12 Avoidable, Delayed or Undertransfusion (ADU) (formerly Inappropriate and Unnecessary I&U)

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Definitions:

(Please note these have been updated[23]. The terminology has been changed from 'inappropriate and unnecessary' as the word 'avoidable' is preferable, and the category is now more explicit about delays or a transfusion of insufficient quantity of blood for the clinical circumstances)

- **Where the intended transfusion is carried out, and the blood/blood component is suitable for transfusion, but where the decision leading to the transfusion is flawed including transfusions given on the basis of erroneous, spurious or incorrectly documented laboratory testing results for haemoglobin, platelets and coagulation tests**
- **Transfusions given as a result of poor understanding and knowledge of transfusion medicine, such that the decision to transfuse puts the patient at significant risk, or was harmful**
- **Avoidable use of emergency O RhD negative blood where group-specific or crossmatched blood was readily available for the patient**
- **Where a transfusion of blood/blood component was clinically indicated but was not undertaken or was significantly delayed (there is no defined time limit: this is a clinical judgement when 'delay' puts the patient at risk of, or causes harm)**

DATA SUMMARY
Total number of cases: 145

Implicated components		Mortality/morbidity	
Red cells	114	Deaths due to transfusion	0
FFP	16	Deaths probably/likely due to transfusion	0
Platelets	8	Deaths possibly due to transfusion	0
Cryoprecipitate	4	Major morbidity	2
Granulocytes	0	Potential for major morbidity (Anti-D or K only)	N/A
Anti-D Ig	N/A		
Multiple components	2		
Unknown	1		

Gender		Age		Emergency vs. routine and core hours vs. out of core hours		Where transfusion took place	
Male	52	≥ 18 years	132	Emergency	36	Emergency Departments	21
Female	88	16 years to <18 years	1	Urgent	44	Theatre	14
Not known	5	1 year to <16 years	6	Routine	53	ITU/CCU/NNU/HDU/ Recovery	15
		>28 days to <1 year	1	Not known	12	Wards	80
		Birth to ≤28 days	5			Delivery Ward	4
		Not known	0	In core hours	93	Postnatal	0
				Out of core hours	49	Medical Assessment Unit	7
				Not known/Not applicable	3	Community	0
						Outpatient/day unit	2
						Hospice	0
						Antenatal Clinic	0
						Unknown	2

Overview

A total of 145 reports were analysed relating to 52 male patients and 88 female patients. In 5 reports the gender was not specified. Thirteen reports related to children and are discussed in the Paediatric chapter (Chapter 27). The median age was 67 (range 0 days to 92 years). Nineteen cases of delayed transfusion are included in these numbers.

Deaths n=0

There were no deaths associated with avoidable, delayed or undertransfusion in 2012.

Major morbidity n=2

There were 2 cases of major morbidity. One case is described below, and the other, a child who was transfused to a Hb of 270 g/L, is discussed in the Paediatric chapter (Chapter 27).

Case 1: A patient of low body weight repeatedly overtransfused

A patient weighing 35.1kg with small bowel angiodysplasia and anaemia received 6 red cell transfusions over a 3 month period. A fall precipitated her admission and her Hb was then found to be 222 g/L and she was generally deteriorating. She was dyspnoeic with a tachycardia and had symptoms consistent with polycythaemia. A haematology specialist registrar noted the patient was plethoric and she then required repeated venesection. She developed renal impairment with long term morbidity.

An incident investigation showed that the patient had been overtransfused on at least 6 occasions. Review showed that despite having normal and increasing haemoglobin results, transfusions were regularly given (Hb 134 g/L and 3 units given, Hb 158 g/L and 3 units given, Hb 182 g/L and 3 units given). The repeat prescriptions were authorised by a consultant.

This patient was attending the haematology outpatient department but was also under the care of the gastroenterology department.

