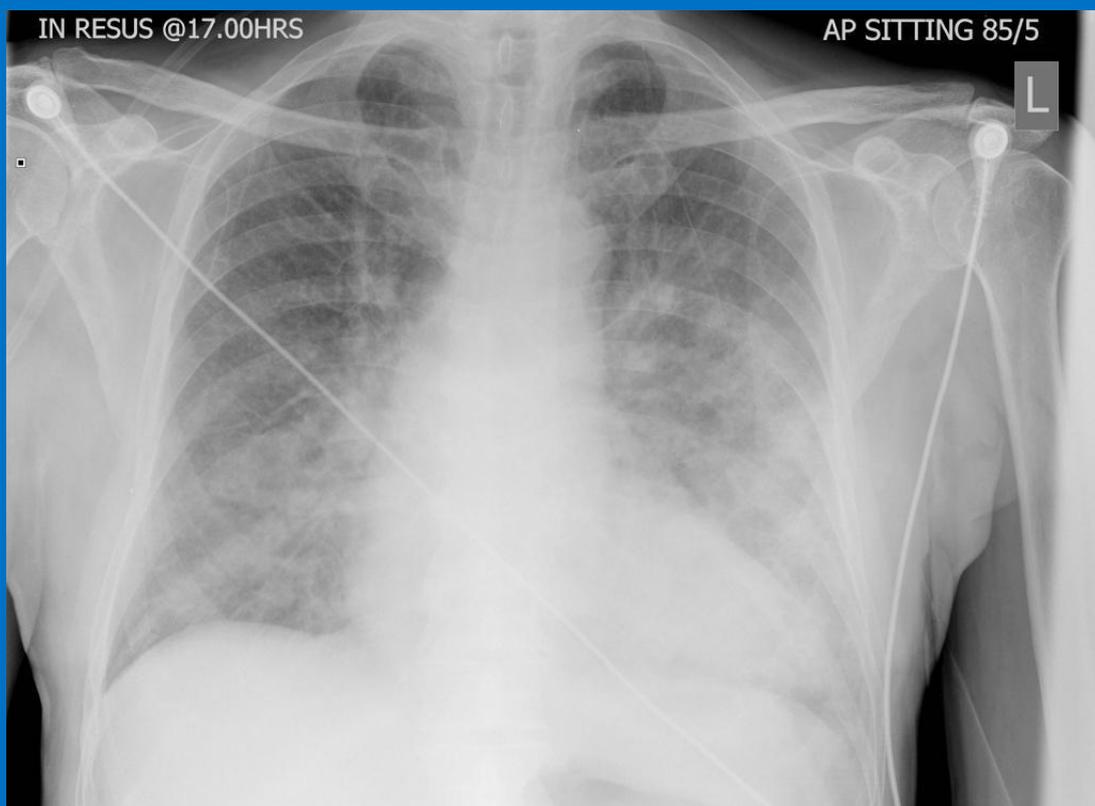


National Comparative Audit of Blood Transfusion

2017 Transfusion Associated Circulatory Overload Audit



Serious Hazards Of Transfusion

SHOT



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Abbreviations and definitions

ALT	Alanine transaminase
BSH	British Society of Haematology
CCF	Congestive cardiac failure
CMT	Core medical training or trainee
CT	Core trainee
CXR	Chest x-ray
eGFR	estimate glomerular filtration rate
FY1/2	Foundation Year 1 or 2 doctor
Hb	Haemoglobin
HDU	High dependency unit
IP	Inpatient
ITU	Intensive therapy (care) unit
JPAC	Joint UK Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee
NBTC	National Blood Transfusion Committee
NICE	National Institute of Health and Care Excellence
OP	Outpatient
RBC	Red blood cell (transfusion)
SHO	Senior House Officer (usually a foundation year 2 doctor or core medical or surgical trainee; includes those undertaking general practitioner training and speciality trainees in years 1 and 2)
SHOT	Serious Hazards of Transfusion
SpR	Speciality registrar
ST	Speciality trainee
TACO	Transfusion-associated circulatory overload

Authorisation and prescription of blood:

The use of the words 'prescribe' and 'prescription' of blood are used to refer to the authorisation of blood. We acknowledge that, legally, blood is authorised and not prescribed.

Pre-emptive diuretic:

A diuretic given within the 6 hours prior to transfusion and not part of the patient's regular medication

Transfusion episode:

Any component transfused in a 24-hour period following the start of the index unit



Executive Summary

Transfusion-associated circulatory overload (TACO) is the most common cause of transfusion associated mortality reported to Serious Hazards of Transfusion (SHOT) (SHOT, 2017) and in many cases is thought to be preventable. This national audit evaluates identification and management of patients at risk of TACO and identification and management of those developing TACO. 2461 inpatient transfusions and 2119 outpatient transfusions were audited.

A summary of recommendations is given in the next section. See the full text for justification of the audit standards and how figures were derived, including missing data.

National Results Standard	Number of transfusions meeting the audit standard	
	Inpatient	Outpatient
Assessing risk of TACO		
1. Document the indication for transfusion in the notes	1799/2425 (74%)	150/2112 (71%)
2. Risk assess all patients for TACO and document this in the notes	502/2449 (20.5%)	Not collected
Pre-emptive measures to mitigate against TACO		
3. Use restrictive red cell transfusions for patients other than those with major haemorrhage, acute coronary syndrome or a chronic transfusion requirement	109/384 (28%)	25/125 (20%)
4. Use single unit red cell transfusions for patients who do not have active bleeding	659/1788 (37%)	231/1090 (21%)
5. Perform a clinical risk assessment of the stable, non-bleeding patient after each unit to assess need for further transfusion <ul style="list-style-type: none"> haemoglobin check 	173/1204 (14%)	180/1669 (10.7%)
	140/1204 (12%)	Not collected
6. If risk factors are present take the following steps to reduce the risk: <ul style="list-style-type: none"> measure fluid balance consider prophylactic diuretics 	769/1349 (57%)	Not collected
	236/2175 (11%)	Not collected
Diagnosis and treatment of TACO		
7. Suspect TACO when there is respiratory distress with features of fluid overload	69/107 (64%)	7/7 (100%)
8. Treat patients developing features of TACO with a trial of diuretics, morphine or nitrates	16/21 (76%)	1/2 (50%)
Reporting		
9. Report all patients with TACO to SHOT	3/11 (27.3%)	No cases

Further notable information from the audit data included

- 89.2% patients had a risk factor for TACO in addition to age
- 61% inpatients and 23% outpatients were weighed within the week prior to the transfusion
- Inpatient clinical areas where transfusion with haemoglobin above 70g/L occurs most frequently are GI surgery (9% transfusions occur at or below 70g/L), oncology (13%) and orthopaedics (15%). Outpatient numbers are small but obstetrics and gynaecology, orthopaedics and haematology are least compliant with guidelines.
- 9% inpatients had their care transferred from one team to another between the decision being made to transfuse and the end of the transfusion.
- Clinical review between units occurred in 14% inpatients but when occurring, management of the patient changed as a result in 13%.
- Prescribers were twice as likely to prescribe a pre-emptive diuretic had they seen the patient within a week prior to the transfusion; 9.0% (81/899) versus 4.2% (49/1164) if they hadn't ($p < 0.05$).
- Over-transfusion to above 110g/L occurred in 5.8% inpatients.
- 18% of inpatients with completed fluid balance were more than 1500 ml positive over the 24 hours prior to the start of the transfusion.
- 1.7% outpatients were admitted within 24 hours of the transfusion and in 29% this was after they had gone home following the transfusion. 20% were admitted due to worsening respiratory symptoms.
- 3.9% inpatients required either non-invasive ventilation or transfer to intensive care or high dependency within 24 hours of the transfusion.
- 11.8% all inpatients in this audit had died at a median of 30 days following the transfusion.

Summary of Recommendations

- Include a formal pre-transfusion risk assessment for TACO in hospital transfusion policies. The 2016 SHOT report example (SHOT, 2017) is reproduced in Appendix A.
- We recommend the use of a checklist highlighting the following risk factors
 - ✓ Age > 50 years
 - ✓ Congestive cardiac failure, left ventricular failure or aortic stenosis
 - ✓ Chronic kidney disease
 - ✓ Liver dysfunction
 - ✓ Peripheral oedema
 - ✓ Prescription of concomitant IV fluids
 - ✓ Pulmonary oedema
 - ✓ Undiagnosed respiratory symptoms
 - ✓ Use of regular diuretics
 - ✓ Weight < 50kg
- In patients identified as having risk factors, the tool should recommend documenting:
 - ✎ risk of TACO
 - ✎ benefits of transfusion
 - ✎ discussion with the patient



- ✎ Include risk of TACO as part of the consent for transfusion for all patients; this should be recorded clearly in the notes.
- Weigh all patients prior to transfusion (or record an estimated weight if the clinical situation does not allow an accurate weight to be measured). We recommend all patients are weighed within the 7 days prior to the transfusion.
- ✎ Document the patient's weight on the transfusion prescription chart or other readily accessible location.
- The person authorising/prescribing the blood must review the patient. We recommend this is within the preceding 7 days if the patient is an outpatient and the preceding 24 hours (at most) if the patient is an inpatient.
- Implement patient blood management measures and ensure compliance with NICE transfusion guidelines (NG24); demonstrate non-adherence to NICE guidelines and quality standards to gain support from senior Trust management to access Trust induction/mandatory training, encourage Trust wide engagement and show a need for resources.
- The quality improvement tools soon to be available on the NHSBT National Comparative Audit website can be used to facilitate implementation of the recommendations in the audit.
- In patients at risk of TACO:
 - Monitor fluid balance
 - Prescribe one unit at a time and consider prescribing according to body weight
 - Transfuse at a slower rate
 - Consider use of a prophylactic diuretic
 - Monitor the observations closely, including oxygen saturations
 - Review the patient following each unit
- Empower nurses and biomedical scientists to challenge prescribing/requesting at inappropriate thresholds or with inappropriate numbers of units.
- Review inpatients after every unit to assess:
 - Whether further transfusion is required
 - Whether complications from transfusion are developing
- For outpatients an individualised approach is required to ascertain need for assessment during the transfusion; emphasis should be on pre-transfusion assessment (see recommendations under 'Assessing Risk').
- Educate transfusion teams and clinical teams on clinical features of TACO, highlighting that *respiratory distress, hypoxia, increased respiratory rate* within 24 hours of transfusion may be a sign of TACO.



- Inform patients they should seek medical attention if they experience breathlessness within 24 hours of having a blood transfusion.
 - For patients developing respiratory distress during or within 24 hours of transfusion, prompt clinical assessment is required. The following actions should be undertaken:
 - Stop or slow the transfusion
 - Perform a CXR
 - Consider a trial of diuresis
 - Involve intensive care or outreach team early if the patient does not respond to initial measures
 - Patients who have an episode of TACO should be considered at high risk of further events and measures should be taken to prevent future episodes of TACO, in line with recommendations made in the previous section.
 - All cases of TACO must be reported to SHOT
 - Include a reminder to report cases of SHOT to the hospital transfusion team in blood transfusion training, in TACO checklists and hospital transfusion procedures.
- 

Vignettes

A lady in her 80s received a 2-unit red cell transfusion with no clear indication and had a baseline haemoglobin 71 g/L. She was cared for by multiple teams during her inpatient admission but under an elderly care team when she was transfused. She had no documented weight, her eGFR was 56 and she had a low albumin level. The transfusion was prescribed by a consultant and there was no risk assessment documented. Each unit was prescribed over 4 hours. Her fluid balance was >1500ml positive in the 24 hours prior to the transfusion and she had been receiving concomitant fluids of 2000ml over the preceding 24-hour period. No pre-emptive diuretics were given and there was no clinical review between units. According to the audit proforma returned, no observations were done during the transfusion. The transfusion started at 21:05. No post transfusion haemoglobin was undertaken. The patient developed worsening SOB during transfusion and no imaging undertaken. It was no clear if a diuretic given or what the response was.

Although this lady survived to discharge there were multiple failures to provide a safe level of care. She had multiple risk factors for TACO and had inadequate pre transfusion pre-emptive measures as well as inadequate monitoring of her transfusion. This was despite being under the care of an elderly care team who may be anticipated to understand the dangers of fluid management in this patient group.

Measures to improve care in this patient would include

- Clear documentation of the indication for transfusion and the risks and benefits
- One unit transfused at a time
- Weight documented prior to transfusion
- Reduction in the concomitant IV fluids to allow for the transfusion volume
- Observations performed at baseline, 15 minutes and completion of the transfusion (or more frequently)
- Transfusion administered during working hours
- Transfusion over 3 hours (as 4 hours is not recommended due to cold chain regulations)
- A clinical review following the first unit
- Clinical review with CXR and diuretics at the occurrence of breathlessness with appropriate documentation in the notes

A lady in her 80s under the care of the orthopaedic team with no documented weight was transfused 2 units for asymptomatic anaemia, with a baseline haemoglobin of 103 g/L. She was on regular diuretics (which were continued at the time of the transfusion) but had no other risk factors for TACO. It is not clear who prescribed the blood. Each unit was prescribed over 4 hours. The transfusion was started at 16:30 and finished at 23.30. Fluid balance was incomplete. There were no concomitant IV fluids. No additional diuretics were given. No assessment was undertaken between the 2 units. Post transfusion Haemoglobin was 138 g/L.

Although the indication for the transfusion was documented in this case there was no acceptable indication within current guidelines. The transfusion was actually given faster than it was prescribed (although a unit to be given over 4 hours is not recommended). This appears to be a clear case of unnecessary over transfusion (it was not reported to SHOT).



A lady in her 70s under the care of the orthopaedic team with no documented weight and an eGFR of 24 ml/min was transfused 2 units of red cells by an F1 doctor for asymptomatic anaemia with a baseline haemoglobin of 63 g/L. The unit was started at 18:15. The second unit was given at 15:15 the following day and there was a clinical assessment following the first unit although no repeat Haemoglobin was undertaken. The fluid balance was documented (500-1000ml positive in the 24h prior to the transfusion) and concomitant fluids of 1400ml/24 hours were running. No diuretics were given. Observations were performed during the transfusion but BP was missing on more than one occasion. The post transfusion Haemoglobin was 133 g/L.

