Challenging blood transfusion practice: effect of targeted behavioural intervention on red cell transfusion in a district general hospital

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ABSTRACT

Existing evidence shows that restrictive blood transfusion is safe and may avert potential harm associated with more liberal transfusion strategies. A significant number of patients are being both unnecessarily transfused and over-transfused for their age, diagnosis and comorbidities.

We describe the implementation of a behavioural strategy through educational sessions and the provision of individualised patient-centred advice, offering haematinic investigation and supplementation where appropriate. We compared our interventional data with a retrospective analysis of patients receiving blood transfusion for number of units transfused, haemoglobin triggers and incidence of haematinic investigations. The data were also analysed for patient length of stay and cost effectiveness.

There was a significant reduction in the number of red cell units transfused across all specialties (p=0.003). In total, 431 units were transfused in the interventional group compared with 571 in the control group. There was a significant reduction in over-transfusion (p=0.003). Patients undergoing haematinic testing increased by 16.6% (p=0.0002). There was no change in length of hospital stay and our strategy has been shown to not only be cost effective, but provide significant monetary saving.

Our patient-centred approach, through clinician engagement and challenging outdated behaviours, has been shown to significantly reduce inappropriate blood transfusions.

KEYWORDS: Blood, quality improvement project, transfusion

Introduction

Blood transfusion offers lifesaving therapy for patients with acute blood loss and severe anaemias. However, blood is becoming an increasingly scarce and costly resource as it relies on volunteer donations. In addition, transfusion carries the risk of a number of adverse reactions, from common transient pyrexias to a potentially fatal ABO mismatch. The risks have been reduced by advances in patient and staff education, safety checklists and monitoring; however, the possibility of transfusion-associated reactions cannot be wholly eradicated, except by transfusion avoidance.

Over the last decade, there has been a 20% decrease in red cell transfusion, largely due to reduced surgical use; however, medical use has remained static.[1] The National Comparative Audit of Use of Blood in Adult Medical Patients demonstrated that the decision to transfuse non-life-threatening anaemia is variable among physicians.[2] A significant number of patients continue to be both unnecessarily transfused, where alternative anaemia management is more appropriate, and over-transfused for their age, diagnosis and comorbidities. Unnecessary, and therefore possibly inappropriate, transfusion is driven by inadequate recognition, investigation and treatment of anaemia while traditional blind prescriptions of 'two units of blood', without relation to body weight, contribute to over-transfusion.[2]

Recent evidence has emerged that a more restrictive transfusion of red blood cells is safe and averts the potential harm associated with more liberal transfusion strategies.[3] Improving transfusion practice among clinicians optimises the use of a limited resource, but may also be beneficial for patients, ensuring they are correctly receiving the necessary amount of blood if required or safely avoiding transfusion.

In our district general hospital we performed a preliminary small-scale audit that indicated up to a quarter of all red cell transfusions may be inappropriate, mirroring the published national data.[2] In accordance with updated national guidance on patient blood management,[4] we describe the local development of an educational and targeted behavioural strategy towards best practice in blood transfusion. By providing educational sessions to develop local clinical knowledge and individualised patient-centred advice, the project aimed to reduce inter-physician variation and safely reduce the number of red cell transfusions.

Methods

West Middlesex University Hospital (WMUH) is a district general hospital with 400 beds, an accident and emergency

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department, and medical, surgical and maternity wards. In 2013, 5,783 red cell units were transfused across all specialties. A preliminary audit of red cell use showed that up to a quarter of red cell transfusions at WMUH were unnecessary, triggered by a combination of inappropriate correction of haematinic deficiencies, over-transfusion and misunderstanding of current guidance.