Learning point

- A named consultant should take responsibility for each patient receiving a transfusion. Having more than one team involved with a patient may result in confusion over 'ownership' i.e. whose responsibility it was to review results, but no transfusion should be prescribed or given without proper assessment of the patient including review of the latest haemoglobin results

Cause of erroneous results that led to avoidable transfusions n=46

Cause	Total
Dilute sample (most common cause was sample from drip arm)	12
Point of care test/Blood gas analyser	9
'Wrong blood in tube' – full blood count sample	9
Hb error (transcription, wrong patient results used, communication issues)	8
Inadequate sample e.g. short/poor sample/contaminated	5
Clumped platelets	1
Clotted sample	1
Erroneous Hb result – unknown cause	1

Table 12.1: Cause of erroneous results that led to avoidable transfusions n=46

It is notable that as in previous years, the leading causes of erroneous results were the use of dilute and/or inadequate samples.

Learning point

- The use of point of care haemoglobin machines or blood gas analysers may lead to wrong results. It is essential that any point of care machines are properly quality assured for Hb results and that they are used only by staff who have received appropriate training. A UK National External Quality Assurance Scheme (UKNEQAS) is now available for haemoglobin analysis on blood gas machines – contact haem@ukneqas.org.uk for further information

Case 2: Telephoned result leads to wrong patient being readmitted and transfused

A 17 year old man with acute myeloid leukaemia in remission was recalled after a day case visit and transfused on the basis of his apparent Hb result. His true Hb was 140 g/L but a telephoned abnormal low Hb had been received on the ward when the nurse misheard the name, and despite repeating back the name, the biomedical scientist (BMS) thought he heard the right name.

The laboratory protocol for telephoned results had included only the name and as a result of this case has been modified to include all four essential patient identifiers (i.e. to include first name, surname, case note number and date of birth).

Avoidable/delayed transfusions due to full blood count (FBC) 'wrong blood in tube' n=9

It is not only transfusion samples labelled with the wrong patient details which are dangerous. Wrong blood count samples can also have serious consequences. In 9/145 (6.2%) reports, patients received an avoidable or delayed blood transfusion based on a 'wrong blood in tube' full blood count sample. Wrong coagulation or biochemistry samples are also dangerous and can lead to inappropriate treatment. The same standard of identification and labelling should apply to all patient samples.

Table 12.2: Errors relating to 'wrong blood in tube' – full blood count sample n=9

Urgency	Error	Detected by	Outcome
Urgent	FBC sample taken from wrong patient	Doctor coincidentally reviewing patient's results noted that previous results were within normal limits	Patient was prescribed 2 pools of platelets. First pool in progress when error identified and transfusion stopped
Routine	FBC sample from Patient X was labelled with Patient Y's details by phlebotomist	A repeat FBC sample taken the following day showed the Hb had risen from 75 g/L pre transfusion to 137 g/L after 1 unit of red cells	Unnecessary unit of red cells transfused.
Urgent	Two patients bled on the same ward for FBC. Samples transposed during labelling by phlebotomist	Clinical chemistry reviewing the results the following day	Patient had already received an unnecessary 2 units of red cells before the error was detected
Routine	Samples put on the desk and wrong ones picked up for labelling	Patient Hb post transfusion had risen from 76 g/L to 116 g/L	Unnecessary unit of red cells transfused
Urgent	FBC sample from Patient X was labelled with Patient Y's details	Detected by ward staff – unspecified	Patient X received an unnecessary 2 unit red cell transfusion
Emergency	FBC sample labelled with incorrect details	Initial FBC sample taken in A&E was discrepant with FBC sample from GP which arrived later. Urgent repeat FBC matched the Hb from the GP sample	1 unit transfusion based on the erroneous initial Hb sample taken in A&E
Urgent	FBC sample labelled away from bedside with another patient's barcode	Further testing the following day identified normal platelet count	Patient received 2 units red cells and 1 pool of platelets
Routine	Wrong addressograph label on FBC sample	Detected by lab staff – unspecified	Patient received 2 units red cells transfusion
Routine	Correct patient bled but form and sample labelled with another patient's details	No results available for the patient	Delayed transfusion

Avoidable use of O RhD negative blood n=6

Case 3: Emergency O RhD negative blood used when it might have been unsafe because the patient has irregular red cell antibodies

A 53 year old woman was known to have a complicated antibody history (anti-E, anti-K, anti-Jk^a, and a positive direct antiglobulin test). The BMS in the hospital transfusion laboratory advised the ward staff that a repeat sample would need to be taken if the patient required transfusion. No repeat sample was sent then, nor before an elective surgical procedure, angioplasty of her foot, which began in the radiology department 2 days later.

