus.

Audit tool development

A National Blood Authority (NBA) audit tool was adapted to the local context for data collection, in consultation with the blood bank manager, two consultant haematologists and the chair of the Blood Management Committee [13]. Informal consultations occurred over multiple rounds to finalise the tool. Pilot testing was undertaken by two of the authors (AD, DM). A sample of patient charts from previously audited data was used to assess the tool for usability, reliability and whether it provided the data necessary to form an accurate picture of clinician decision-making. Pilot testing suggested the need for small changes to be made to the formatting of questions but otherwise revealed a functional and easy-to-use audit tool. An online data collection tool facilitated the collation of information. Data were collected on patient characteristics, preoperative anaemia rates and compliance with the NBA Perioperative Patient Blood Management recommendations. The audit assessed each episode by haemoglobin level (using restrictive thresholds – 70 g/l in otherwise well patients and 80 g/l in cardiac comprised patients), whether or not there was evidence of haemodynamic or respiratory decompensation (secondary to anaemia) and whether or not there was evidence of a clinical reassessment after each unit.

Data collection

Data were collected retrospectively from the scanned health record system by two of the authors (AD & DM). Audit questions are outlined in the table in Appendix 1. To document the clinical decision-making behaviours of prescribers, each red blood cell (RBC) unit administered was classified as a single- or multiple-transfusion episode. If the patient was transfused more than one unit in six hours, it was attributed to a multiple-unit episode classification. When deciding if a patient was anaemic, the laboratory reference ranges that outline the haemoglobin levels for healthy male and female patients (120 g/l male and 110 g/l female) were used. The patient health record was reviewed for any additional information that may not have been documented at the time of the transfusion episode that would have supported the need for a transfusion such as deranged patient observations and operating theatre notes indicating significant blood loss. All audit data were then collated, analysed and synthesised in a data analysis spreadsheet, prior to input into the clinical appropriateness decision tree (Fig. 1).

Results

Forty-five patients (orthopaedic $n = 35$ and gastrointestinal $n = 10$) underwent surgery and received blood between July and December 2017 (Table 1). There were 72 transfusion episodes, 60% of which were considered to have been clinically appropriate (Table 2).

Preoperative anaemia

Forty-two percentage ($n = 19$) of patients were anaemic preoperatively, with the majority of these (13/19) from the private patient cohort. Of the patients who were anaemic ($n = 19$), only 21% ($n = 4$) had iron studies performed, and only one had intravenous iron (Table 2).

Evidence of decompensation

Overall, 40% of episodes were considered inappropriate ($n = 29$). Of these, 76% ($n = 22$) of episodes were deemed inappropriate due to a lack of evidence in the health record of respiratory or haemodynamic decompensation. In patients who demonstrated decompensation ($n = 44$), there was no evidence of reassessment after transfusion in 16% ($n = 7$) of episodes (Table 2).

Patient assessment

In 29% ($n = 21$) of 72 episodes, patients were not assessed at the required time-points (Table 2). Where multiple units were issued, the patients were only assessed at the correct time-points in 38% ($n = 13$) of 34 episodes. We did not account for the reassessment of transfusion efficacy in the decision tree if there was no evidence of decompensation or if the haemoglobin was less than 70 g/l.

Reason for transfusion

The most common reason for transfusion was symptomatic anaemia ($n = 23$), representing 32% of episodes. 30% ($n = 7$) of episodes that noted this as the reason did not have data to substantiate it. Decisions based on haemoglobin level alone formed 29% ($n = 21$) of decisions, followed by clinically significant bleeding, which was noted in 19% ($n = 14$) of cases. The remaining 19% ($n = 14$) did not list a reason for the transfusion at all.

