9. Inappropriate, Unnecessary or Under/Delayed Transfusion (I&U)

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Definition

- **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 either puts the patient at significant risk, or was actually harmful.**
- **Under-transfusion or delayed transfusion resulting in morbidity.**

DATA SUMMARY
Total number of cases: 149

Implicated components		Mortality/morbidity	
Red cells	112	Deaths due to transfusion	1
FFP	8	Deaths due to under-transfusion	1
Platelets	23	Deaths *possibly* due to transfusion	0
Red cells and plasma	4	Major morbidity	5
Red cells, plasma & platelets	2	Potential for major morbidity *(Anti-D or K only)*	0

Gender		Age		Emergency vs. routine and core hours vs. out of core hours		Where transfusion took place	
Male	66	≥ 18 years	135	Emergency	52	A&E	18
Female	82	16 years to <18 years	3	Urgent	39	Theatre	22
Not known	1	1 year to <16 years	3	Routine	48	ITU/NNU/HDU/Recovery	14
		>28 days to <1 year	3	Not known	10	Wards	66
		Birth to ≤28 days	2			Delivery ward	6
		Not known	3	In core hours	92	MAU	16
				Out of core hours	54	Community	2
				Not known	3	Outpatient/day unit	2
						Not known	3

Overview

149 cases were analysed this year compared to 110 in 2010, an increase of 35.5%.
The median age was 60 years and the range was 0-94 years. The 11 paediatric cases are included in the paediatric chapter (Chapter 22).

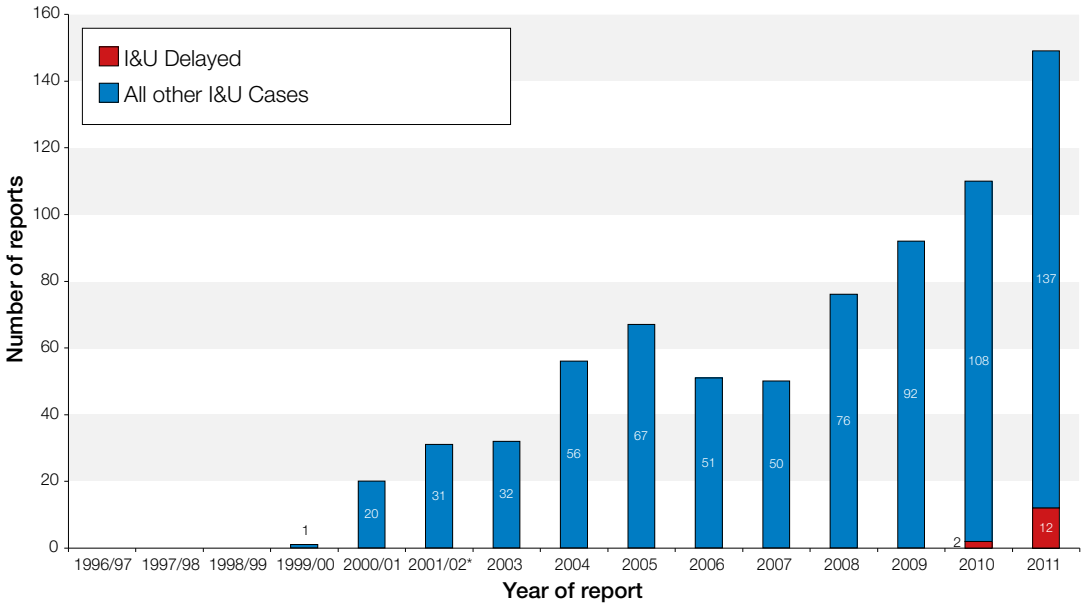
Deaths n=2

There were 2 deaths, in one the patient was excessively and rapidly transfused and an obstetric patient with major haemorrhage received too little too late.

Major morbidity n=5

Four cases were associated with surgery for abdominal aortic aneurysm (AAA) – one patient received excessive red cell transfusion and in 3 cases morbidity was related to delayed transfusion. In the fifth case, seven units of blood were extravasated due to a displaced central line.

Figure 9.1
Total Cases of inappropriate and unnecessary, and delayed or under-transfusion 1996-2011
(Note: reports of delayed transfusions have only been collected for 2010 onwards)



Inappropriate and unnecessary transfusion n=137

Death n=1

Case 1

Haematemesis with excessive transfusion and transfusion-associated circulatory overload (TACO)

A middle-aged woman with known alcoholic liver disease presented with haematemesis estimated to be more than 500 mL and was urgently transfused 7 units of red cells without monitoring of the Hb. The Hb on the previous day was 11.3 g/dL. The patient was not reviewed regularly during transfusion. Her Hb rose to 16.4 g/dL post-transfusion requiring venesection of 2 units and admission to high dependency unit (HDU) for ventilation because of pulmonary oedema. She later died of multi-organ failure. It was felt that death was related to the excessive transfusion.