We hypothesised that providing an intervention targeted at clinical decision making would reduce unnecessary transfusions. A project-specific multidisciplinary team (MDT) consisting of a consultant haematologist, a junior doctor, a transfusion specialist nurse and the lead transfusion biomedical scientist was created. The MDT used previously published definitions of unnecessary transfusions (Box 1) and reversible anaemia (Box 2). Over-transfusion was defined as transfusion to more than 20 g/dL above haemoglobin threshold set for the patient group, or over 20 g/dL above pre-transfusion haemoglobin where a reversible anaemia was identified.[2]

At WMUH red cell transfusion requests were made via a paper referral system; the forms included details of patient demographics, admitting specialty and clinical indication for transfusion. Each paper request for transfusion was reviewed by a member of the MDT. The clinical indication, haemoglobin level and haematinic status were assessed against the given standards for transfusion. Approved transfusion requests were processed by the transfusion laboratory, with the necessary safety assurances and blood type cross-matching prior to dispensing red cell units. When requests did not meet the necessary criteria, the requesting clinical teams were approached with individual patient-centred advice and, where appropriate, haematinic supplementation offered as an alternative to transfusion.

Box 1. Definition of possible unnecessary transfusion above pre-transfusion haemoglobin (Hb) trigger.

The categories below are stepped in that anaemia patients at one level are those remaining after patients belonging to all earlierlevels have been excluded. For example, level 2 patients with thalassaemia are selected from the whole group of anaemia patients after excluding the level 1 patients with radiotherapy.

1. Radiotherapy **and** pre-Hb >110 g/L
2. Thalassaemia **and** pre-Hb >100 g/L Age >65 with bone marrow failure[A] **and** pre-Hb >90 g/L
3. Age >65 with chemotherapy **and** pre-Hb >90 g/L
4. Age >65 without bone marrow failure[A] or chemotherapy or comorbidity[B] **and** pre-Hb >80 g/L
5. Any age with comorbidity[B] **and** pre-Hb >80 g/L
6. Age ≤65 with bone marrow failure[A] **and** pre-Hb >80 g/L
7. Age ≤65 with chemotherapy **and** pre-Hb >80 g/L
8. Age ≤65 without bone marrow failure[A]or chemotherapy or comorbidity[B] **and** pre-Hb >70 g/L

[A]*Aplastic anaemia, Acute myeloid leukaemia, Acute lymphoblastic leukaemia, Myelodysplasia, Myeloproliferative disease (myelofibrosis), Chronic leukaemia any type, Myeloma, Non-haematological malignant infiltration (Q6B1 thru Q6B9)*
[B]*Cardiac, respiratory or vascular disease (Q13) or on any of the drugs (Q13b)*

In patients with acute blood loss, a threshold of 100 g/L has been set

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Box 2. Definition of possible potentially reversible anaemia.

Iron deficiency = Ferritin ≤15 mcg/L (female) or ≤20 mcg/L (male) ***or if there was no Ferritin result then*** Iron studies suggestive of TSAT ≤20 ***or if there was also no TSAT result then*** TIBC ≥85 µmol/L ***or if there was also no TIBC result then*** MCV ≤78 fl

B12 deficiency = B12 ≤150 ng/L (pg/mL)

Folate deficiency = Serum folate ≤2 mcg/L (ng/mL) ***or if there was no serum folate result then*** Red cell folate ≤80 mcg/L (ng/mL)

Autoimmune haemolytic anaemia = Direct Antiglobulin Test (DAT) 'Positive' or grade 1 and above

Renal Anaemia (definition 1) calculated eGFR of ≤44 (Chronic Kidney Disease stage 3b to 5) but excluding patients with 'acute renal failure', 'blood loss' and unknown age or gender.

Renal Anaemia (definition 2) calculated eGFR of ≤30 (Chronic Kidney Disease stage 4 to 5) and chronic renal failure as ONLY diagnosis 'ticked'

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Prior to initiation of our project, a power calculation demonstrated that a minimum sample size of 200 transfusions would be required to detect a reduction in inappropriate red cell transfusions from 25% to 10% (power 90%, p=0.05). A study duration of 6 weeks ensured this target was reached. The total number of red cell units transfused during this time was recorded, with pre-transfusion and post-transfusion haemoglobin and haematinic status for patients receiving transfusion also documented. For evaluation, our interventional data was compared with a retrospective analysis of red cell transfusions over the 6-week period immediately prior to the study period.