Discussion

In Australia, challenges have been reported by health facilities when trying to encourage the uptake of PBM guidelines, particularly within private facilities [14–18]. Although a small study, with a highly specific population, our results mirror this sentiment, with clear opportunities for improvement within the private sector. Areas that require particular focus include: (1) preoperative screening of anaemia and subsequent investigation and treatment; (2) reducing the incidence of red cell transfusions

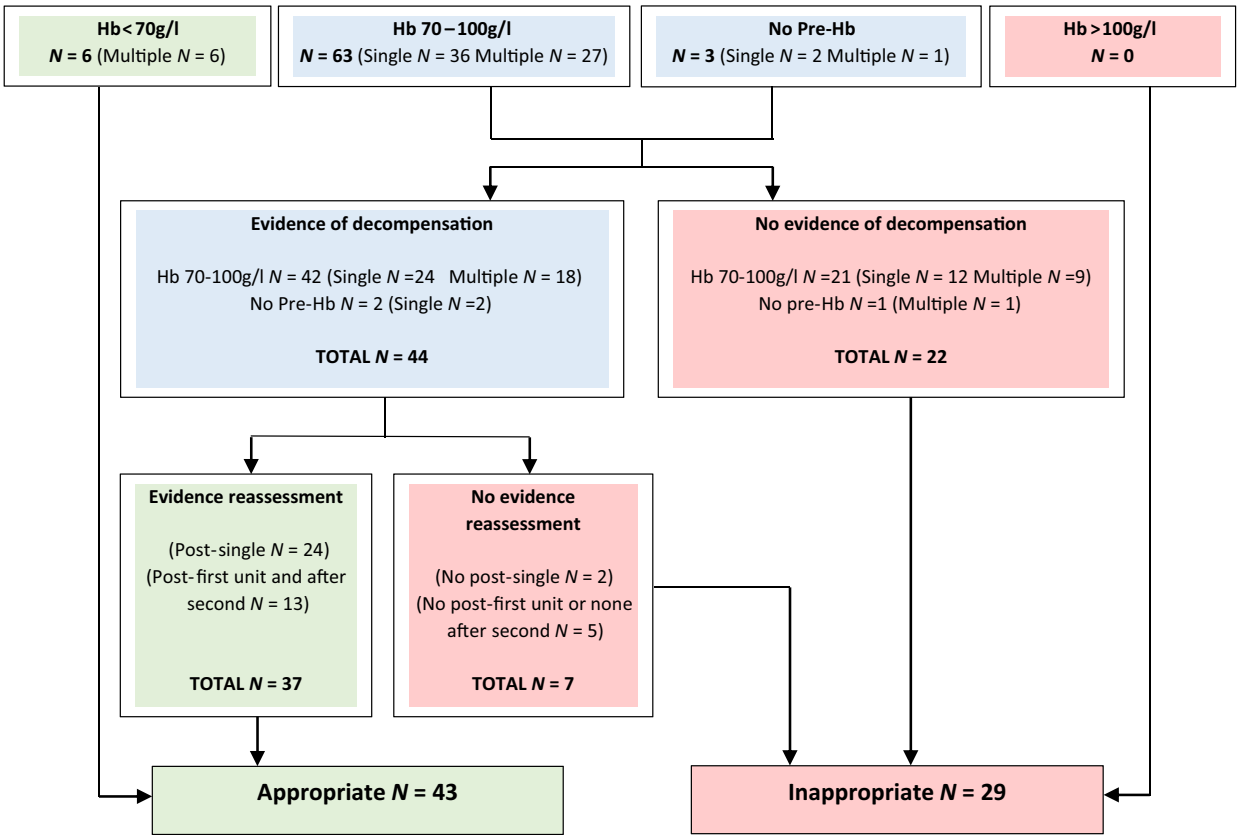

Fig. 1 Assessment of transfusion episodes according to Perioperative Patient Blood Management (PBM) guidelines (*N* = 72).

Table 1 Patient demographics

	Orthopaedics		Gastroenterology		
Demographics	**Public**	**Private**	**Public**	**Private**	**Total (all patients)**
N	16	19	5	5	45
% Male (*n*)	19% (3)	47% (9)	60% (3)	40% (2)	38% (17)
% Female (*n*)	81% (13)	53% (10)	40% (2)	60% (3)	62% (28)
Age–overall (median)	71 years	77 years	66 years	81 years	74 years
Male–average (median)	66 years (47–72)	79 years (68–88)	74 years (55–80)	83 years (81–85)	77 years (47–88)
Female–average (median)	72 years (58–90)	69 years (57–89)	65·5 years (65–66)	66 years (54–86)	70 years (54–90)
Preoperative anaemia % (*n*)	19% (3)	47% (9)	60% (3)	80% (4)	42% (19)
Iron studies completed % (*n*)	6% (1)	11% (2)	20% (1)	40% (2)	13% (6)
Anaemic patients treated % (*n*)	0% (0)	0% (0)	0% (0)	20% (1)	5% (1)

where documented evidence suggests that the patient was clinically stable and the transfusion episode was dictated by a haemoglobin level alone; (3) ensuring that patients who do require a transfusion receive one unit and are then clinically reassessed to check for treatment efficacy; and (4) a clear and defined indication for transfusion documented.