The big change in haemoglobin suggests that either the pre or post transfusion haemoglobin was erroneous. Given the patient was asymptomatic a check haemoglobin would have been advised prior to starting the transfusion. Additional measures which may have improved care in this case include:

- Clear documentation of the risks and benefits of the transfusion with consideration given to IV diuretics given the low GFR and concomitant fluids
- One unit transfused at a time with a haemoglobin checked following the first unit
- Weight documented prior to transfusion
- Reduction in the concomitant IV fluids to allow for the transfusion volume
- Complete set of observations taken on each occasion
- Transfusion administered during working hours

An example of good practice

A lady in her 70s under elderly care and on a general medical ward was transfused for symptomatic anaemia with a haemoglobin of 74 g/L. She had pre-existing respiratory symptoms and hypoalbuminaemia but no other risk factors for TACO. She weighed 47 kg. Both the indication for the transfusion and a risk assessment were documented. Fluid balance was documented. No pre-emptive diuretic was given. One unit was prescribed by a CMT/SHO level doctor. The unit was commenced at 11:45 over 3 hours. She was reviewed following the single unit transfusion. Post transfusion Haemoglobin was 95 g/L.

This patient could very easily have been over transfused had a 2-unit transfusion been given with a significant risk of TACO. Ideally furosemide could have been given with the transfusion but critically she was assessed both clinically and with a haemoglobin check following the single unit.



Background

Transfusion-associated circulatory overload (TACO) is the most common cause of transfusion associated mortality reported to Serious Hazards of Transfusion (SHOT) (SHOT, 2017) and in many cases is thought to be preventable.

An international consensus definition of TACO is currently under further development; the current International Society of Blood Transfusion (ISBT) definition of TACO is

Any 4 of the following occurring within 6 hours of transfusion

- Acute respiratory distress
- Tachycardia
- Increased blood pressure
- Acute or worsening pulmonary oedema
- Evidence of positive fluid balance

(ISBT, 2013)

The more recent definition in the 2016 SHOT report (SHOT, 2017) uses the following key clinical features

- Acute respiratory distress (in the absence of other specific causes)
- Acute or worsening pulmonary oedema on imaging
- Evidence of a positive fluid balance
- Evidence of volume intolerance (response to treatment for circulatory overload or evidence of pulmonary oedema on clinical examination) occurring within 24 hours of the transfusion.

Patients are categorised according to likelihood:

Highly likely: ≥3 features

Probable: respiratory distress and improvement with diuresis

Possible: respiratory distress and positive fluid balance

(SHOT, 2017)

The aetiology of the condition is traditionally considered an excess of fluid leading to increased hydrostatic pressures and subsequent pulmonary oedema. However recent evidence suggests the pathophysiology may be more complex than this; fever is reported more frequently in patients with TACO and there has been a reduction in TACO cases in some haemovigilance systems since the introduction of universal leukocyte reduction (although this has not been the UK experience) (Andrzejewski et al., 2013).

Despite controversies around the aetiology and pathophysiology it is clear that while even a small volume transfusion can lead to TACO, higher volumes of transfused components are associated with increased risk (Clifford et al., 2015; Li et al., 2011). Risk factors are discussed in more detail in the relevant section below. Minimising risk of TACO includes ensuring all transfusions given are clinically indicated and are done so with appropriate monitoring.



A pre-transfusion TACO checklist and diagnostic algorithm have been proposed in recent SHOT reports (SHOT 2016, SHOT 2017) (see appendix A) and similar tools have been proposed in the literature (Alam et al., 2013).

Previous audits and studies have shown poor recognition of risk factors and that even when TACO does occur, only a minority of cases are reported (Bartholomew et al., 2015; Gosmann et al., 2017; Hendrickson et al., 2016; Raval et al., 2015). Therefore, it is clear that the morbidity and mortality reported internationally to haemovigilance organisations represent only the 'tip of the iceberg'. Retrospective observational studies have shown the incidence of TACO to be between 1 and 10% of patients receiving a transfusion (Roubinian et al., 2017; Hendrickson et al., 2016; Sovic et al., 2014; Gosmann et al., 2017) and that TACO carries a mortality of 6-10% (Popovksy, 2002). Patients with TACO also have longer ITU and overall inpatient stays (Clifford et al., 2017; Murphy et al., 2013).

We set out to establish whether patients at risk of TACO are identified and managed with appropriate pre-emptive measures, and to establish whether patients developing TACO are identified, treated appropriately and subsequently reported.

Aims of the audit

- A comparison of the practice of each reporting hospital against all hospitals nationally
- A comparison of practice against British Society of Haematology (BSH), SHOT and National Institute for Health and Care Excellence (NICE) recommendations
- A greater understanding of how patients at risk of TACO are identified and managed in practice
- The dissemination of recommendations for best practice
- The production and distribution of tools to aid local improvements in practice

Audit standards

Standard	Sources
Assessing risk of TACO	
1. Document the indication for transfusion in the notes	JPAC guidelines 4.2 BSH administration guideline 2012
2. Risk assess all patients for TACO and document this in the notes	SHOT checklist 2016 BSH administration guideline 2012
Pre-emptive measures to mitigate against TACO	
3. Use restrictive red cell transfusions for patients other than those with major haemorrhage, acute coronary syndrome or a chronic transfusion requirement	NICE guideline NG24 2015 1.2.1 NBTC indication codes
4. Use single unit red cell transfusions for patients who do not have active bleeding	NICE guideline NG24 2015 1.2.5 BSH administration guideline 2012
5. Perform a clinical risk assessment of the stable, non-bleeding patient, including haemoglobin check, after each unit to assess need for further transfusion	NICE guideline NG24 2015 1.2.6 NICE Quality Standard QS138, statement 3 BSH administration guideline 2012
6. If risk factors are present take the following steps to reduce the risk: <ul style="list-style-type: none"> • dose according to body weight • give 1 unit at a time • measure fluid balance • consider prophylactic diuretics • monitor observations closely 	SHOT 2016 BSH administration guideline 2012
Diagnosis and treatment of TACO	
7. Suspect TACO when there is respiratory distress with features of fluid overload	SHOT 2016
8. Treat patients developing features of TACO with a trial of diuretics, morphine or nitrates	SHOT 2014 BSH administration guideline 2012
Reporting	
9. Report all patients with TACO to SHOT	SHOT NICE Quality Standard 66, statement 4



Methodology

The audit was offered to all NHS and independent sector hospitals in the UK. Participating sites were sent a pack containing audit proformas and guidance notes. Sites were asked to audit a maximum of 20 consecutive inpatient and 20 consecutive outpatient red cell transfusions. Patients were eligible for inclusion provided they were aged 60 or over. Should an auditor, while identifying consecutive patients to audit, discover a patient had died, they were asked to attempt to call the notes for audit. Each patient could be included once as an inpatient and once as an outpatient only; throughout the report 'patient', 'case' and 'transfusion episode' are therefore used interchangeably.

If case notes were not available, the auditor was asked to note that the patient was excluded and a replacement patient found to make up the sample size. Sites were asked to report on how many patients identified in the case finding stage had died and whose notes were unobtainable. Further, for those patients who were part of the audit sample, but who had died, sites were asked to provide details of the cause of death, if known. In each section, denominators have been reduced to reflect incomplete data or data not returned. Numbers of missing data are given in brackets.

A 'transfusion episode' is taken to include any component transfused during 24 hours following the start of the red cell transfusion being audited. Where the report describes 'prescribing' of blood components, this is taken as the act of 'authorising' blood.

CLINICAL AUDIT

157/171 (92%) sites contributed data on 4604 patients. 14 patients were excluded because they did not meet the audit inclusion criteria (aged 60 years or over and received at least 1 unit of red cells), and a further 10 were discarded because data were insufficient to allow meaningful analysis, leaving 4580 transfusion episodes for analysis.

Sites were asked to audit patients having a transfusion during the period March to April 2017 (n = 4359) but the returned data also included 221 patients transfused in January, February and May; all returned episodes have been included irrespective of date. It was not possible to collect information on the total number of eligible patients transfused during the audit period, and so overall denominator data are unavailable.

2461 inpatient transfusions and 2119 outpatient transfusions were audited. The median number of inpatient transfusions per site was 12, and the median outpatient number was 18.

PATIENT DEMOGRAPHICS

Table 1 - Demographics

	Gender	Median age (range) years
Inpatients		
Male	50% (1220/2461)	77 (60 - 101)
Female	50% (1241/2461)	80 (60 - 101)
Outpatients		
Male	57% (1217/2119)	77 (60 - 98)
Female	43% (902/2119)	76 (60 - 103)

SURGERY

735 inpatient surgical transfusions were audited. Of those, 63 (8%) were given while the patient was in theatre.

Table 2 - Location of surgical inpatients during transfusion

Location	National N (%)
Trauma and orthopaedics	325 (43%)
Gastrointestinal surgery	81 (11%)
Vascular surgery	53 (7%)
Cardiac surgery	32 (4%)
Obstetrics and gynaecology	17 (2%)
Other	164 (24%)
Not stated	63 (8%)

25 patients were transfused as surgical outpatients: Gastrointestinal surgery (10); Gynaecology/Obstetrics (5); Orthopaedics/Trauma (3); Other (7).



MEDICINE

1726 medical inpatient transfusions and 2094 medical outpatients were audited.

Table 3 – Subspecialties of patients transfused in medical settings

Medical Subspecialty	Inpatients N (%)	Outpatients N (%)
Acute medicine	393 (23%)	88 (4.2%)
Cardiology	82 (5%)	3 (0.1%)
Elderly care	207 (12%)	34 (1.6%)
Emergency Department	71 (4%)	
Gastrointestinal & Liver medicine	142 (8%)	36 (1.7%)
Haematology	182 (11%)	1420 (67.8%)
Intensive Care/HDU	222 (13%)	
Oncology	103 (6%)	368 (17.6%)
Renal medicine	74 (4%)	48 (2.3%)
Respiratory medicine	60 (3%)	3 (0.1%)
Other	190 (11%)	94 (4.5%)

ASSESSING RISK OF TACO

Standard 1: Document the indication for transfusion in the notes

Why this standard is important

Documentation of the indication for transfusion provides a rationale for transfusion, although on its own it does not provide evidence that a clinical assessment has taken place.

Documentation provides a record and handover for clinical colleagues reminding them to assess the patient following the initial transfusion to establish whether the blood component has achieved the desired effect and whether the patient is developing features of TACO.

How we assessed performance against this standard and why

1a. *Number of inpatients and outpatients where the indication for the transfusion is documented in the notes.*

Performance against this standard

1a.IP 1799/2425 (74%) inpatients had the indication for the transfusion documented in the notes (not stated = 36)

1a.OP 1502/2112 (71%) outpatients had the indication for the transfusion documented in the notes (not stated = 7)

The indication for transfusion was able to identified by the auditor in 2372/2461 (96%) inpatients and 2069/2119 (98%) outpatients.

Table 4 - Reason for transfusion – Inpatients (Text in blue is the NBTC indication code)

Reason		National N (%)
Symptomatic anaemia in a stable patient	R2	769 (31.2%)
Acute blood loss with haemodynamic instability	R1	493 (20%)
Asymptomatic anaemia in a stable patient	R2	410 (16.7%)
Anaemia in a patient with cardiovascular disease	R3	196 (8%)
Chronic transfusion-dependent anaemia	R4	141 (5.7%)
Anaemia in a patient receiving radiotherapy	R5	13 (0.5%)
Other		350 (14.2%)
No apparent indication		89 (3.6%)

NB it was beyond the scope of this audit to ascertain whether the indication given was appropriate.



Table 5 - Reason for transfusion – Outpatients (*Text in bold blue is the NBTC indication code*)

Reason		National N (%)
Chronic transfusion-dependent anaemia	R4	998 (47.1%)
Symptomatic anaemia in a stable patient	R2	538 (25.4%)
Asymptomatic anaemia in a stable patient	R2	149 (7%)
Anaemia in a patient receiving radiotherapy	R5	49 (2.3%)
Anaemia in a patient with cardiovascular disease	R3	46 (2.2%)
Acute blood loss with haemodynamic instability	R1	5 (0.2%)
Exchange Transfusion	R6	2 (0.1%)
Other		282 (13.3%)
No apparent indication		50 (2.4%)

Standard 2: Risk assess all patients for TACO and document this in the notes

Why this standard is important

Pulmonary complications and particularly TACO remain the commonest cause of death and major morbidity reported to SHOT (SHOT, 2017). All patients should have their risk of TACO assessed as part of the decision to transfuse. Any risk assessment or decision process should be clearly documented, which should include detail of any discussion with the patient or their relatives. Documentation also provides a handover for clinical teams that the patient is at risk of TACO.

How we assessed performance against this standard and why

- 2a. *Number of inpatients who had any documentation of an assessment regarding benefits/risks of transfusion documented in the notes.*
- 2b. *Number of inpatients noted by auditors to have had 2 or more risk factors (according to the 2016 SHOT algorithm) who had risk of TACO documented in the notes.*

These data were not collected for outpatients as it would have taken an excessive use of resource to exhaustively establish whether a risk assessment was documented. However, we accept that best practice would be for a clear risk assessment to be made and documented where it can most readily be seen by the prescriber, so it can be found easily by the nursing team administering the transfusion and any health care professionals who may subsequently review the patient.

'2 or more risk factors for TACO' as identified by the auditors was taken to mean 2 or more of the criteria in the 2015 SHOT report (SHOT, 2016); the 2016 SHOT report (SHOT, 2017) had not been published at the time of the audit.

Figure 1: TACO risk assessment/pre-transfusion checklist as published in the 2015 SHOT report (SHOT, 2016 *courtesy of Sharran Grey*)



TACO Checklist Red Cell Transfusion for Non-Bleeding Patients	
	<p>Does the patient have a diagnosis of 'heart failure' congestive cardiac failure (CCF), severe aortic stenosis, or moderate to severe left ventricular dysfunction?</p> <p>Is the patient on a regular diuretic?</p>
	<p>Is the patient known to have pulmonary oedema?</p> <p>Does the patient have respiratory symptoms of undiagnosed cause?</p>
	<p>Is the fluid balance clinically significantly positive?</p> <p>Is the patient on concomitant fluids (or has been in the past 24 hours)?</p> <p>Is there any peripheral oedema?</p>

2c. *Number of outpatients who were seen in the preceding 7 days by the prescriber*

Risk of TACO cannot be assessed if the person prescribing the prescription has not physically assessed the patient. In order to limit data collection this was not assessed for inpatients but we suggest that inpatients should have been assessed by the person prescribing the transfusion within the preceding 24 hours.