The two cohorts were compared for number of units of red cells transfused, haemoglobin triggers, patients undergoing haematinic investigations and adverse transfusion reactions. Data was collected from all specialties – namely medicine, surgery, obstetrics and gynaecology, and haematology. SPSS 14 (SPSS, Chicago, ILL) was used to assess statistical significance. Paired t-test was performed to detect differences in continuous parameters (age, pre- and post-transfusion haemoglobin and over transfusion); chi square test was used for categorical demographic differences. Unbalanced three-way ANOVA with interactions was used to compare units transfused in the two cohorts; analysis was adjusted for age and sex. Software package WinPath 5.32SP21 was used to retrieve transfusion data.

To determine the cost effectiveness of the intervention, cost per unit of blood (£123.31), transfusion giving set device (£7.89 each), working time of nurses for red cell unit checking and patient monitoring (£10.66 per hour) and working time of biomedical scientists (£15.41 per hour) were compared between the two cohorts. The cost of laboratory reagents was considered negligible for this time period. For the interventional cohort, physician time (£16.48 per hour) was calculated based on the

Table 1. Patient characteristics.

Characteristic	Control Period	Intervention period	p-value	Difference (95% CI)
Number of patients, n	367	308		
Average age, years	60	57.7	0.22	–2.3 (–5.69 to 1.09)
Women, %	63.2	61.3	0.62	–1.9 (–1.97 to –1.82)
Division				
Medicine, %	53.1	49.4	0.37	
Surgery, %	21	18	0.31	
Obstetrics & gynaecology, %	25.9	32.8	0.05	
Clinical indication				
Patient bleeding, %	24.5	27.27	0.42	2.77 (–4.58 to 4.63)
Patients with BM failure, %	5.99	8.76	0.17	2.77 (–0.20 to 0.35)

salary of an unbanded core medical trainee. We determined the average length of patient stay for individuals with transfusion requests and compared the two time periods to determine whether a reduced number of transfusions would have a negative impact on length of stay.

Results

Data from 675 consecutive requests for blood transfusion during the 12-week period (6 weeks prior to and 6 weeks during the intervention) were collected. Table 1 shows the patient characteristics during the two study periods. There was no significant difference in age, gender or clinical indication for transfusion (bleeding or bone marrow (BM) failure) between the two cohorts. The only significant demographic difference was a larger group of obstetrics and gynaecology patients in the interventional cohort.

There were 214 transfusion episodes and a total of 431 units of red cells transfused during the intervention period, compared with 263 transfusion episodes and 571 units of red cells in the control cohort. This represents a reduction of 140 red cell units – a 24.5% decrease.

Table 2 demonstrates the significant decrease in total number of units transfused between the two cohorts. There was a significant increase in appropriate haematinic investigation and treatment with intravenous iron. There was no significant difference in the mean pre-transfusion haemoglobin; however, there was a significant reduction in over transfusion, supported by a significant decrease in post-transfusion haemoglobin, an increase in single unit transfusion and a concurrent reduction in two unit transfusions.

There were no adverse transfusion reactions in either cohort. The average length of stay for patients was 12.8 days in the control cohort and 11.8 days in the intervention cohort;

Table 2. Comparison of investigation, transfusion and outcome between cohorts.

Characteristic	Control period	Intervention period	p-value
Total number of units transfused	571	431	<0.001
Units tranfused by division			
Medicine	317	245	
Surgery	106	76	
Obstetrics & gynaecology	98	79	
Appropriate management of haematinic deficiency			
Haematinics checked, %	52.09	68.6	0.0004
Patients receiving IV iron, n	17	26	0.043
Avoidance of over transfusion			
Mean pre-transfusion haemoglobin, g/L	77.8	75.3	0.068
Mean post-transfusion Hb, g/L	95.83	92.93	0.015
Hb increment >20 g above target, %	27	15	0.004
Mean number of units transfused per patient	2.17	1.52	
Single unit transfusion, %	17.22	29.43	0.001
Two unit transfusion, %	63.25	53.73	0.035
Mean length of stay, days	12.8	11.8	

Table 3. Comparison of costs and savings between cohorts.