The patient began bleeding during surgery and was transferred from the radiology intervention room to theatre for vascular surgery. Blood was requested, a sample sent, but this sample was clotted and the request form was also incorrect so that the laboratory staff required a repeat sample. The surgical staff did tell the laboratory the urgency of the situation. The anaesthetist determined from near patient testing that the Hb was 31 g/L, and transfused emergency O RhD negative units.

The BMS realised that emergency O RhD negative units had been removed from the satellite refrigerator (computer flag) and alerted the doctor that the patient had many antibodies (so emergency O RhD negative units may not be safe). However the patient was now stable. The patient died unrelated to the transfusion a few hours later.

A good root cause analysis (RCA) was performed with many lessons learnt, particularly that radiology departments where vascular interventions take place need to have transfusion protocols including the management of major haemorrhage. Review of postgraduate training curricula in all specialties has been undertaken by the Education Subgroup of the National Blood Transfusion Committee (NBTC). This group noted that there is no reference to blood transfusion training in this specialty (report made to NBTC April 2013).

1. This case demonstrates a lack of understanding concerning O RhD negative red cells, that they are not universally safe.
2. There was evidence of poor communication between the laboratory and ward staff, since a repeat sample for transfusion could have been sent prior to the procedure.
3. Staff in radiology departments may not consider that knowledge of transfusion and activation of major haemorrhage protocols is relevant to their practice. However, following this event the departmental guidelines were revised to include indications for blood group and antibody screening with new checklists. Radiology medical and nursing staff are now required to attend mandatory transfusion training.
4. The clinical area referring the patient to radiology also agreed to provide a registered nurse escort to ensure adequate handover of clinical information.

Recommendation

- Hospital transfusion committees should review their transfusion protocols and training to ensure that all relevant departments in their hospitals, including radiology and any others where invasive procedures are performed, have appropriate measures in place

Action: Hospital Transfusion Committees; Hospital Transfusion Teams

In one of the other 5 cases where emergency O RhD negative units could have been avoided, an acutely bleeding patient was repeatedly given emergency O RhD negative units despite the consultant haematologist informing the clinical area that crossmatched blood was now available.

In 2 reports, the group and screen samples were rejected by the laboratory due to sample labelling errors. One patient had 3 separate samples taken and all were rejected due to missing details on the tube.

In 2 further cases, no group and antibody screen sample was available for patients undergoing surgery resulting in emergency O RhD negative units being used to prevent any delay to surgery.

Case 4: 'Wrong blood in tube' from clinical area leads to delay in provision of compatible group specific blood

Blood was requested for an obstetric patient (Patient X) in theatre with a ruptured uterus. A sample had apparently already been sent. The BMS advised the ward that a sample for Patient X had not yet been received and repeatedly requested that one should be sent. The sample eventually arrived in the laboratory over an hour later. Emergency O RhD negative units were issued to theatre in the meantime.

Two FBC requests and a single request for group and screen had previously been received for Patient Y. It was subsequently discovered that the sample for Patient Y grouped as O RhD positive although her historic group on the laboratory system was A RhD positive.

The junior doctor telephoned the laboratory to say that one of the FBC samples could not have been from Patient Y as she was only bled once – other sample was from Patient X. The sample subsequently received on Patient X also grouped as O RhD positive. The junior doctor had recently arrived in UK and had not had the usual induction in the obstetrics department.

Inappropriate transfusion to patients with objections to transfusion n=3

Three patients who had a religious objection to cellular blood components were transfused with red cells. These inappropriate transfusions resulted from failure in correct procedure of informed consent for blood transfusion (unrecognised language barrier), communication and documentation procedures (specific instructions moved from front page to elsewhere in case notes where they were not seen). One of the patients was not able to give consent being unconscious but the specific instruction was in the case notes and overlooked.