Performance against this standard

- 2a. 502/2449 (20.5%) of all inpatients had any documentation of an assessment regarding benefits/risks of transfusion documented in the notes (not stated =12)
- 2b. 978/2461 (40%) inpatients were noted by auditors to have had 2 or more risk factors (aged 60 or over and at least 1 additional risk factor as defined by the 2015 SHOT report) for TACO but of those only 21/189 (11%; not stated = 789) had risk of TACO documented in the notes.

Table 6 - Inpatients with any additional risk factors for TACO (All inpatients n = 2461)

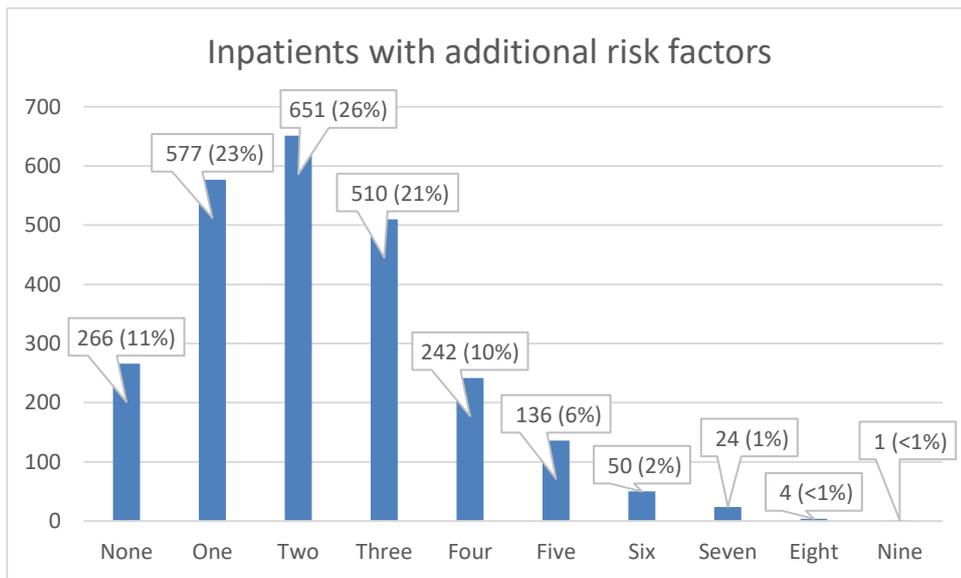
Risk factor	National N (%)
Albumin below lower limit of normal	1283/2461 (52.1%)
Positive fluid balance >500ml in the 24 hours prior to transfusion, and not previously in a negative fluid balance	286/808 (35%)
Concomitant IV fluids, or drugs diluted in 500ml or more, in 24 hours prior to transfusion	949/2461 (39%)
Chronic kidney disease (stage 3a or above)	824/2391 (34%)
On regular diuretics even if paused	610/2459 (24.8%)
Liver dysfunction (ALT above upper limit of normal)	486/2461 (19.7%)
CCF/Aortic stenosis/Left Ventricular Failure	378/2461(15.4%)
Peripheral oedema	354/2461 (14.4%)
Weight < 50kg	151/1513 (10%)

Respiratory symptoms of undiagnosed cause	151/2461 (6.1%)
Pulmonary oedema	94/2461 (3.8%)
No risk factors stated	266/2461 (10.8%)

Table 6 notes:

1. Numbers shown exceed 2461 because more than one risk factor was documented for most patients.
2. Denominators reflect incomplete data e.g. patient not weighed, no creatinine done
3. All patients have at least one risk factor by virtue of being >60 years old
4. These risk factors are based on the SHOT recommendations, with the addition of weight <50kg for which there is clear published evidence (see discussion)

Figure 2 – Inpatients with risk factors in addition to age



Patient weights

Only 61% (1513/2461) inpatients and 23% (490/2119) outpatients were weighed within the week prior to the transfusion.

Figure 3 – Inpatient weights

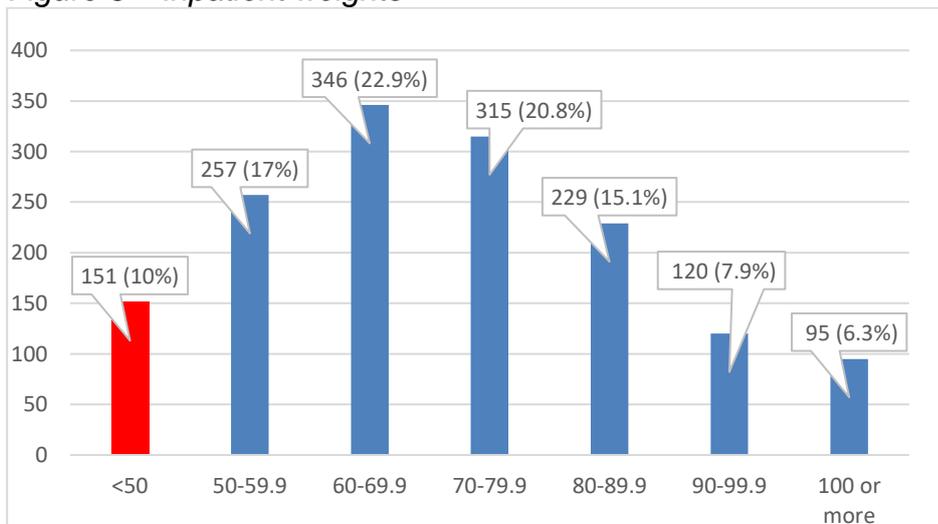
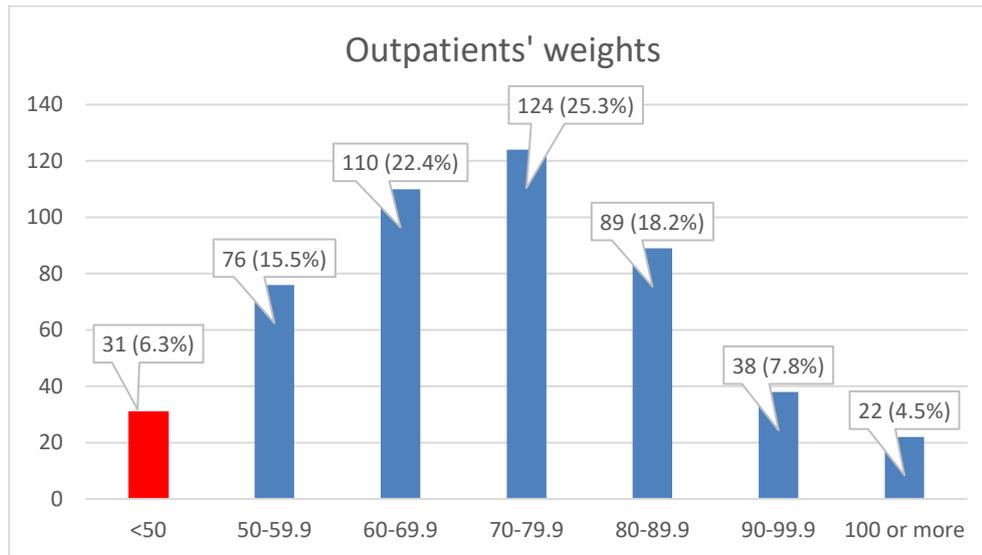


Figure 4 – Outpatient weights



Prescribing the transfusion

2c. 915/2119 (43%) outpatients were seen in the preceding 7 days by the prescriber

Table 7 - Health care professionals prescribing the transfusion

Type of staff	Inpatients N (%)	Outpatients N (%)
Consultant	473 (19.2%)	680 (32.1%)
SpR (ST3 or middle grade doctor)	424 (17.2%)	444 (21%)
SHO grade (FY2 ST1 ST2 or CT1 CT2 or GP trainee)	667 (27.1%)	276 (13%)
FY1 doctor	321 (13%)	52 (2.5%)
Other doctor	109 (4.4%)	106 (5%)
Nurse	17 (0.7%)	212 (10%)
Other*	1 (0.1%)	-
Unable to establish	449 (18.2%)	349 (16.5%)

*Advanced care practitioner

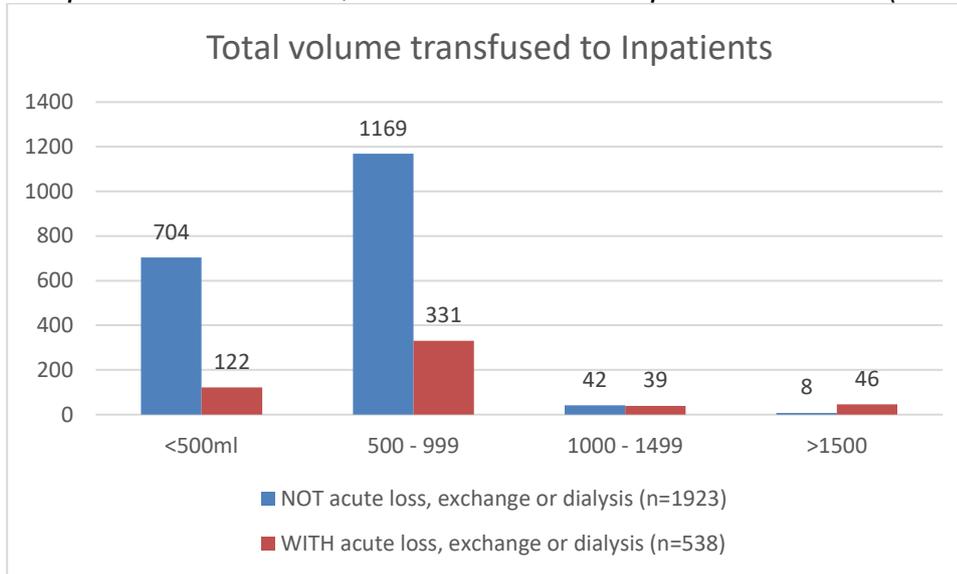
CT: core trainee; FY: foundation year; GP: general practitioner; SHO: senior house officer; SpR: specialist registrar; ST: speciality trainee

53% (113/212) outpatients whose transfusions were authorised by a nurse were seen by the nurse within 7 days prior to the transfusion, compared to 49% (765/1558) by doctors ($p=0.25$).

39% (962/2458, not stated for 3) inpatients had been under the care of more than one team at the point in the care at which the transfusion was audited. 9% (203/2298, not stated =163) had their care transferred from one team to another between the decision being made to transfuse and the end of the transfusion.

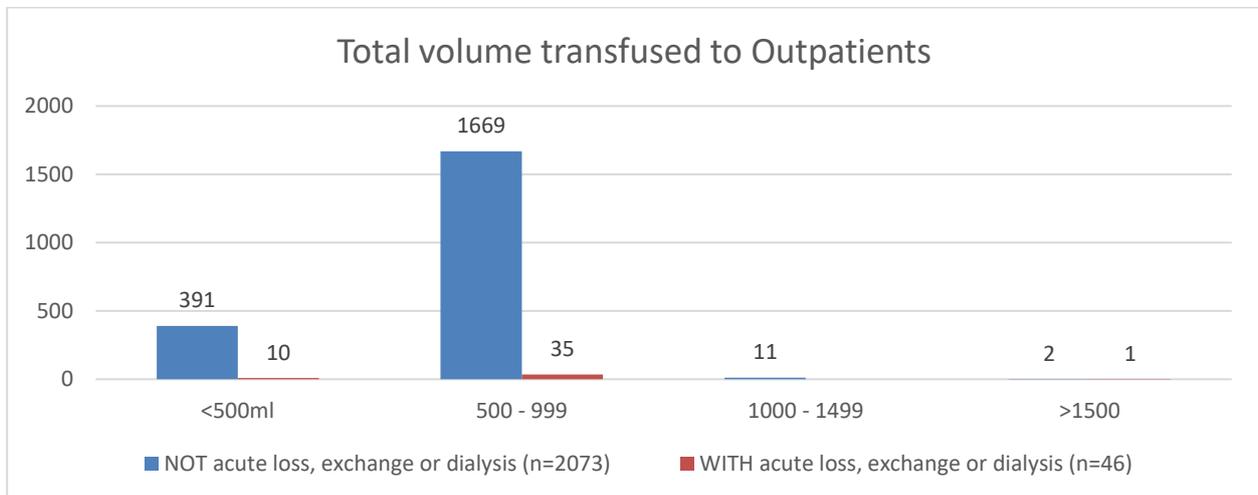
Volume of transfusion

Figure 5: Inpatients - Volume transfused per transfusion episode (including all components transfused, based on mean component volumes (NHSBT Portfolio, 2016))



NB Any patient receiving >500ml had (by definition) more than one unit transfused.