Cost item, £	Control period	Intervention period	Cost difference
Red blood cell units	70,410.01	53,146.61	17,263.40
Blood transfusion giving sets	4,505.19	3,400.59	1,104.60
Bioscientist time	3,028.07	2,635.11	392.96
Nursing time	4,057.91	3,062.97	994.94
Physician time	0.00	1,054.72	–1,054.72
Total	82,001.18	63,300.00	18,701.18

reducing red cell transfusions did not lengthen the duration of patient admission or impact hospital bed flow.

In terms of cost effectiveness, there was an overall saving of £18,701.18 between the two time periods, as shown in Table 3. £17,263.4 was saved in red blood cell units; £1,104.60 was saved in blood transfusion giving sets. An estimated £994.94 was saved in nursing time, with a calculated time saving of 93.3 hours. A reduction in use of biomedical scientist time of 25.5 hours elicited a saving of £392.96. The behavioural intervention required an investment of 64 physician hours – a combination of teaching sessions, transfusion request reviews and one-to-one discussions with clinicians at a cost of £1,054.72.

Discussion

A targeted strategy of providing evidence-based guidance and patient-specific advice reduced the number of red blood cells transfused by a quarter, limiting inappropriate and over-transfusion. Investigation and management of haematinic deficiencies also improved. This project demonstrates that clinical decision-based intervention strategies such as ours are not only more efficacious, but additionally provide significant monetary saving. Importantly, patient length of hospital stay is not adversely affected, suggesting that the reduction in blood transfusion was clinically acceptable in stabilising the patient's haematological parameters prior to discharge. Direct interaction with clinical teams allowed patient-specific advice to be given, reinforcing education of current evidence; in essence, this employs the dictum that 'the NHS should continually and forever reduce patient harm by embracing wholeheartedly an ethic of learning'.[5] Physicians were keen to participate and we noticed that transfusion practice improved very quickly; the use of simple transfusion triggers and a personal approach to each transfusion episode had a positive impact on study outcomes. The interventional cohort had fewer overall transfusion requests than the control group, suggesting a heightened awareness of the risk and consequences of the intervention, which therefore reduced the initiation of inappropriate requests. The knowledge that each transfusion request would be challenged appeared to result in a positive culture change and supported the self-perpetuating nature of the intervention. Further audit, several months later, confirms ongoing good practice with single unit policy; the National Comparative Audit of Patient Blood Management in adults undergoing elective, scheduled surgery in 2015 showed WMUH had a 50% rate of single unit transfusion compared with the national average of 28%.[6] This not only reveals the longevity of the intervention, but also the educational diffusion into other specialties. We postulate that this may be secondary to the rotation of junior medical staff, initially involved in our study.

The improvement in appropriate transfusion practice implies an improvement in clinical safety by avoiding or reducing the many risks of transfusion. There were no adverse transfusion reactions throughout the study period so there is no objective measurement; however, it should be noted that no patients came to harm from transfusion avoidance. Increased haematinic investigations allowed clinicians to better identify and treat underlying anaemias, ultimately treating the cause rather than the symptom and, therefore, prioritising clinical effectiveness.

Although unmeasured, there was a perceived improvement in staff enthusiasm surrounding the blood transfusion process. Evidence suggests that the experience of staff in terms of support and engagement, in essence workforce morale, has a positive impact on patient experience and outcome.[7] Patient experience was not formally measured and was outside the scope of this study. However, blood transfusion is associated with adverse reactions and patient anxiety;[8] reducing the frequency of transfusion is therefore likely to result in an improvement in patient experience.