The Advisory Committee on the Safety of Blood, Tissues and Organs (SaBTO) issued guidelines for patient consent for blood transfusion in 2011, and these outline the necessary steps to obtain informed consent[54].

The Blood Services produce patient information leaflets which are available in many different languages. The 'Hospital Liaison Committee Network' was established by the Jehovah's Witness community. Their representatives are trained to facilitate communication between patients and medical staff and to provide information and support for both. The Better Blood Transfusion – 'appropriate use of blood toolkit'[55], also provides information for the management of patients who express their wish to refuse blood components.

Inappropriate management of anticoagulant reversal n=6

Case 5: Inappropriate use of fresh frozen plasma (FFP) to reverse warfarin causes mild allergic reaction

An elderly woman presented with a rectal bleed; she was also being treated with warfarin (for atrial flutter). The INR (international normalised ratio) on admission was 5.8, however it was 2.9 just prior to transfusion. The patient's Hb had dropped from 104 g/L to 79 g/L. Following the FFP transfusion (she had also received 2 units of red cells), the patient experienced a mild allergic reaction with an itchy rash on the face and arms. The symptoms subsided following administration of antihistamine and hydrocortisone. Prothrombin complex concentrate (PCC) could have been made available by discussion with the consultant haematologist.

(This case is one of 3 acute transfusion reactions that took place following inappropriate transfusions).

Learning point

- Transfusion laboratories should have protocols in place to ensure that fresh frozen plasma (FFP) is not used inappropriately for warfarin reversal. The correct treatment as recommended in British Committee for Standards in Haematology (BCSH) guidelines is to use PCC[56]

Case 6: Inappropriate transfusion of cryoprecipitate for a false derived fibrinogen result in a patient on dabigatran

An 87 year old woman on dabigatran for atrial fibrillation was admitted with melaena, vomiting and dizziness. Her coagulation tests were deranged with an elevated prothrombin time (PT) of 27 seconds, activated partial thromboplastin time (APTT) of 70 seconds and a low fibrinogen of 0.35 g/L.On the advice of a haematology registrar she received prothrombin complex for the deranged PT and APTT, and cryoprecipitate to correct the apparently low fibrinogen.

A false low derived fibrinogen is a recognised problem with this anticoagulant and the cryoprecipitate was unnecessary. There are marked variations in fibrinogen measurements with different reagents[57].

This is the first case SHOT has received relating to the newer anticoagulants. Guidelines are available to assist in the management of patients with haemorrhage who are receiving the newer anticoagulants[58].

Learning point

- When assessing coagulation tests in patients on dabigatran a derived fibrinogen is not reliable

Failure to review patient results and/or instructions in casenotes or failure to make an appropriate request for assistance n=33

In 33/145 (22.8%) cases, patients received unnecessary transfusions due to failure to review available blood results, not waiting until the results were available prior to transfusion or not following instructions for the patient's management detailed in the patient casenotes. One of these resulted in major morbidity for the patient (Case 1). A patient received repeated FFP infusions which were not effective and not indicated for his condition; a referral for a haematology opinion would have been more appropriate. In addition, 4 patients were transfused red cells unnecessarily, 3 for iron deficiency anaemia, and 1 for megaloblastic anaemia. Another patient was prescribed 2 units of red cells, one to be given each day on two consecutive days with diuretic, but both were given on the same day without diuretic and the patient suffered from transfusion-associated circulatory overload.

Case 7: Repeated cancellation of surgery results in unnecessary transfusion and wastage of fresh frozen plasma (FFP)

A patient with congenital factor V deficiency was due for a cholecystectomy but after having the necessary FFP infusion, the procedure was cancelled; this happened on 3 separate days.

A written plan for surgery in patients with inherited bleeding disorders is recommended with good communication not only between surgeon and haematologist but also with surgical co-ordinators who plan the lists[59,60].

Delayed transfusion n=20

There were 7 reports where there was delay in transfusion and the patient died, but in all cases the deaths were unrelated to the delay in transfusion.