Figure 6: Outpatients - Volume transfused per transfusion episode (including all components transfused, based on mean component volumes)

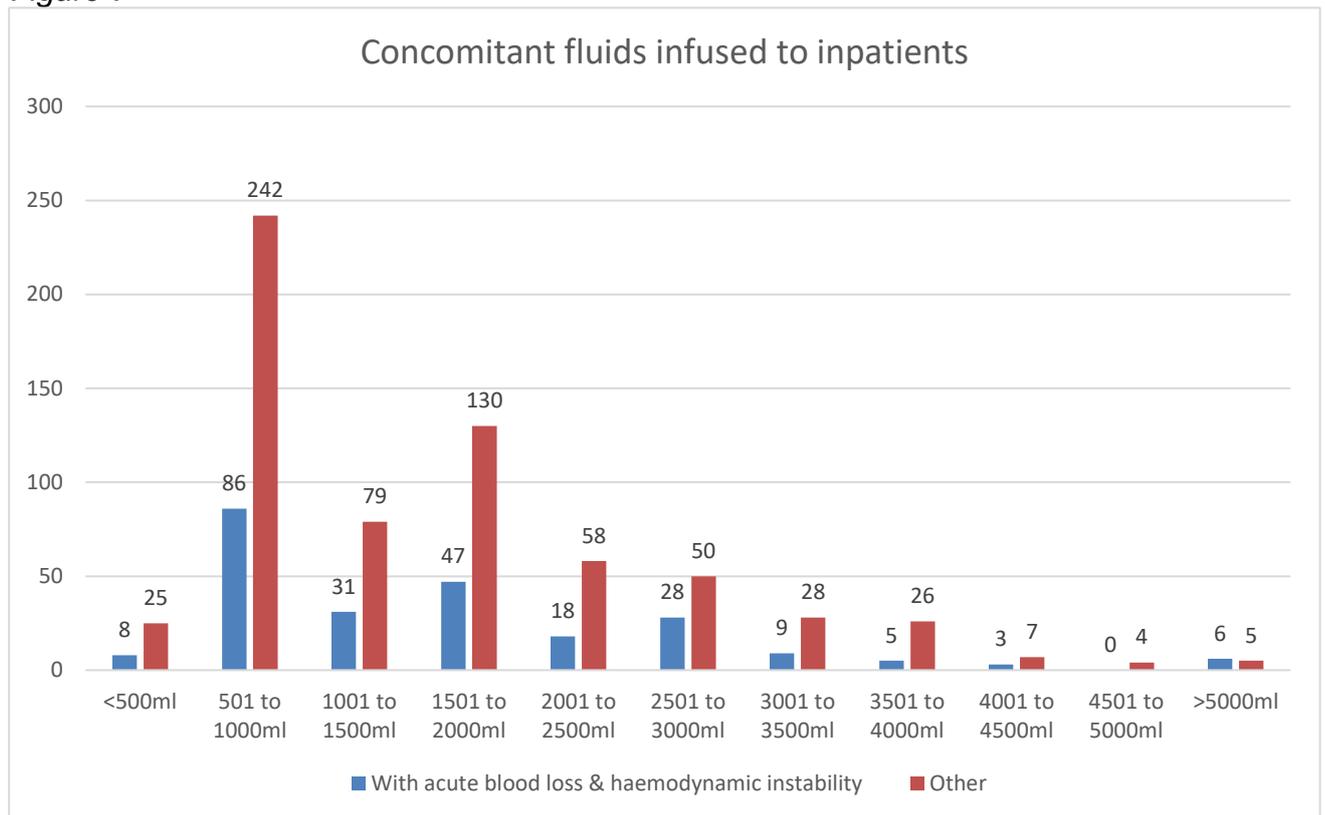


949/2461 (38.6%) inpatients had been on concomitant fluids prior to the transfusion starting. 247 patients were transfused due to acute blood loss with haemodynamic instability and have been excluded from the following data.

654/702 inpatients received a known volume of concomitant fluids (unknown volume for 48). The median volume of concomitant fluids was 1500 ml, range 60 - 9750 ml. 69/654 (11%) had > 3000ml concomitant fluids in the 24 hours prior to the start of their transfusion



Figure 7



Discussion

This audit shows that nearly 90% patients over the age of 60 years have an additional risk factor for TACO. The most common risk factors were low albumin, positive fluid balance and concomitant IV fluids.

Although the auditor could establish the reason for the transfusion in 96% of both inpatient and outpatient episodes the number of episodes where the reason for transfusion was actually documented in the notes was significantly lower.

Despite the great majority of patients in the audit having at two risk factors for TACO (i.e. age and one other), the risk of TACO was recorded in very few cases. TACO is the most commonly reported cause of major morbidity and mortality following transfusion (SHOT, 2017); the incidence of TACO is reported to be between 1 and 10% (Roubinian et al, 2017; Hendrickson et al., 2016; Sovic et al., 2014; Gosmann et al., 2017) with a mortality of 6-10% (Popovksy, 2002). Patients with TACO have higher inpatient stays and longer ITU stays (Clifford et al., 2017; Murphy et al., 2013). Hence TACO should be specifically mentioned in any discussion, and documented accordingly.

Data were collected on the person prescribing the transfusion, although we did not collect data on the method of prescription (paper or electronic). Less than half of outpatient transfusions were prescribed by someone who had seen the patient within the preceding 7 days. It is possible that with increased use of electronic prescribing and the ability to prescribe drugs and blood components remotely, clinicians are able to prescribe blood without being in the same location as the patient and thus without assessing the patient (although we note that it is also possible to issue a paper prescription for the patient without physically assessing them). Transfusion teams should be aware of this potential problem with remote prescribing and consider ways to prevent this practice.

Electronic prescribing has many advantages, including the potential for electronic decision support. Decision support can include prompting the user to consider patient risk factors for TACO, such as weight, age, eGFR, albumin, history of cardiac disease and so on. Electronic prescribing has been shown to reduce inappropriate transfusion (Hibbs et al., 2015). As electronic prescribing and electronic decision support become more widely used it is important that transfusion teams are engaged with the implementation of such systems to ensure they are used as effectively as possible.

Outpatient transfusions were most likely to be prescribed by a consultant while inpatient transfusions were most likely to be prescribed by an 'SHO' level doctor. Non-medical prescriptions were most frequent among outpatients but comprised overall a very small proportion of prescriptions. In outpatients, there was no significant difference between medical and non-medical prescribers with regards whether the patient was seen in the 7 days prior (this was not assessed for inpatients).

There may be an assumption that chronically transfused patients are known to the clinical team and therefore regular repeated assessments are not required. However, many such patients will have, and are likely to develop, additional risk factors for TACO.



For example, they may be

- elderly and frail with comorbidities, where weight loss or additional comorbidities or medications may alter their ability to withstand the transfused volume;
- undergoing treatment with chemotherapy where weight loss and chemotherapy complications (cardiotoxicity, renal impairment) may occur during treatment.

Low body weight, age over 50 years, renal dysfunction and heart failure are all risk factors for TACO (Andrzejewski et al., 2012; Clifford et al., 2015; Lieberman et al., 2013; et al., 2013).

A similar approach applies to weighing the patient prior to transfusion. A surprisingly small number of outpatients (23%) were weighed within a week of their outpatient transfusion, given that many were on dialysis or under oncology or haematology care (i.e. likely to be having chemotherapy). It is possible that patients were weighed but that the weight was not readily available to the auditor, however in such cases it is also likely the weight was also not readily available to the prescriber. Patients who are not physically able to be weighed should have a considered, estimated weight recorded.

Of those who were weighed, 6% of outpatients and 10% of inpatients weighed less than 50kg, putting them at high risk of TACO. Although we did not audit specifically whether transfusions were prescribed according to body weight it is important to consider that the often used rule that *1 unit = rise in haemoglobin of 10g/L* applies only to a 70-80kg adult. The average unit of red cells equates to 5.6ml/kg for a 50kg adult and will give an increment of 14.1 g/L (BCSH, 2012). This equates to 7.1 ml/kg for a 40kg adult, and an increment of 17.6 g/L. An increment of 1g/L will usually be achieved by 4ml/kg of red cells (BCSH 2012), that is 200ml red cells in a 50kg adult, or 160ml in a 40kg adult.

Table 8: Transfused volumes and haemoglobin increment by patient weight

Weight	ml/kg when transfusing 1 unit RBC*	Hb increment given by 1 unit RBC*	Volume of RBC to increase Hb by 10g/L
40kg	7.1	17.6	160
50kg	5.6	14.1	200
60kg	4.7	11.8	240
70kg	4.0	10.1	280

*mean volume of 1 unit of red cells =282ml (NHSBT, 2017).

Transferring care from one team to another during the transfusion process may increase the chance that the transfusion is prescribed by a clinician who has not assessed the patient, or is given by a nurse who is not familiar with the patient and therefore their potential risk factors. Nearly half of patients in the audit had their care transferred during their stay, and 8% had their care transfused between the start of the transfusion process (i.e. decision to transfuse) and the completion of the transfusion. It is vital in such cases that a thorough and timely handover occurs between nursing staff and between medical staff. This should include risks and benefits of the transfusion as well as risk factors for TACO and need for close monitoring and review following the first (and subsequent) unit(s).

The majority of patients had more than one unit transfused in 24 hours, further increasing risk of TACO. Assessment between units is covered in the next section.



Nearly half of patients were receiving additional intravenous fluids at the time of transfusion and more than 10% had >3 litres in the 24 hours prior. This potentially carries a significant risk of TACO. There is a danger that blood components may not be considered when calculating a patient's IV fluid requirement; while approximately 2/3 of infused crystalloids will leave the vasculature (and more in septic patients) (Smorenberg et al., 2017), due to its cellular and protein content the majority of the transfused volume of blood components will stay in the circulation. Thus more cardiovascular reserve is required to tolerate the same volume of blood versus crystalloid. It is important this is considered when considering not only the patient's fluid requirement but their ability to tolerate a volume load.

Recommendations for improvement

- Include a formal pre-transfusion risk assessment for TACO in hospital transfusion policies. The example given in the 2016 SHOT report (SHOT, 2017) is reproduced in Appendix A.
- We recommend the use of a checklist highlighting the following risk factors
 - ✓ Age >50 years
 - ✓ Congestive cardiac failure, left ventricular failure or aortic stenosis
 - ✓ Chronic kidney disease
 - ✓ Liver dysfunction
 - ✓ Peripheral oedema
 - ✓ Prescription of concomitant IV fluids
 - ✓ Pulmonary oedema
 - ✓ Undiagnosed respiratory symptoms
 - ✓ Use of regular diuretics
 - ✓ Weight <50kg
- In patients identified as having risk factors, the tool should recommend documenting:
 - ✎ risk of TACO
 - ✎ benefits of transfusion
 - ✎ discussion with the patient

Measures to mitigate against risk of TACO are discussed in the next section of this report.

- ✎ Include risk of TACO as part of the consent for transfusion for all patients; this should be recorded clearly in the notes.
- Weigh all patients prior to transfusion (or record an estimated weight if the clinical situation does not allow an accurate weight to be measured). We recommend all patients are weighed no later than 7 days prior to the transfusion.
- ✎ Document the patient's weight on the transfusion prescription chart or other readily accessible location.
- ✎ The person authorising/prescribing the blood must review the patient. We recommend this is within the preceding 7 days if the patient is an outpatient and the preceding 24 hours (at most) if the patient is an inpatient.



PRE- EMPTIVE MEASURES

Standard 3: Use restrictive red cell transfusion thresholds for patients other than those with major haemorrhage, acute coronary syndrome or a chronic transfusion requirement

Why this standard is important

Restrictive transfusion thresholds have been shown to be as effective as liberal thresholds in many randomised controlled trials (Carson et al., 2011; Hebert et al., 1999; Holst et al., 2014) and are thus recommended in both national and international guidelines (Carson et al., 2016; NICE, 2015; NBAA, 2012; NBTC, 2016). Restrictive thresholds reduce the risk of TACO by reducing the volume of blood transfused and reducing the number of patients who require transfusion.

How we assessed performance against this standard and why

3a. In stable patients with asymptomatic anaemia, number of patients with pre-transfusion haemoglobin ≤ 70 g/L

3b. In stable patients with cardiovascular disease with asymptomatic anaemia, number of patients with pre-transfusion haemoglobin ≤ 80 g/L.

These standards are in keeping with national and international guidelines for transfusion. Patients with symptomatic anaemia and patients with chronic transfusion dependent anaemia should be transfused according to their symptoms and are thus excluded from these standards. Radiotherapy patients are transfused to higher thresholds; NBTC indication codes give a threshold of 110g/L. Patients with acute blood loss and haemodynamic instability, or who are undergoing exchange transfusion, or are receiving radiotherapy, should not be transfused to a restrictive threshold. These patients are thus excluded from the analysis which follows.

Patients who did not have a pre-transfusion haemoglobin recorded within 24 hours (inpatients) or 72 hours (outpatients) of the transfusion are excluded from the analysis as the haemoglobin was not collected for these patients.

Performance against this standard

3a.IP 109/384 (28%) stable inpatients with asymptomatic anaemia were transfused with a pre-transfusion haemoglobin ≤ 70 g/L (not known =20 patients)

3a.OP 25/125 (20%) stable outpatients with asymptomatic anaemia were transfused with a pre-transfusion haemoglobin ≤ 70 g/L (not known =14 patients)

3b.IP 129/182 (71%) inpatients with anaemia and cardiovascular disease were transfused with a pre-transfusion haemoglobin ≤ 80 g/L (not known =9 patients)

3b.OP 20/38 (53%) outpatients with anaemia and cardiovascular disease were transfused with a pre-transfusion haemoglobin ≤ 80 g/L (not known =8 patients)

Excluding 493 inpatients with acute blood loss and haemodynamic instability, 96% (1889/1968) had a pre-transfusion haemoglobin performed in the 24 hours prior to the transfusion; 89% (1886/2114) of outpatients (excluding 5 with acute blood loss and



haemodynamic instability) had a pre-transfusion Haemoglobin measured within 72 hours before the start of the transfusion.

390 inpatients were stable with asymptomatic anaemia had a known pre transfusion haemoglobin. Of those, 110/390 (28%) had haemoglobin ≤ 70 g/L. Table 8a shows the proportion of **appropriate** transfusions in each clinical area. NB these transfusions do not include transfusions given to patients with chronic transfusion dependent anaemia, cardiovascular disease or having radiotherapy.