The reduction in red cell transfusions that we have shown is in line with national data indicating that 25% of transfusions are potentially inappropriate and avoidable.[2] Protocols for requesting and issuing blood are similar within most hospital trusts, largely due to national guidelines. This provides the opportunity for strategies such as ours to be implemented in other hospitals, furthering the potential for improved clinical effectiveness and efficiency savings. The likely limitation would be the variability in availability of transfusion practitioners and invested physician time.

Our strategy provided not only cost effectiveness for improved patient safety, but a significant saving. Our calculations determine a saving of £18,701.18 over the 6-week intervention period. The success of our experience provided the basis of a business proposal for sustaining cost improvement and resulted in the employment of a second specialist transfusion nurse to ensure continued good practice. The projected annual saving for WMUH is calculated at over £168,000; the annual cost of a specialist assistant transfusion practitioner is £29,000, estimating an overall annual saving of £139,000. Were this figure to be extrapolated to determine potential national saving, it would approach £25 million. Undoubtedly this boasts many assumptions – that all 178 acute trusts undertake the same number of transfusions, that the procurement costs and staffing structures are the same and that the same degree of improvement needs to be made – but what is clear is that there is scope to nationally save a significantly large sum of money by reducing inter-physician variation and providing the tools to enable clinicians to employ best transfusion practice.

The Carter report highlighted current areas for improvement in NHS operational productivity, such as the ability to make efficiency savings.[9] Our project, although preceding the publication, illustrates how the reduction in 'unwarranted

variability' can lead to reduced costs. We have demonstrated that identifying an area for quality and efficiency improvement, such as blood transfusion, has resulted in efficiencies in nursing hours, biomedical scientist hours and red blood cell units themselves; we have endeavoured to 'identify what good looks like'.[9] Our intervention also embodies other recommendations, including staff engagement, job planning, optimising resources (staff, laboratory and procurement) and acting on standards of best practice (in blood transfusion).

Limitations

Our study had a number of limitations. The number of transfusions had already been decreasing, both locally and nationwide, therefore it is possible that not all of the change and improvement in practice can be assigned to our intervention. In addition, the use of retrospective data as a control group raises the possibility that there were simply more appropriate transfusions during that period. The authors feel that this possibility was minimised by using the immediate preceding 6 weeks where the admission rate was stable and the authors are not aware of any changes in transfusion practice prior to our intervention. The MDT implemented the intervention during working hours, namely Monday to Friday 09.00 to 17.00, leaving out-of-hours transfusion requests unchallenged. Few transfusions were missed, however, because of well-circulated guidance advising against transfusion outside normal working hours.[10] Another limitation is the availability of information regarding indication for transfusion, especially in the control cohort, as the request information that was available was less comprehensive; this particularly impacts the ability to define over-transfusion where that patient's haemoglobin trigger is based on their age, diagnosis and comorbidity. Finally, pharmacy costs were not incorporated into increased interventional costs; although oral haematinic supplementation is relatively inexpensive, the same cannot be said of their intravenous counterparts.

Conclusion

Blood transfusions are performed in NHS hospitals every day. The risks and potential harm associated with transfusions are well documented. Our patient-centred approach, through clinician engagement and challenging clinical decision making, has been shown to significantly reduce inappropriate blood transfusions. We have demonstrated that good practice is continuing and therefore sustainable with invested staff and managerial support.

Our study demonstrates the ability to improve blood transfusion practice; however, further studies are needed to elucidate the generalisability of our intervention. Future studies are also needed to determine the longer term cost implications of transfusion reduction, specifically the potential of increased burden on pharmacy budgets. In addition to safety and clinical effectiveness, patient experience is a crucial part of quality healthcare,[11] therefore any further interventions should consider determining if patient experience improves with more restrictive blood transfusion practice. ■

Conflicts of interest

All authors declare no conflicts of interests.

Author contributions

KGW responsible for study design, clinical implementation of project, data collection, and drafting of manuscript. MC contributed to clinical implementation of project and data collection. KB contributed to data collection and data analysis. MJAO responsible for study design, data analysis and critical evaluation of manuscript.

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