In 2/20 cases the delay was caused by failure to authorise urgent overnight transfusion because it was hospital policy not to transfuse at night. Other causes of delay include poor communication across disciplines including poor handover. An additional case of delayed transfusion was described earlier in the section on FBC 'wrong blood in tube' incidents.

Case 8: Delayed transfusion as a consequence of poor handover

A 77 year old man was admitted with melaena. His Hb was 58 g/L. Four units of red cells were prescribed at 17:00. He was transferred from the emergency department to a ward at 22:00. A verbal non-documented handover was made stating that he was stable and did not require transfusion. At 01:00 he developed signs of decompensation with tachycardia and hypotension and was given fluids, but not transfused until 05:00, 10 hours after the blood was prescribed.

Learning point

- Caution is required in the strict application of guidelines when the clinical needs of the patient warrant a properly managed deviation from the routine protocol

Case 9: Patient put at risk by wrong labelling of Hb sample

A patient required an Hb estimation following surgery (total hip replacement). Although the correct patient had been bled, addressograph labels from another patient were attached to the form and sample and no result could be issued. This resulted in a delay in transfusion.

Case 10: Fire drill/evacuation during massive haemorrhage

The transfusion laboratory was informed at 08:30 that a unit of emergency O RhD negative blood had been transfused. Ten minutes later a second unit of emergency blood had been used for the same patient. Within the next 5 minutes the laboratory issued and replaced the O RhD negative units that had been used. At 09:30, the patient's Hb was now 30 g/L (result from blood gas analyser) and further units were requested urgently. At 09:40 the pre-transfusion sample testing was incomplete so 6 emergency uncrossmatched red cell units were issued. During the issue process, the fire alarm sounded and the printer ran out of compatibility labels. Three of 6 units had already been labelled but due to the urgency of the situation, all 6 units were boxed and transported to the clinical area.

This is similar to a report submitted in this section in 2011. The two reporters involved requested permission via SHOT to contact each other to share their RCA and lessons learned. Feedback from the reporters was that this was a very positive exercise and they both gained a great deal from sharing their respective experience. The end result was a change in policy relating to fire drills in the new reporting Hospital B. Using a shared example of an action plan for a real fire alarm from Hospital A, further work was being done to develop this in the Hospital B.

Learning point

- Good incident investigations with root cause analysis (RCA) may be very helpful to share with other hospitals. Reporters are encouraged to give permission to SHOT to share the anonymised RCA via a page on the SHOT website (see also Chapter 8 on investigation of incidents and root cause analysis)

Overtransfusion n=13

The reasons for overtransfusion are the same as in previous years. In 4 cases, the patient's low body weight was not taken into consideration or the amount of blood to be transfused was incorrectly calculated (see also Chapter 25, transfusion-associated circulatory overload, and the recent addendum to the guidelines on the administration of blood[26]).

In one case, a small child was overtransfused to haemoglobin of 270 g/L. This case is discussed in more detail in the paediatric chapter (Chapter 27).

Undertransfusion of FFP n=4

In all cases the FFP transfusions were indicated according to BCSH guidelines[61] but an insufficient

dose given. The causes were erroneous and unclear prescribing, misunderstanding, communication failure between two doctors, and simple failure to give 3 of the 4 units prescribed. These findings are consistent with those of the National Audit of FFP (2009) which showed that in 40% of transfusions to adults (873/2186) the dose given was subtherapeutic, being less than 10mL/kg[62].

Prescription errors n=12

In 4/12 cases components were given that were not prescribed. In a further 2/12 cases, components were transfused using a prescription that was not signed.

The incorrect volume of cryoprecipitate was prescribed in 3/12 cases due to confusion over doses. Clinicians made requests for 6 or 10 units, expecting single donor units and not realising that this component is now supplied as pools of 5 single donations. Requestors included junior and senior haematologists.

Learning point

- Biomedical scientific staff (BMS) and consultant haematologists need to educate users about the change in presentation of cryoprecipitate. BMS staff should be encouraged to challenge orders which seem inappropriate. Clinical staff should heed the advice of transfusion experts and check their request carefully

Miscellaneous n=2

A blood sample taken from a patient was not sent to the laboratory in a timely manner, but retained on the ward for 6 hours. Then when the patient bled in theatre uncrossmatched group-compatible blood had to be issued.