Table 8a: **Appropriate** transfusions given to inpatients with Hb ≤ 70 g/L

Clinical area	Number of patients with pre-transfusion Hb ≤ 70 g/L	Total number of patients with known pre-transfusion Hb	%
Most appropriate transfusions			
Respiratory medicine	6	8	75%
Liver medicine	4	6	66%
Emergency Dept	4	8	50%
Acute medicine	18	41	44%
Vascular	5	12	42%
Other medical	15	36	42%
Gastroenterology	6	16	38%
Haematology	5	15	33%
Elderly care	11	40	28%
Cardiology	3	12	25%
Renal medicine	2	8	25%
Other	1	4	25%
Other surgical	6	31	19%
Obstetrics and gynaecology	1	5	20%
Intensive care/High dependency	8	40	20%
Orthopaedics	12	81	15%
Oncology	2	15	13%
Gastrointestinal surgery	1	11	9%
Least appropriate transfusions			

Similarly, 149 outpatients were stable with asymptomatic anaemia. Of those the pre-transfusion haemoglobin was measured for 131. Of those, 27/131 (21%) had a haemoglobin of ≤ 70 g/L and were cared for in the following areas:



Table 8b: **Appropriate** transfusions given to outpatients with Hb \leq 70 g/L

Clinical area	Number of patients with pre transfusion \leq 70 g/L	Total patients with known pre transfusion Hb	%
Most appropriate transfusions			
Gastroenterology	1	1	100%
Acute medicine	2	4	50%
Elderly care	1	2	50%
Gastrointestinal surgery	1	2	50%
Other	5	13	38%
Renal medicine	2	6	33%
Oncology	6	33	18%
Haematology	9	67	13%
Obstetrics and gynaecology	0	2	0%
Trauma and orthopaedics	0	1	0%
Least appropriate transfusions			

Excluding those undergoing radiotherapy, exchange transfusion or with acute blood loss with haemodynamic instability, 27/1828 (1.5%, not known =4) of all inpatients who had a pre-transfusion haemoglobin performed and 37/1806 (2%, not known =6) of all outpatients who had a pre-transfusion haemoglobin performed, had a pre-transfusion haemoglobin of $>100\text{g/L}$.

Standard 4: Use single unit red cell transfusions for patients who do not have active bleeding

Why this standard is important

Although TACO can occur following even single unit transfusions, increased volume of transfusion increases risk of circulatory overload (Clifford et al., 2015; Li et al., 2011). Single unit transfusions are recommended by national and international guidelines (NICE, 2015; NBAA, 2012) and reduce the risk of TACO by ensuring every unit transfused is clinically appropriate as well as providing an opportunity for the patient to be assessed for features of TACO following the first unit.

How we assessed performance against this standard and why

4a. *Number of single unit transfusions, excluding patients*

- *undergoing exchange transfusion*
- *transfused for chronic transfusion dependent anaemia*
- *with acute bleeding with haemodynamic instability*
- *transfused on dialysis*

It is expected that most patients transfused in the remaining categories (symptomatic anaemia in a stable patient, asymptomatic anaemia in a stable patient, anaemia in a patient with cardiovascular disease, anaemia in a patient receiving radiotherapy) are suitable for transfusion with single units. Clinical assessment following the first unit is discussed in standard 6 below.



NICE Guidelines state to consider single-unit red cell transfusion for adults who do not have active bleeding.

Patients on chronic transfusion programmes are transfused with the goal of maintaining quality of life. They should each have their own transfusion threshold and target clearly documented (collection of this information was beyond the scope of this audit). The minimum number of units should be used to achieve the target haemoglobin.

For patients transfused on dialysis, timing does not usually permit an interim haemoglobin to be performed. Such patients are continually monitored, having their fluid balance carefully controlled. It was therefore decided to omit these patients from this analysis.

Single units should not be given to those having exchange transfusion and those with acute blood loss who are unstable.

Patients who received more than one unit who had a clinical review and haemoglobin check between every unit are detailed separately.

Performance against this standard

NB the following standards exclude those undergoing exchange transfusion, transfused for chronic transfusion dependent anaemia, with acute bleeding with haemodynamic instability and those transfused on dialysis.

4a.IP 659/1788 (37%) inpatients received a single unit transfusion

4a.OP 231/1090 (21%) outpatients received a single unit transfusion

Standard 5: Perform a clinical assessment of the patient stable, non-bleeding patient, including haemoglobin check, after each unit to assess need for further transfusion

Why this standard is important

NICE guidance recommends a clinical review after each unit of red cells transfused (NICE). Clinical assessment is necessary to assess the response to the first unit i.e. to establish whether a further unit is required, and secondly to assess any detrimental effect of the first unit such as evidence of TACO (e.g. shortness of breath, basal crepitation's). Patients not reviewed between each unit may be at increased risk of unnecessary transfusion and of developing worsening circulatory overload with subsequent units transfused.

How we assessed performance against this standard and why

- 5a. *Patients receiving more than one unit who had a clinical review between every unit (excluding patients with acute blood loss and haemodynamic instability and those transfused on dialysis).*
- 5b. *Inpatients receiving more than one unit who had a haemoglobin checked between every unit (excluding patients with acute blood loss and haemodynamic instability, and those transfused on dialysis).*



It is assumed that those patients with acute blood loss and haemodynamic instability, and those on dialysis, are under continuous observation. It may be neither practical nor necessary to check the haemoglobin or document a clinical review after every unit in these circumstances.

Outpatients on chronic transfusion programmes have been included in the data examining clinical assessment; many have risk factors for TACO and multiple cases are reported to SHOT every year of patients on chronic transfusion programmes who develop TACO. Data were not collected on haemoglobin performed after the first unit for outpatients.

Performance against this standard

NB the following standards exclude those with acute blood loss and haemodynamic instability and those transfused on dialysis

5a.IP 173/1204 (14%) inpatients had a documented clinical review between every unit (not stated = 6)

5a.OP 180/1669 (10.7%) outpatients had a documented clinical review between every unit (not stated =13)

Table 9 - Clinical review between transfused red cell units – all patients receiving more than 1 unit of red cells who were not transfused for major blood loss with haemodynamic instability, and who were not transfused on dialysis

Review	Inpatients (n = 1210) N (%)	Outpatients (n = 1682) N (%)
Yes after every unit	173 (14.3%)	180 (10.7%)
Yes, but not after every unit	141 (11.7%)	104 (6.2%)
No review done	890 (73.5%)	1385 (82.3%)
Not stated	6 (0.5%)	13 (0.8%)

5b. National: 140/1204 (12%) inpatients had a haemoglobin checked after the first unit (not stated = 6)

In the 173 instances where there was a clinical review of inpatients during the transfusion, subsequent management was altered as a result in 21/166 (13%) (not stated =7).

89% (2174/2448) of inpatients had a post-transfusion haemoglobin performed within 24 hours of the transfusion. Post-transfusion in the patients discussed above are as follows:

In stable patients with asymptomatic anaemia the post-transfusion haemoglobin should be 70-90g/L (in accordance with NICE guidelines).

136/354 (38%) inpatients had a post transfusion haemoglobin 70-90g/L (haemoglobin not stated =1)



In stable patients with cardiovascular disease and asymptomatic anaemia, the post-transfusion haemoglobin should be 80-100g/L.

121/182 (66%) inpatients had a post transfusion haemoglobin 80-100g/L (haemoglobin not stated =14)

188/2174 (8.6%, not stated =13) inpatients had a post transfusion haemoglobin of >110 g/L. Of these, 1 was transfused prior to radiotherapy and 61 were transfused for acute blood loss with haemodynamic instability. The remaining 126 patients (5.8%) would be considered to have been over transfused.

47 inpatients were transfused in theatre for acute bleeding with haemodynamic instability. Pre-transfusion haemoglobins in these patients ranged from 66 g/L to 154 g/L with post-transfusion haemoglobin 78-147g/L.

For outpatients, there was great variation in when the haemoglobin was next measured. 27% outpatients (575/2119) had not had a post-transfusion haemoglobin taken at the time their transfusion was audited.

Table 10 - Outpatient post-transfusion haemoglobin measurement (n = 1520; data incomplete for 24)

Time between transfusion and Hb measurement*	National N (%)
Within 7 days	736 (48.5%)
Between 8 and 14 days	373 (24.5%)
Between 15 and 31 days	332 (21.9%)
More than 31 days	79 (5.1%)

The median post-transfusion haemoglobin overall was 92 g/L (range 45 to 146g/L).

Standard 6: If risk factors are present take the following steps to reduce the risk:

- **dose according to body weight**
- **give 1 unit at a time**
- **measure fluid balance**
- **consider prophylactic diuretics**
- **monitor observations closely**

Why this standard is important

These are the measures that are likely to reduce the risk of patients developing TACO in the presence of risk factors. Although there are no high quality data to guide best practice in prevention of TACO, the harm associated with these measures is low, and they are commonly accepted as appropriate practice (Alam et al., 2013).

How we assessed performance against this standard and why

6a. *Number of inpatients with at least 1 additional risk factor for TACO who had a completed fluid balance in the 24 hours prior to transfusion*

6b. *Number of patients with at least 1 additional risk factor for TACO who received pre-emptive diuretics prior to the transfusion.*



As outpatients will not have had a fluid balance in the 24 hours prior to transfusion, they are not included in the fluid balance standard.

A 'pre-emptive dose' of diuretic was defined as a one off or extra dose given in the 6 hours prior to transfusion.

For this standard, risk factors are taken as all those listed in Table 6.

Dosing of the transfusion has been addressed in the previous standards.

Performance against this standard

6a. 769/1349 (57%) inpatients with at least 1 additional risk factor had a completed fluid balance in the 24 hours prior to transfusion (not recorded = 846)

Figure 8 – Fluid balance for inpatients with at least 1 additional risk factor (n=2195)

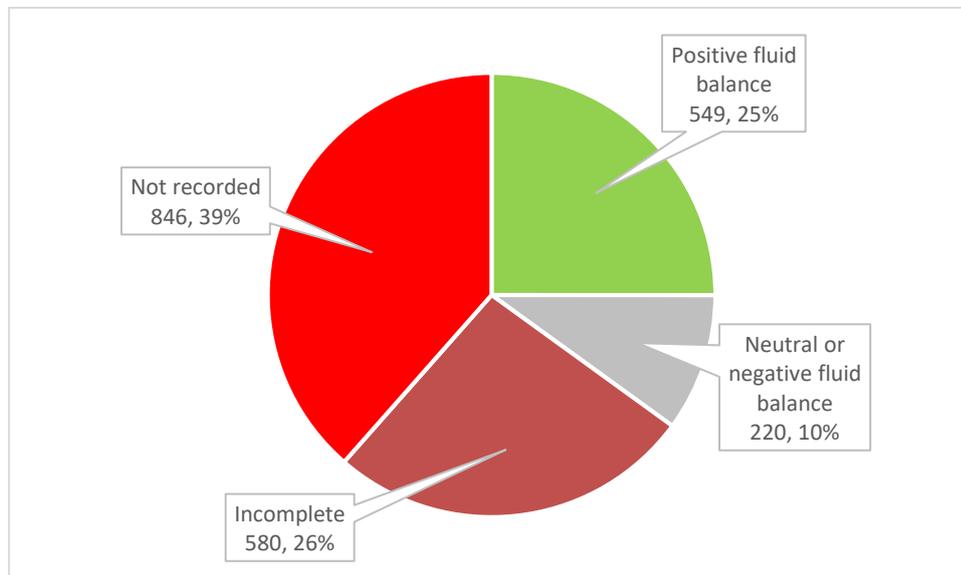
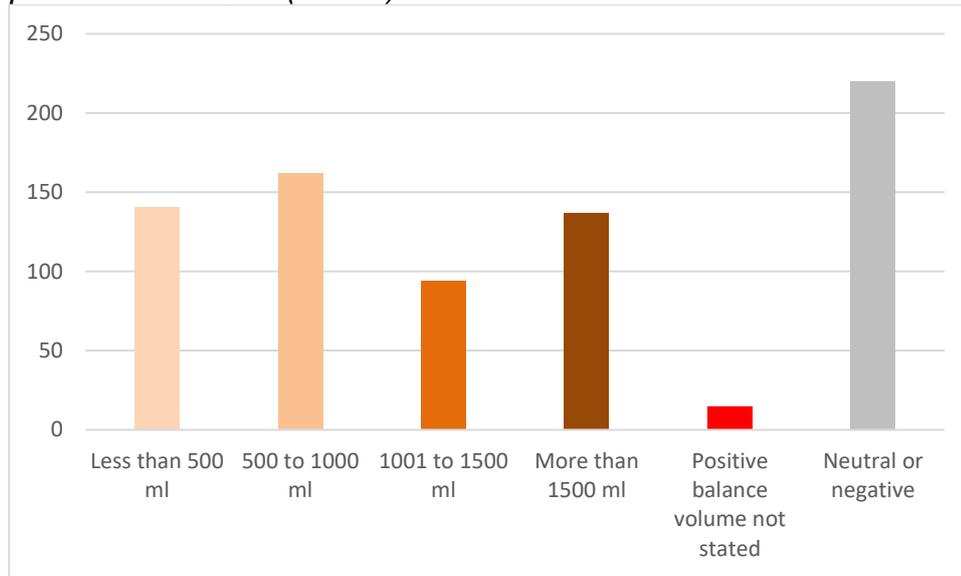


Table 11 - Inpatients with at least 1 additional risk factor and with completed fluid balance prior to transfusion (n=769)

Volume in mls	National N (%)
Less than 500 ml	141 (18%)
500 to 1000 ml	162 (21%)
1001 to 1500 ml	94 (12%)
More than 1500 ml	137 (18%)
Not recorded	15 (2%)
Neutral or negative	220 (29%)

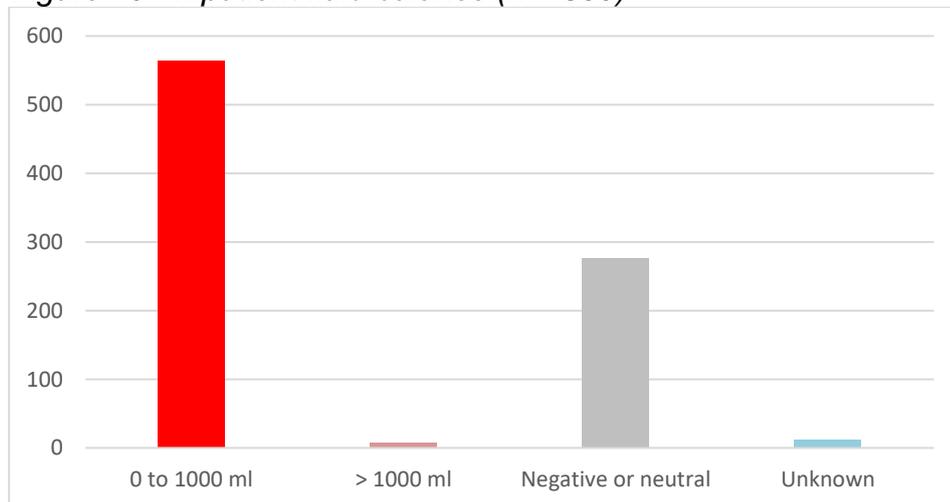
Figure 9 - Inpatients with at least 1 additional risk factor and with complete fluid balance prior to transfusion (n=769)



Of inpatients with a positive fluid balance, 146/549 (27%, not stated =13 inpatients) had previously been in a negative balance - i.e. may have been recovering from a previous fluid deficit.