The prevalence of anaemia remains high globally, and efforts have been made worldwide to ensure that it is addressed preoperatively in elective surgical patients [19]. Some facilities have implemented a preoperative anaemia screening programme and used links with the patient's general practitioner to ensure patients are followed up if their haemoglobin is outside of normal ranges [20]. Other facilities have set up dedicated preoperative anaemia screening clinics [21]. While some success has been seen with these programmes, success is variable, and healthcare facilities continue to lament the difficulties with

Table 2 Transfusion episode demographics

	Orthopaedics		Gastroenterology		Overall Total
	Public	Private	Public	Private	All patients
Transfusion episodes					
No. of patients	16	19	5	5	45
No. of transfusion episodes	19	37	6	10	72
1 unit (*n*)	47% (9)	57% (21)	33% (2)	60% (6)	53% (38)
2 units (*n*)	53% (10)	38% (14)	67% (4)	40% (4)	44% (32)
>2 units (*n*)	0% (0)	5% (2)	0% (0)	0% (0)	3% (2)
Haemoglobin – pretransfusion (g/l) mean	77	83	81	88	82
Haemoglobin – post-transfusion (g/l) mean	94	96	96	96	96
Evidence of decompensation (*n*)	63% (14)	57% (25)	83% (5)	60% (6)	69% (50)
Evidence of reassessment (*n*)	63% (14)	57% (25)	83% (5)	70% (7)	71% (51)
Clinically appropriate (*n*)[a]	63% (12)	59% (22)	67% (4)	50% (5)	60% (43)
Not clinically appropriate (*n*)	37% (7)	41% (15)	33% (2)	50% (5)	40% (29)
Documented reason for transfusion					
Clinically significant/recent history of bleeding (*n*)	5% (1)	14% (5)	33% (2)	60% (6)	19% (14)
Symptomatic anaemia (*n*)	79% (15)	19% (7)	0% (0)	10% (1)	32% (23)
Haemoglobin only (*n*)	16% (3)	35% (13)	50% (3)	20% (2)	29% (21)
No reason documented (*n*)	0% (0)	32% (12)	17% (1)	10% (1)	19% (14)

[a]Transfusion episodes had to demonstrate both evidence of decompensation and evidence of reassessment to be deemed appropriate if the haemoglobin was over 70 g/l.

implementing these processes [14,19,22]. Our audit reflects such difficulties, with almost half of patients coming to surgery with existing anaemia. This group represents a substantial number of patients where a blood transfusion could have been minimised with improved preparation. Current barriers in the facility to implementing this practice are related to the variable and individualised preadmission clinical assessments in private and public patients. Often private, elective patients are not identified as anaemic (through routine blood screening) until the day of surgery. The development and implementation of a protocolised anaemia screening programme could help address this issue. The health facility is undertaking activities to support the introduction of such a programme this year.

The second clinical consideration that should be made when considering whether or not a surgical patient requires a transfusion pertains to whether or not the patient is demonstrating any signs or symptoms of respiratory or haemodynamic decompensation secondary to anaemia. Past studies have demonstrated that in some instances, it is preferable for a patient to sustain a low haemoglobin level (70 g/l), rather than receiving a blood transfusion [23]. A recent Cochrane review by Carson *et al.* [24] supports this practice, demonstrating no increased risk of mortality in patients who were prescribed transfusions according to restrictive thresholds (versus liberal thresholds). The exception to this is in patients who are demonstrating some form of respiratory or haemodynamic compromise secondary to anaemia. In some audited cases, there was no evidence that the patient was unwell (and therefore, in need of a transfusion). The disparity between the indication documented by the prescriber and the lack of evidence to support it reflects a knowledge gap that should be addressed with prescribers. It should be noted that this practice point is the most difficult to report on as these decisions are made in real time and are not always documented clearly in the clinical notes. Our results may represent a picture that is more negative than reality, simply because clinical assessments were not adequately documented. The decision tree provided aims to improve prescriber practice by demonstrating an opportunity to improve documentation.