A patient was transferred to another hospital with a transfusion in progress without informing the consultant haematologist or the laboratory, and the patient was not accompanied by appropriately qualified staff.

COMMENTARY

Cases of avoidable, delayed or undertransfusion were reported with the same causes as in previous years, for example excessive volumes prescribed for children or adults of low body weight, patients transfused for treatable anaemias (iron deficiency and megaloblastic anaemia), patients transfused on the basis of wrong Hb results and patients receiving the wrong component. In one case the prescriber used unfamiliar terminology (PRP – platelet rich plasma – for platelets) which was misinterpreted as FFP by the laboratory. These errors occur because of poor practice, failure to follow protocols, short cuts and hurry, especially in the emergency situation, and poor communication and handover as patients are moved between different wards and departments. As patients are moved around hospitals they become the responsibility of a series of different teams (and shifts) without any consultant having clear ownership. Good handover and clear lines of responsibility would help prevent many errors.

There have been incidents this year where a blood transfusion was inappropriately delayed because of misinterpretation of the overnight blood transfusion policy.

In 2005, SHOT made a recommendation that transfusion outside core hours should be avoided unless clinically essential because of evidence that pre-transfusion testing and blood administration were less safe and SHOT also recommended that auditing the number of patient safety incidents during different time periods may be useful[63].

In January 2008, the National Comparative Audit of overnight red cell transfusion[62] identified that 32% of patients transfused at night had no clinical indication to be transfused ‘out of hours’. Overnight transfusion can be more of a risk because many ward areas are poorly illuminated with fewer staff available to monitor the transfusion. However, clearly some patients have an urgent need for transfusion which overrides such a policy.

Summary of learning points:

- Confusion over 'ownership' of patients may contribute to poor management (Case 1: whose responsibility it was to review results), but no transfusion should be prescribed or given without proper assessment of the patient including review of the latest Hb results
- The use of point of care haemoglobin machines or blood gas analysers may lead to wrong results. It is essential that any point of care machines are properly quality assured for Hb results and that they are used only by staff who have received appropriate training. A UK NEQAS scheme is now available for haemoglobin results from blood gas machines since April 2013, contact haem@ukneqas.org.uk for details
- Hospital transfusion committees should review their transfusion protocols and training to ensure that all relevant departments in their hospitals, including radiology and any others where invasive procedures are performed, have appropriate measures in place
- Transfusion laboratories should have protocols in place to ensure that FFP is not used inappropriately for warfarin reversal and that prothrombin complex concentrates are available
- Caution is required when interpreting coagulation tests in patients receiving the new anticoagulants (direct thrombin inhibitors such as dabigatran, or direct anti-Xa inhibitors such as rivaroxaban and apixaban). Guidelines for managing haemorrhage in these patients are available[58]. When assessing coagulation tests in patients on dabigatran a derived fibrinogen is not reliable
- Good incident investigations with root cause analysis may be very helpful to share with other hospitals. Reporters are encouraged to inform SHOT if permission is granted to share the anonymised RCA via a page on the SHOT website
- Biomedical scientific staff (BMS) and consultant haematologists need to educate users about the change in presentation of cryoprecipitate. BMS staff should be encouraged to challenge orders which seem inappropriate and clinical staff should heed their advice where appropriate

Recommendations

- A zero tolerance policy should be introduced for labelling of all patient samples and not restricted to transfusion samples. Dangerous consequences can arise from wrong full blood count, wrong coagulation and wrong biochemistry results

Action: Trust/Hospital/Health Board Chief Executive Officers (CEOs) Hospital Pathology Managers; Hospital Transfusion Teams (HTT)

- Particular attention should be paid to the correct labelling of all samples at the patient's side, particularly in emergencies where additional delays resulting from a need for repeat samples may increase risks to the patient

Action: Trust/Hospital/Health Board CEOs; Hospital Pathology Managers; HTT