Fluid balance during and after the transfusion was recorded for 860/2442 (35%, not stated =19) inpatients.

Figure 10 - Inpatient fluid balance (n = 860)



6b. 236/2175 (11%, not stated =20) inpatients with at least 1 additional risk factor received pre-emptive diuretics prior to the transfusion

610 inpatients were on regular diuretics at the time of the transfusion, and in 143 cases the diuretics were paused at the time of the transfusion. Pre-emptive diuretics were

given to 249/2439 (10%) inpatients overall (not known for 22) and to 6% (130/2053) outpatients (not known =66).

Prescribers were twice as likely to prescribe a pre-emptive diuretic had they seen the patient within a week prior to the transfusion; 9.0% (81/899) versus 4.2% (49/1164) if they hadn't ($p<0.05$).

Information about patient observations taken before and during the transfusion were collected for inpatients and outpatients. Full statistical analyses of these data are being undertaken and will be issued in a supplementary report.

Discussion

Despite publication of NICE guidelines and a much work being undertaken by transfusion teams nationally a large proportion of transfusions continue to occur in patients whose haemoglobin exceeds the recommended threshold. Most patients are not transfused with single units and most are not assessed between units.

Haemoglobin thresholds for outpatients may be more liberal and single unit transfusions may be less commonly used because it is neither practical nor in the patient's best interests to be reviewed daily in this setting. Anticipated changes in haemoglobin from the time of assessment to the time of the transfusion should be taken into account, and the patient transfused according to the anticipated haemoglobin at the time of transfusion. This may explain why adherence to standards was lower in outpatients than inpatients but even in inpatients compliance was poor. Furthermore, only stable patients with asymptomatic anaemia were assessed in the thresholds standards (3a and 3b) and patients undergoing transfusion for chronic anaemia were excluded from the single unit standard (3c).

Very few patients in this audit had a haemoglobin or clinical review following the first unit. For outpatients assessment between units is less important (and less practical) than ensuring the patient has been reviewed within an appropriate time prior to the transfusion. Although many outpatients receiving transfusion are regularly transfused, as discussed in the previous section they are also likely to develop additional risk factors for TACO and should therefore not be assumed to be low risk on the basis of having had multiple previous (uneventful) transfusions. In cases where there was a clinical review of inpatients following the first unit, subsequent management was altered in 13% (21/166). This demonstrates the value of the clinical review.

While the post-transfusion haemoglobin was checked very frequently in inpatients, there was a high rate of over transfusion indicated by the post transfusion haemoglobin. NICE guidelines state that those transfused at a threshold of 70g/L should have a post transfusion haemoglobin of 70-90g/L and those transfused at 80g/L a target of 80-100g/L (NICE, 2015).

Almost a third of post transfusion haemoglobins $>110\text{g/L}$ occurred in patients with acute blood loss and haemodynamic instability, suggesting the volume of blood loss was overestimated. Despite the immediate concerns of severe bleeding, TACO is a recognised complication of massive transfusion and severity of bleeding may be overestimated by clinicians. Emergency surgery, intraoperative fluids, transfusion of



mixed components (e.g. red cells and plasma) and number of blood products transfused are all risk factors for TACO (Andrzewski et al., 2012; Clifford et al., 2015; Clifford et al., 2017; Murphy et al., 2013; Li et al., 2011).

Unnecessary and over transfusion puts patients at unnecessary risk of TACO and it is clear that more needs to be done to target clinical areas continuing to transfuse above appropriate haemoglobin thresholds. Of patients transfused with a pre-transfusion haemoglobin above the recommended thresholds, the most common clinical areas were gastrointestinal surgery, oncology and trauma and orthopaedics and we would suggest targeting these areas for delivering education on patient blood management.

Fluid balance is poorly documented and even when done shows approximately 2/3 patients (where data are known) are in positive balance prior to the transfusion. This also relates to large volumes being transfused and frequent use of concomitant IV fluids which are discussed in the previous section. Only a third of inpatients had fluid balance measured during and after the transfusion; two-thirds of these patients were in a positive fluid balance at the end of the day on which they had the transfusion.

Very low numbers (11%) of patients with risk factors were prescribed pre-emptive diuretics. Patients assessed by the person prescribing the blood were more likely to be prescribed a pre-emptive diuretic (9% versus 4.2%, $p < 0.05$), further emphasising the benefit of timely clinical assessment.

Recommendations for improvement

- Implement patient blood management measures and ensure compliance with NICE transfusion guidelines (NG24); demonstrate non-adherence to NICE guidelines and quality standards to gain support from senior Trust management to access Trust induction/mandatory training, encourage Trust wide engagement and show a need for resources.
- The quality improvement tools soon to be available on the NHSBT National Comparative Audit website can be used to facilitate implementation of the recommendations in the audit.
- In patients at risk of TACO
 - Monitor fluid balance
 - Prescribe one unit at a time and consider prescribing according to body weight
 - Transfuse at a slower rate
 - Consider use of a prophylactic diuretic
 - Monitor the observations closely, including oxygen saturations
 - Review the patient following each unit
- Empower nurses and biomedical scientists to challenge prescribing/requesting at inappropriate thresholds or with inappropriate numbers of units.
 - Review inpatients after every unit to assess
 - Whether further transfusion is required



- Whether complications from transfusion are developing
 - For outpatients an individualised approach is required to ascertain need for assessment during the transfusion; emphasis should be on pre-transfusion assessment (see recommendations under 'Assessing Risk').
- 

DIAGNOSIS AND TREATMENT OF TACO

Standard 7: Suspect TACO when there is respiratory distress with features of fluid overload

Why this standard is important

When breathlessness, hypoxia or increased respiratory rate occurs during or following transfusion, clinical assessment and investigation is required to establish a possible diagnosis of TACO in order to implement appropriate treatment.

How we assessed performance against this standard and why

- 7a. *Number of inpatients who developed acute or worsening respiratory distress who had a CXR*
- 7b. *Number of outpatients admitted with respiratory symptoms who had a CXR*

Although there is little high quality evidence to guide treatment of TACO, standard treatment of TACO includes appropriate investigation with a CXR or other imaging (SHOT 2016;).

In order to rationalise time spent on the audit, auditors were not asked to review all outpatient notes and thus data were only collected on those outpatients who were admitted within 24 hours of the transfusion.

Performance against this standard

NB outpatient data not shown below for individual Trusts as numbers are very small.

- 7a. 69/107 (64%) inpatients who developed acute or worsening respiratory distress had a CXR (not stated =0)
- 7b. 7/7 (100%) outpatients admitted with worsening respiratory symptoms had a CXR (not stated =0).

Standard 8: Treat patients developing features of TACO with a trial of diuretics, morphine or nitrates

Why this standard is important

TACO should be treated promptly in order to prevent excess morbidity and mortality.

How we assessed performance against this standard and why

- 8a. *Number of inpatients who developed acute or worsening respiratory distress and had CXR features of fluid overload who had treatment with a diuretic and/or morphine and nitrates*
- 8b. *Number of outpatients admitted with acute or worsening respiratory distress and had CXR features of fluid overload who had treatment with a diuretic and/or morphine and nitrates*



Although there is little high quality evidence to guide treatment of TACO, standard treatment of TACO includes a trial of diuresis (SHOT 2016).

Patients with new onset radiological pulmonary oedema but who were not documented to have respiratory distress are included.

In order to rationalise time spent on the audit, auditors were not asked to review all outpatient notes and thus data were only collected on those outpatients who were admitted within 24 hours of the transfusion.

Performance against this standard

NB outpatient data not shown below for individual trusts as numbers are very small.

- 8a. 16/21 (76%) inpatients who developed acute or worsening respiratory distress had and who showed CXR features of fluid overload had a trial of diuresis
- 8b. 1/2 (50%) outpatients admitted with acute or worsening respiratory distress with worsening chest x-ray changes had a trial of diuresis (not stated =0)

4.4% inpatients (107/2426, not stated for 35) developed acute or worsening respiratory distress within 24 hours of transfusion. 102/107 (95%) of those patients displayed one or more additional risk factors referred to earlier in this report. An additional 11 patients had pulmonary oedema on post transfusion imaging, either that had worsened from previous imaging, or with no previous imaging. 21 patients had both acute or worsening respiratory distress and chest x-ray changes.

Of 118 inpatients with respiratory symptoms or radiological features of fluid overload, auditors felt the respiratory deterioration or pulmonary oedema *not* to be due to TACO in 85 (72%), leaving 33 cases of possible TACO. Eleven inpatients were identified by the treating teams as having TACO (see 'Reporting TACO')

Table 12: Outcomes of outpatients transfused (n=2111, not stated =8)

	National -jN (%)
Admitted	
Yes	35 (1.7%)
No	2075 (98.3%)
Timing of admission	
Admitted immediately from the day unit	25 (71%)
Admitted within 24 hours of transfusion after being discharged from day unit	10 (29%)
Location of readmission	
Admitted to same hospital	33 (94%)
Admitted to other hospital	2 (6%)
Admitted due to worsening respiratory symptoms	7/35 (20%)
Respiratory symptoms thought to be due to the transfusion	2/7 (28.6%)



Inpatient outcomes

95 inpatients (4%) required increased support in the 24 hours following their transfusion.

Table 13 - Inpatient complications within 24 hours after the transfusion (of 2461 inpatients)

Complication*	National N (%)
Any complication	97 (3.9%)
Non-invasive ventilation (CPAP, BiPAP)	7 (0.3%)
Invasive ventilation	9 (0.4%)
HDU admission	25 (1.0%)
ITU admission	60 (2.4%)

**some patients developed more than 1 complication/requirement*

At a median of 29 days from transfusion to audit, outcomes were as follows:

Table 14 - Inpatient outcome at the time of audit (n = 2461)

Outcome	National N (%)
Discharged	1391 (56.5%)
Inpatient: ongoing stay unrelated to transfusion	776 (31.5%)
Inpatient: prolonged admission due to transfusion complications	6 (0.2%)
Died	288 (11.8%)

Of the 288 deaths, only 2 were thought to be “possibly related” to the transfusion but causes of death were not available.

Outpatient outcomes

One outpatient required admission to HDU and one to ITU, but in neither case was the transfusion thought to be implicated.

At the time the notes were audited, 22/35 (63%) inpatients who were admitted following the transfusion had been discharged. 6 (18%) were still an inpatient and 6 (18%) had died (not known for one patient). The transfusion was not thought to be implicated in any of the deaths.



Discussion

1.7% of inpatients experienced worsening respiratory distress within 24 hours of the transfusion. Previous SHOT and current ISBT definitions of TACO refer to symptoms and signs that develop within 6 or 12 hours of the transfusion (ISBT, 2013; SHOT 2016) but in 26 cases of TACO reported to SHOT between 2010 and 2016 the deterioration occurred between 12 and 24 hours following the transfusion (SHOT, 2017). Difficulties in establishing timing of symptoms can occur particularly if the patient is at home, or a CXR or clinical review is not performed immediately at the onset of symptoms. It is therefore important not to exclude TACO as a cause of respiratory distress following transfusion simply because the deterioration was not recorded within 6 or 12 hours.

Interestingly the majority of outpatients admitted with breathlessness within 24 hours of the transfusion were felt by the auditor **not** to have been admitted as a result of the transfusion.

Appropriate investigation and management of TACO was seen in around only half of patients; more than a third of inpatients with respiratory distress following the transfusion did not undergo a CXR and even fewer had a trial of diuresis. Although the evidence is lacking, basic investigations and a trial of diuresis is accepted as standard practice in investigation and management of TACO (SHOT, 2017).

Although any implication of the transfusion in a patient's deterioration was identified in very few cases, it is interesting to note that nearly 20% patients admitted within 24 hours of their transfusion died during that admission.

As part of further statistical analysis we aim to identify which patients developed features in keeping with TACO but who were not identified by the treating teams as having TACO.

Recommendations for improvement

- Educate transfusion teams and clinical teams on clinical features of TACO, highlighting that *respiratory distress, hypoxia, increased respiratory rate* within 24 hours of transfusion may be a sign of TACO.
- Inform patients they should seek medical attention if they experience breathlessness within 24 hours of having a blood transfusion.
- For patients developing respiratory distress during or within 24 hours of transfusion, prompt clinical assessment is required. The following actions should be undertaken:
 - Stop or slow the transfusion
 - Perform a CXR
 - Consider a trial of diuresis
 - Involve intensive care or outreach team early if the patient does not respond to initial measures
- Patients who have an episode of TACO should be considered at high risk of further events and measures should be taken to prevent future episodes of TACO, in line with recommendations made in the previous section.



REPORTING OF TACO

Standard 9: Report all patients with TACO to SHOT

Why this standard is important

TACO is frequently unrecognised as a transfusion reaction (Hendrickson et al., 2017) and clinical teams may treat fluid overload without being aware the patient had TACO. In order to identify areas of practice that could benefit from improvement it is important all events are recognised and treated appropriately.

How we assessed performance against this standard and why

9a. *Number of patients identified by the treating team as having TACO that were reported to SHOT*

Performance against this standard

9a.IP 3/11 (27.3%) inpatients identified by the treating team as having TACO were reported to SHOT. A fourth was reported in another category for which details were not provided.

9a.OP No outpatients were identified by the treating team as having TACO.

All patients in the audit reported to SHOT as TACO were identified by the treating team as having TACO.

Discussion

The audit is in line with published evidence suggesting reports of TACO are the 'tip of the iceberg' and that most episodes of TACO go unreported. Even in those cases identified by the treating team as TACO only 33% were reported. We suspect more patients developed TACO than were identified by the treating teams and will issue a subsequent report following further statistical analysis. In one case the transfusion team reported a diagnosis other than TACO to SHOT.

Furthermore, there was an increase in TACO cases reported to SHOT during the audit period (Paula Bolton-Maggs, medical director for SHOT, personal communication) and so it is likely that reports to SHOT are over represented in these data.