If a patient does require a transfusion, prescribers should be encouraged to administer a single unit and then reassess the patient to check for effect [4]. One of the more widely implemented PBM interventions has been the implementation of a single-unit transfusion policy [14,25,26]. The implementation of this policy requires work within the facility, given that a substantial proportion of transfusion episodes comprised two or more units. The difference in patient assessment practice demonstrates (1) a lack of understanding with regard to administering single units and reassessing the patient at the correct time-points, or (2) a lack of time or practicality for prescribers to return to assess their patients following an initial transfusion to determine whether the second was

indicated. Adherence to single-unit policies can be encouraged using strategies such as audit and feedback, blood bank consultation when prescribing outside of guidelines, and electronic decision-making assistance/hard stops when attempting to order multiple units [17,27]. Development of audit and feedback tools (such as the one described in this report) is currently underway to help improve knowledge of, and compliance with, this recommendation.

Within the literature, the top three reasons for non-adherence with PBM guidelines generally include lack of prescriber engagement, lack of adequate resources (e.g. preoperative anaemia screening clinics) and lack of staff awareness (limited knowledge about the guidelines) [17,28,29]. These data reflect similar trends (e.g. absence of uniform preoperative anaemia screening, lack of staff awareness); however, work is needed to identify the barriers to further optimising practice. Our aim in conducting this audit was to provide validated and rigorous data to clinicians to demonstrate baseline practice and understand the reasons for the high transfusion rates. We propose this decision tree as a new classification method for health services wishing to undertake a similar audit, as it provides a clear visual representation of how prescribers can improve practice. These results will help inform an improvement plan to enhance practice.

Conclusion

These audit results reveal opportunities for the facility to improve preoperative anaemia screening and clinical decision-making behaviours in transfusion practice. The observations, as outlined in this report, will serve as a baseline for a further improvement plan designed to develop a uniform preoperative anaemia screening process and to enhance the clinical appropriateness of transfusion prescribing behaviours within the institution.

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Conflict of interests

The authors declare no conflicts of interests.

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Appendix 1: Audit questions

Patient blood management quality initiative		
Auditor Payroll Number:		
Clinical Stream:		
Is this a private or public patient?		
Unit/Ward:		
Patient demographics		
Patient UR number		
Patient gender		Select one
Patient age		
Clinical speciality		Drop down list
Urgent/Non-emergent		
Is this a surgical patient?		
Indication for iron therapy		
Was the patient anaemic pre-operatively?	Yes/No	
Were iron studies completed prior to admission?	Yes/No	
Did the patient receive iron therapy pre-operatively	Yes/No	
Did the patients haemoglobin level drop more than 30 g/l?	Yes/No	
Did the patient receive iron therapy post-operatively?	Yes/No	
Transfusion details		
Date of Transfusion		
Time of Transfusion		
Pre-transfusion haemoglobin		
Number of units transfused		
Post-transfusion haemoglobin		
If more than a single unit, what was the reason?		
<8 g/l rise in Hb,		
Acute blood loss,		
Chest pain,		
Hb remains < 70,		

Appendix 1. (Continued)

Patient blood management quality initiative	
No reason,	
Not applicable	
Did patient assessment occur between transfusions?	Yes/No
Clinical appropriateness	
Clinical reason for transfusion?	
Clinically significant or recent history of bleeding,	
Acute ischaemia,	
Evidence of respiratory or haemodynamic decompensation related to anaemia,	
Bone marrow failure/thalassaemia/sickle cell/Haemoglobinopathies,	
None of the above	
Is the transfusion in line with PBM guidelines? (Select one)	Drop down list (see following)
Hb < 70 documented reason	
Hb < 80 Acute Coronary Syndrome	
Hb 70–100 Documented reason	
Hb 70-90 for obstetrics with no reason documented	
Hb > 100 with indication documented	
Hb > 70 no reason	
Hb 70–90 obstetric no reason	
Hb 70–100 no reason given	
Hb > 100 no reason given	
Hb < 70 no documented reason	