Recommendations for improvement

All cases of TACO must be reported to SHOT

Include a reminder to report cases of SHOT to the hospital transfusion team in blood transfusion training, in TACO checklists and hospital transfusion procedures.



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Appendix A – SHOT TACO pre-transfusion checklist

Reproduced from the 2016 SHOT report (SHOT, 2017). Courtesy of Sharran Grey and Paula Bolton-Maggs

TACO Checklist	Red cell transfusion for non-bleeding patients	If 'yes' to any of these questions
	<p>Does the patient have a diagnosis of 'heart failure' congestive cardiac failure (CCF), severe aortic stenosis, or moderate to severe left ventricular dysfunction?</p> <p>Is the patient on a regular diuretic?</p>	<p>1</p> <ul style="list-style-type: none"> Review the need for transfusion (do the benefits outweigh the risks)?
	<p>Is the patient known to have pulmonary oedema?</p> <p>Does the patient have respiratory symptoms of undiagnosed cause?</p>	<p>2</p> <ul style="list-style-type: none"> Can the transfusion be safely deferred until the issue can be investigated, treated or resolved?
	<p>Is the fluid balance clinically significantly positive?</p> <p>Is the patient on concomitant fluids (or has been in the past 24 hours)?</p> <p>Is there any peripheral oedema?</p> <p>Does the patient have hypoalbuminaemia?</p> <p>Does the patient have significant renal impairment?</p>	<p>3</p> <ul style="list-style-type: none"> Consider body weight dosing for red cells (especially if low body weight) Transfuse one unit (red cells) and review symptoms of anaemia Measure the fluid balance Consider giving a prophylactic diuretic Monitor the vital signs closely, including oxygen saturation

Due to the differences in adult and neonatal physiology, babies may have a different risk for TACO. Calculate the dose by weight and observe the notes above.

Appendix B – Clinical Audit Tool

INPATIENT TRANSFUSION EPISODE

Demographics and speciality

1. Date episode audited 2017

2. What was the date of the transfusion that you are auditing? 2017

3. What is the patient's gender? Male Female

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

5. What was the location of the patient when the transfusion was commenced?

General medical ward

If under a subspecialty, please specify

- Acute medicine
- Cardiology
- Elderly care
- Gastrointestinal medicine
- Liver medicine
- Oncology
- Renal medicine
- Respiratory medicine
- Other (*we don't need the details*)

Q5 continues on next page . . .



General surgical ward

If under a subspecialty, please specify

Cardiac surgery

Gastrointestinal surgery

Orthopaedics/trauma

Vascular surgery

Other (*we don't need the details*)

Tick if transfusion occurred in theatre

Emergency department

Gynaecology/obstetrics

Haematology

Intensive care unit / HDU

Other (*we don't need the details*)

6. Has the patient been under the care of MORE THAN 1 other additional team during this inpatient episode at the point of transfusion? (e.g. admitted through ED, then under acute medicine and receives transfusion under respiratory team).

Yes No

7. Was the patient's care transferred from one team to another between the decision being made to transfuse and the end of the transfusion?

Yes No Cannot tell from clinical record

8. Was the patient weighed within a week prior to the transfusion starting?

Yes No

If yes, go to Q9. If no, go to Q10

9. How much did the patient weigh (kg)? (if multiple weights, use that closest to the start of the transfusion episode)

--	--	--

Kg

Please tick if this is an estimated weight only



Risk factors for TACO

10. Is there any evidence the patient had a diagnosis of congestive cardiac failure, severe aortic stenosis or moderate-severe left ventricular dysfunction at the time of the transfusion?

Yes No

11. Is there any evidence there was peripheral oedema prior to the transfusion?

Yes No

12. Was the patient on a regular diuretic at the time of the transfusion?

Yes, but diuretics *were not* paused Yes, but diuretics *were* paused No

13. Did the patient have documented pulmonary oedema at the time of the transfusion?

Yes No

14. Did the patient have respiratory symptoms of undiagnosed cause documented prior to the transfusion?

Yes No

15. If yes to any of Q10-Q14, was a risk of TACO documented anywhere in the patient record relating to this transfusion episode, prior to the transfusion starting?

Yes No

16. Did the patient have any of the following at the time of the transfusion?



- Documented liver dysfunction or ALT or ALP > upper limit of normal?
- Albumin < lower limit of normal
- None

17. What was the patient's eGFR or creatinine value immediately pre transfusion?

(Please report creatinine and ethnicity if eGFR not done)

eGFR **OR**
 Creatinine
 Ethnicity



Prescription

18. How many units were given in this transfusion episode?

(A transfusion episode is defined as all units transfused within a 24-hour period)

Red cells

Platelets

Plasma (FFP or Octaplas)

19. To the best of your knowledge what was the reason for transfusion?

- Acute blood loss with haemodynamic instability
- Anaemia in a stable patient
Symptomatic? Yes No
- Anaemia in a patient who has cardiovascular disease
- Chronic transfusion dependent anaemia
- Anaemia in a patient receiving radiotherapy
- Exchange transfusion
- Other (*we don't need the details*)
- No apparent indication

19a. Was the reason for the transfusion documented in the notes?

Yes

No

20. Who authorised ('prescribed') the transfusion?

- Unable to establish
- Consultant
- SpR, ST3+ or middle grade doctor
- SHO grade (F2, ST1, ST2 or CT1, CT2 or GP VTS)
- F1 doctor
- Other doctor (*we don't need the details*)
- Nurse
- Other (please specify)

21. Was any risk assessment documented in the notes regarding benefits/risks of transfusion?



Yes No

22. At what rate was each unit prescribed? (Please include all units of red cells, platelets and plasma transfused during the episode. Document "NR" if not recorded. Complete an additional sheet if required)

Date and time prescribed to start	Red cells, platelets or plasma (FFP/Octaplas)	Rate (hours)	Comment (e.g. patient on dialysis)

23. At what time did the patient start and finish the whole transfusion episode? (Enter "NR" if not recorded)

Start date (dd:mm) 2017 Time (hh:mm 24h) :

End date (dd:mm) 2017 Time (hh:mm 24h) :

Fluid balance

24. What was the patient's fluid balance on the day prior to the start of the transfusion? (Include any blood components transfused)

- Positive fluid balance
- Less than 500 ml in last 24 hours
 - 500 to 1000 ml
 - 1001 to 1500 ml
 - Greater than 1500 ml
- Neutral or negative fluid balance
- Not recorded
- Incomplete

25. If positive fluid balance in Q24, was the patient previously clinically in a negative fluid balance? (e.g. admitted with sepsis or acute kidney injury and thought clinically dehydrated)

Yes No

26. Has the patient been on concomitant IV fluids, or drugs diluted in 500ml or more, in the 24 hours prior to the start of the transfusion?

Yes No

If yes, go to Q27. If no, go to Q28



27. What was the total volume in the last 24 hours? mls

28. Were pre-emptive diuretics given? (e.g. "one off" or extra dose given in the 6 hours prior to transfusion)

Yes No

29. Was the patient's fluid balance monitored during and for 24 hours following the transfusion?

Yes Yes but incomplete No

If yes, go to Q29a. If no, go to Q30

29a. What was the fluid balance at the end of the day of the transfusion you are auditing?

- Positive fluid balance
 >1000ml
 0 to 1000ml
 Neutral or negative fluid balance

30. Was there evidence of a clinical review between each unit transfused?

- Yes, after every unit
 Yes, but not after every unit
 No
 Only 1 unit transfused

If you ticked Yes, go to Q30a. Otherwise, go to Q31

30a. Did the review result in a change in the rate of transfusion or the volume transfused?

Yes No

Haemoglobin assessment

31. Was a pre-transfusion Hb measured within 24 hours of the start of the transfusion?

Yes No

If yes, go to Q32. If no, go to Q33



32. What was the Hb?

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 g/L

33. Was the Hb measured after each unit transfused?

 Yes No

34. Was a post-transfusion Hb taken within 24 hours of the end of the transfusion episode?

 Yes No

If yes, go to Q35. If no, go to Q36

35. What was the Hb post transfusion? (Use the first Hb checked after the transfusion episode)

--	--	--	--

 g/L

Clinical course

36. Were the patient's observations taken within the hour preceding the start of the transfusion?

 Yes No Yes but incomplete

36a. Please indicate for all observations in the 24 hours following the start of the transfusion when they were taken and *tick whether each parameter was recorded*

Tick here if the patient was on continuous monitoring



Date and time of observations	Temp	HR	BP	O ₂ saturations	RR
<i>Example: 12/03/17 10:45</i>	✓	✓	✓	<i>Leaving this blank means it was not done</i>	✓



37. Did the patient develop acute or worsening respiratory distress (including hypoxia or CXR changes) within 24 hours of the transfusion?

Yes No

If yes, go to Q37a. If no, go to Q38

37a. If yes, was there a possible cause other than TACO?



Yes No

38. Did the patient develop new or worsening pulmonary oedema (on CXR or other imaging) within 24 hours of the transfusion?



Select one of:

- a) Pulmonary oedema (+/- cardiomegaly) not on pre-transfusion imaging *OR* worsening compared to pre-transfusion image
- b) Pulmonary oedema (+/- cardiomegaly) with no pre-transfusion imaging for comparison
- c) No change from previous imaging
- d) Pulmonary oedema not present
- e) No imaging undertaken

39. If you answered yes to Q37 or you ticked option a) or b) in Q38, what was the clinical response?



- Improvement with diuretics and/or morphine and nitrates alone (*not administered with steroid, antihistamine or bronchodilator*)
- Improvement with diuretics and/or morphine and nitrates alone (*also administered with steroid, antihistamine or bronchodilator*)
- No improvement or worsening after diuretic
- Unable to assess response to diuretic
- Diuretic not given

40. Was the patient identified as having TACO? (Tick Yes if this was included in a list of differential diagnoses and answer for all patients)

Yes No

41. Was the patient reported to SHOT? (For any reason at all. Please answer for all patients)

Yes No



If yes, go to Q41a. If no, go to Q42

41a. What was reported?

- TACO
 Transfusion associated dyspnoea
 Other (please state)

42. Did the patient come to require any of the following within 24 hours after the transfusion? (Tick all that apply. Only tick if the patient was not already having this treatment prior to the transfusion)

- Non-invasive ventilation (CPAP, BiPAP) **now go to Q42a**
 Invasive ventilation **now go to Q42a**
 HDU admission **now go to Q42a**
 ITU admission **now go to Q42a**
 None of the above **now go to Q43**

42a. Was the transfusion felt to be implicated?

- Unlikely/No
 Possible
 Likely
 Certain/Yes
 Unable to answer



43. What was the patient's outcome at the time you audited the patient?

- Discharged
 Inpatient; prolonged admission due to transfusion complications
 Inpatient; unrelated to transfusion
 Died; please give the date of death 2017

If the patient died, please answer Q43a. Otherwise, you have completed this audit booklet

43a. Was the transfusion implicated in the patient's death?

- Unlikely/No
 Possible
 Likely
 Certain/Yes



Thank you for collecting data on this transfusion episode.



OUTPATIENT TRANSFUSION EPISODE

Demographics and speciality

OP1. Date episode audited 2017

OP2. What was the date of the transfusion that you are auditing?

2017

OP3. What is the patient's gender? Male Female

OP4. What was the patient's year of birth?

OP5. Which specialty was the patient under?

General medicine

If under a subspecialty, please specify

- Acute medicine
- Cardiology
- Elderly care
- Gastrointestinal medicine
- Gynaecology/obstetrics
- Haematology
- Liver medicine
- Oncology
- Renal medicine
- Respiratory medicine
- Other (*we don't need the details*)
- General surgery

If under a subspecialty, please specify

- Cardiac surgery
- Gastrointestinal surgery
- Orthopaedics/trauma
- Vascular surgery
- Other (*we don't need the details*)

OP6. Was the patient weighed within a week prior to the transfusion starting?

Yes No

If yes, go to OP7. If no, go to OP8

OP7. How much did the patient weigh (kg)? (*if multiple weights, use that closest to the start of the transfusion episode*)

Kg

Please tick if this is an estimated weight only



Prescription

OP8. How many units were given in this transfusion episode? (A transfusion episode is defined as all units transfused within a 24 hour period)

Red cells

Platelets

Plasma (FFP or Octaplas)

OP9. To the best of your knowledge what was the reason for transfusion?

- Acute blood loss with haemodynamic instability
- Anaemia in a stable patient
- Symptomatic? Yes No
- Anaemia in a patient who has cardiovascular disease
- Chronic transfusion dependent anaemia
- Anaemia in a patient receiving radiotherapy
- Exchange transfusion
- Other (we don't need the details)
- No apparent indication

OP10. Was the reason for the transfusion documented in the notes? Yes No

OP11. Who authorised ('prescribed') the transfusion?

- Unable to establish
- Consultant
- SpR, ST3+ or middle grade doctor
- SHO grade (F2, ST1, ST2 or CT1, CT2 or GP VTS)
- F1 doctor
- Other doctor (we don't need the details)
- Nurse
- Other (please specify)

OP12. Is there any evidence the person authorising ('prescribing') the blood had personally seen the patient in the 7 days preceding the transfusion?

Yes No



OP13. At what rate was each unit prescribed? Please include all units of red cells, platelets and plasma transfused during the episode. Document "NR" if not recorded. Complete on additional sheet if required

Date and time prescribed to start	Red cells, platelets or plasma (FFP/Octaplas)	Rate (hours)	Comment (e.g. patient on dialysis)

OP14. Was the patient on a regular diuretic at the time of the transfusion?

Yes No

OP15. Were pre-emptive diuretics given? (e.g. "one off" or extra dose given in the 6 hours before transfusion)

Yes No

OP16. At what time did the patient start and finish the whole transfusion episode? (Enter "NR" if not recorded)

Start date (dd:mm) 2017 Time (hh:mm 24h) :

End date (dd:mm) 2017 Time (hh:mm 24h) :



Clinical assessment

OP17. Was there evidence of a clinical review after each unit transfused?

- Yes, after every unit
- Yes, but not after every unit
- No
- Only 1 unit transfused

OP18. Was a pre-transfusion Hb measured within 72 hours of the start of the transfusion?

- Yes No

If yes, go to OP19. If no, go to OP20

OP19. What was the Hb taken prior to the transfusion?

g/L

OP20. On what date was the next Hb taken after the transfusion?

2017 No Hb yet taken

If you have entered a date, go to OP20a. Otherwise, go to OP21

OP20a. What was the Hb taken on this day?

g/L



Clinical course

OP21. What were the patient's observations, if taken, at the following times? (NB mark 'incomplete' if respiratory rate absent)

Timing of observations	Observations performed	Blood pressure	Heart rate	Respiratory rate	Oxygen saturations	Temperature
Pre-transfusion (within 1 hour)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Incomplete	/	bpm		% <input type="checkbox"/> On air <input type="checkbox"/> On oxygen	°C
At 15 minutes into the transfusion	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Incomplete	/	bpm		% <input type="checkbox"/> On air <input type="checkbox"/> On oxygen	°C
Post-transfusion (within 1 hour)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Incomplete	/	bpm		% <input type="checkbox"/> On air <input type="checkbox"/> On oxygen	°C

OP21a. Were any further observations performed during the outpatient attendance?

Yes No

OP22. Was the patient admitted following the transfusion?

- Admitted directly from the day unit *(If so, go to OP23)*
- Went home and readmitted within 24 hours to this hospital *(If so, go to OP23)*
- Went home and readmitted within 24 hours to another hospital (if information available) *(If so, you have now finished auditing this transfusion)*
- Not admitted to this hospital or any other as far as can be determined *(If so, you have now finished auditing this transfusion)*

The following questions relate to the subsequent re-admission (or direct admission from day case). (If the patient was admitted to your hospital, or to another hospital and you have further information on their admission, please complete the remaining questions).

OP23. On admission was there any documented evidence of worsening respiratory symptoms?

Yes No

OP24. Were the symptoms leading to admission thought to be related to the transfusion?

- Unlikely/No
- Possible
- Likely
- Certain/Yes
- Unable to answer



OP25. Did the patient develop new or worsening pulmonary oedema (on CXR or other imaging) within 24 hours of the transfusion?



Select one of:

- a) Pulmonary oedema (+/- cardiomegaly) not on pre-transfusion imaging *OR* worsening compared to pre-transfusion image
- b) Pulmonary oedema (+/- cardiomegaly) with no pre-transfusion imaging for comparison
- c) No change from previous imaging
- d) Pulmonary oedema not present
- e) No imaging undertaken

OP26. If you ticked option a) or b) in OP25, what was the clinical response?



- Improvement with diuretics and/or morphine and nitrates alone (*not administered with steroid, antihistamine or bronchodilator*)
- Improvement with diuretics and/or morphine and nitrates alone (*also administered with steroid, antihistamine or bronchodilator*)
- No improvement or worsening after diuretic
- Unable to assess response to diuretic
- Diuretic not given

OP27. Was the patient identified as having TACO? (Tick Yes if this was included in a list of differential diagnoses)

- Yes No

OP28. Was the patient reported to SHOT? (For any reason. Please answer for all patients)

- Yes No

If yes, go to OP28a. If no, go to OP29

OP28a. What was reported?

- TACO
- Transfusion Associated Dyspnoea
- Other (please state)



OP29. Did the patient require any of the following within 24 hours of the transfusion?*(Tick all that apply)*

- Non-invasive ventilation (CPAP, BiPAP)
- Invasive ventilation
- HDU admission
- ITU admission

If you ticked any of the options in OP29, go to OP29a. Otherwise, go to OP30**OP29a. Was the transfusion felt to be implicated?**

- Unlikely/No
- Possible
- Likely
- Certain/Yes

OP30. What was the patient's outcome?

- Discharged
- Still an inpatient at the time of auditing
- Died; *please give the date of death* 2017

If the patient died, please answer Q30a. Otherwise, you have completed this audit booklet**OP30a. Was the transfusion implicated in the patient's death?**

- Unlikely/No
- Possible
- Likely
- Certain/Yes

Thank you for collecting data on this outpatient transfusion episode

Appendix C – Tool to use when re-auditing locally

We recommend using this audit proforma to audit any patient receiving a red cell transfusion who is aged 60 or above. This audit tool is focussed to identify areas where practice requires improvement. There are some differences from the original audit in order to minimise the data collection required and conform with updated recommendations.

#	Previous standard	Standard	Questions required	How to calculate numerator	How to calculate denominator
1	2b	Patients at high risk of TACO who had risk of TACO documented in the notes	9, 13	Patients who score ≥ 1 in Q9 Of those, how many answered 'yes' to Q13	Patients who score ≥ 1 in Q9
2	2c	Number of patients seen in the 7 days (OP) or 24 hours (IP) prior to transfusion by the prescriber	12	Patients with 'yes' to 12	All patients
3	n/a	Number of patients weighed within 7 days of the transfusion	8	Patients with 'yes' to 12	All patients
4	3a	Patients with stable asymptomatic anaemia transfused with hb ≤ 70 g/L	11, 18	Of patients with 'anaemia in a stable patient, not symptomatic' in Q11, whose hb in Q18 is ≤ 70 g/L	Patients with 'anaemia in a stable patient, not symptomatic' in Q11
5	3b	Patients with cardiovascular disease and anaemia transfused with hb ≤ 80 g/L	11, 18	Of patients with 'anaemia in a patient who has cardiovascular disease in Q11, whose hb in Q18 is ≤ 80 g/L	Of patients with 'anaemia in a patient who has cardiovascular disease in Q11
6	4a	Patients transfused with single units (excluding those undergoing exchange transfusion, transfused for chronic transfusion dependent anaemia, with acute bleeding with haemodynamic instability or transfused on dialysis)	10, 11, 16	Excluding patients with 'acute blood loss...', 'chronic transfusion dependent anaemia' or 'exchange transfusion' in Q11 OR 'yes' to Q16: Patients who were transfused 1 unit in Q10	All patients other than those with 'acute blood loss...', 'chronic transfusion dependent anaemia' or 'exchange transfusion' in Q11 OR 'yes' to Q16
7	n/a	Patients who had a complete set of observations taken	20	Patients with all boxes ticked in Q20	All patients
8	5a	Patients who were clinically reviewed following the first unit (excluding those with active bleeding, having an	10, 16, 17	Excluding patients with 'acute blood loss', 'exchange transfusion' in Q11 or 'yes' to Q16 AND who answered ≥ 2 units to Q10	Excluding patients with 'acute blood loss', 'exchange transfusion' in Q11 or 'yes' to Q16 AND who answered ≥ 2 units to Q10

		exchange transfusion or transfused on dialysis)		Of those, patients with 'yes, after every unit' in Q17	
9	5b	Patients who had a haemoglobin measured after the first unit (excluding those with active bleeding, having an exchange transfusion or transfused on dialysis)	10, 16, 19	Excluding patients with 'acute blood loss', 'exchange transfusion' in Q11 or 'yes' to Q16 AND who answered ≥ 2 units to Q10 Of those, patients with 'yes' to Q19	Excluding patients with 'acute blood loss', 'exchange transfusion' in Q11 or 'yes' to Q16 AND who answered ≥ 2 units to Q10
10	6a	Patients who had fluid balance monitored (inpatients only)	15	Patients with 'yes' to Q15	All patients
11	6b	Patients with risk factors who were given a pre-emptive diuretic	9, 14	Patients who score ≥ 1 in Q9 Of those, patients with 'yes' to Q14	Patients who score ≥ 1 in Q9
12	8a	Patients with TACO treated with diuretics	21, 22	Patients with 'yes' to Q21 Of those, how many answered 'yes' to Q22	Patients with 'yes' to Q21
13	9a	Patients with TACO reported to SHOT	21, 23	Patients with 'yes' to Q21 Of those, how many answered 'yes' to Q22	Patients with 'yes' to Q21

Appendix D – List of participating sites

Addenbrooke's Hospital
Aintree University Hospital NHS Foundation Trust
Ashford and St Peters Hospitals NHS Foundation Trust
Barnet Hospital
Barnsley Hospital NHS Foundation Trust
Barts Health NHS Trust
Basildon and Thurrock University Hospitals NHS Foundation Trust
Belfast Health and Social Care Trust
Bolton NHS Foundation Trust
Borders General Hospital
Bradford Teaching Hospitals NHS Foundation Trust
Buckinghamshire Healthcare NHS Trust
Burton Hospitals NHS Foundation Trust
Central Manchester University Hospitals NHS Foundation Trust
Charing Cross Hospital
Chase Farm Hospital
Chelsea & Westminster Hospital
Chesterfield Royal Hospital NHS Foundation Trust
City Hospital Campus
City Hospitals Sunderland NHS Foundation Trust
Colchester Hospital University NHS Foundation Trust
Conquest Hospital
Countess of Chester Hospital NHS Foundation Trust
Croydon Health Services NHS Trust
Cumberland Infirmary Carlisle
Darlington Memorial Hospital
Dartford and Gravesham NHS Trust
Derby Teaching Hospitals NHS Foundation Trust
Dorset County Hospital NHS Foundation Trust
East and North Hertfordshire NHS Trust
East Cheshire NHS Trust
East Lancashire Hospitals NHS Trust
Eastbourne Hospital
Epsom Hospital
Forth Valley Royal Hospital
Frimley Park Hospital
Furness General Hospital
Gateshead Health NHS Foundation Trust
George Eliot Hospital NHS Trust
Glangwili General Hospital
Great Western Hospitals NHS Foundation Trust
Guy's Hospital
Hammersmith Hospital



Harefield Hospital
Harrogate and District NHS Foundation Trust
Heart of England NHS Foundation Trust
Hinchingbrooke Hospital
Homerton University Hospital NHS Foundation Trust
Hull Royal Infirmary
Isle of Wight NHS Trust
James Paget University Hospitals NHS Foundation Trust
Kent & Canterbury Hospital
Kettering General Hospital NHS Foundation Trust
King's College Hospital NHS Foundation Trust
Lincoln County Hospital
Liverpool Women's NHS Foundation Trust
London North West Healthcare NHS Trust
Luton and Dunstable University Hospital NHS Foundation Trust
Maidstone and Tunbridge Wells NHS Trust
Medway NHS Foundation Trust
Mid Cheshire Hospitals NHS Foundation Trust
Mid Essex Hospital Services NHS Trust
Milton Keynes University Hospital NHS Foundation Trust
Nevill Hall Hospital
NHS Fife
Norfolk and Norwich University Hospitals NHS Foundation Trust
North Bristol NHS Trust
North Middlesex University Hospital NHS Trust
North Tees and Hartlepool NHS Foundation Trust
Northampton General Hospital NHS Trust
Northern Devon Healthcare NHS Trust
Northern General Hospital
Northern Lincolnshire and Goole NHS Foundation Trust
Northumbria Healthcare NHS Foundation Trust
Oxford University Hospitals NHS Foundation Trust
Papworth Hospital NHS Foundation Trust
Peterborough City Hospital
Pilgrim Hospital
Plymouth Hospitals NHS Trust
Poole Hospital NHS Foundation Trust
Portsmouth Hospitals NHS Trust
Prince Philip Hospital
Princess Royal University Hospital Farnborough
Queen Elizabeth Hospital Greenwich
Queen Elizabeth The Queen Mother Hospital
Queen's Hospital Romford
Queen's Medical Centre



Royal Albert Edward Infirmary
Royal Brompton Hospital
Royal Cornwall Hospitals NHS Trust
Royal Devon and Exeter NHS Foundation Trust
Royal Free Hospital
Royal Gwent Hospital
Royal Hampshire County Hospital
Royal Lancaster Infirmary
Royal Marsden Hospital Chelsea
Royal National Orthopaedic Hospital NHS Trust
Royal Surrey County Hospital NHS Foundation Trust
Royal Sussex County Hospital
Royal United Hospitals Bath NHS Foundation Trust
Salisbury NHS Foundation Trust
Sandwell and West Birmingham Hospitals NHS Trust
Scarborough General Hospital
Sherwood Forest Hospitals NHS Foundation Trust
South Tees Hospitals NHS Foundation Trust
South Tyneside NHS Foundation Trust
South Warwickshire NHS Foundation Trust
Southport and Ormskirk Hospital NHS Trust
SPIRE Washington
St. Helier Hospital
St. Mary's Hospital Paddington
St. Richard's Hospital
Stockport NHS Foundation Trust
Surrey and Sussex Healthcare NHS Trust
Tameside and Glossop Integrated Care NHS Foundation Trust
Taunton and Somerset NHS Foundation Trust
The Christie NHS Foundation Trust
The Clatterbridge Cancer Centre NHS Foundation Trust
The Dudley Group NHS Foundation Trust
The Hillingdon Hospitals NHS Foundation Trust
The Ipswich Hospital NHS Trust
The Leeds Teaching Hospitals NHS Trust
The Mid Yorkshire Hospitals NHS Trust
The Newcastle upon Tyne Hospitals NHS Foundation Trust
The Pennine Acute Hospitals NHS Trust
The Princess Alexandra Hospital NHS Trust
The Rotherham NHS Foundation Trust
The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust
The Royal Hallamshire Hospital
The Royal Orthopaedic Hospital NHS Foundation Trust
The Royal Wolverhampton NHS Trust



The Shrewsbury and Telford Hospital NHS Trust
The Walton Centre NHS Foundation Trust
The York Hospital
Torbay and South Devon NHS Foundation Trust
University College London Hospitals NHS Foundation Trust
University Hospital Lewisham
University Hospital of North Durham
University Hospital of Wales
University Hospital Southampton NHS Foundation Trust
University Hospitals Birmingham NHS Foundation Trust
University Hospitals Bristol NHS Foundation Trust
University Hospitals Coventry and Warwickshire NHS Trust
University Hospitals of North Midlands NHS Trust
Walsall Healthcare NHS Trust
West Middlesex University Hospital
West Suffolk NHS Foundation Trust
Wexham Park Hospital
Whiston Hospital
William Harvey Hospital
Wirral University Teaching Hospital NHS Foundation Trust
Worcestershire Acute Hospitals NHS Trust
Worthing Hospital
Wrexham Maelor Hospital
Wye Valley NHS Trust
Yeovil District Hospital NHS Foundation Trust
Ysbyty Ystrad Fawr