Major morbidity from excessive transfusion n=2

Case 2

Excessive transfusion of red cells during surgery for abdominal aortic aneurysm (AAA)

An elderly man received red cell transfusions during repair of an abdominal aortic aneurysm which ruptured during surgery. The blood loss was difficult to gauge. His post-operative Hb was 19.1 g/dL but the intended Hb was 10 g/dL according to regional guidelines for management of AAA. The man died within 24h of surgery as a result of multiple organ failure related to his aneurysm. The coroner concluded that death was not related to the excessive transfusion.

During surgery for ruptured aortic aneurysm blood loss and replacement can be difficult to manage. Frequent near-patient testing (e.g. HemoCue®) is essential to avoid over-transfusion, especially if cell salvage is used (with the caveat that such instruments are properly quality assured and used by appropriately trained staff as indicated in learning points below).

Case 3

Unnoticed subcutaneous transfusion

A 59 year old man on the intensive therapy unit (ITU), ventilated and undergoing haemodialysis, with sepsis and multiorgan failure, received 7 units of red cells through a subclavian line over a period of two days for anaemia, but without an increase in Hb. ITU staff realised that the central line had become displaced and blood had leaked subcutaneously. The patency of the line had been repeatedly checked with a saline flush but not with test aspiration. Examination of the patient revealed substantial swelling on the chest wall and axilla. A chest X-ray showed that the catheter tip had been displaced out of the subclavian vein. The patient had also received insulin and antibiotics through this line.

It is surprising that this patient received so many units of blood, antibiotics and insulin before the problem was identified. Every central line should be reviewed for patency if unable to withdraw fluid since this indicates a problem[41]. This case also demonstrates the importance of examining the patient fully every day.

Delay in transfusions n=12

There were a total of 12 delayed transfusions reported in 2011. In all cases the delay was during active haemorrhage as shown in table 9.1

Table 9.1 Speciality related to delay in transfusion during haemorrhage

Specialty where event occurred	Number of cases
Cardiology	
Haemorrhage complicating cardiac catheterisation	**1**
Vascular surgery	
Abdominal aortic aneurysm	**1**
Gastroenterology	
GI bleed	**1**
General surgery	**2**
Post operative bleed	1
Abdominal Aortic Aneurysm	1
Accident and Emergency (A&E)	
Intra-abdominal aneurysm	**1**
Obstetrics	**6**
Bleeding during caesarean section	3
Post partum haemorrhage	2
Post C-section haemorrhage	1
Total	**12**

Death n=1

Case 4

Failure to replace blood volume after post partum haemorrhage

A woman in her mid-thirties had a ventouse-assisted vaginal delivery for fetal distress at term. It was then complicated by massive haemorrhage from cervical lacerations. The major haemorrhage protocol was activated, six units of blood were delivered within 5 minutes and one was started immediately. She was transferred from the delivery room to theatre and the bleeding was controlled within 30 min. The blood loss was unclear with losses recorded in both the delivery suite and theatre. A second unit was commenced. About 2 hours later, she suffered cardiac arrest from which she could not be resuscitated despite transfusion of 12 units of blood and 3 units of fresh frozen plasma (FFP). Coagulation tests done about 30 minutes prior to arrest were abnormal. This may be a result of the massive haemorrhage but analysis suggested she may have had a previously unrecognised coagulation factor XI deficiency. (She had a previous birth by caesarean section without excessive bleeding). The coroner confirmed the cause of death to be cerebral hypoxia secondary to haemorrhage.

Root cause analysis of this case provided important learning points. The estimated blood loss may not have been fully appreciated because she was managed first in the delivery suite and then in theatres. In

addition, point of care tests provided Hb results which led to a false sense of security. Two teams were involved in the management and it was not clear who was the leader; there was poor communication with differences of opinion. There were also changes in shifts during the interval between delivery and arrest so that the full picture was perhaps not appreciated.

Although the major haemorrhage protocol was activated, no coagulation tests were taken at the outset. The haemorrhage was controlled but the red cell and fluid replacement was inadequate.

Major morbidity from delayed transfusion n=2

Case 5

Delay in transfusion; emergency AAA repair – communication confusion

An elderly man was undergoing repair of AAA. There was delay in delivery/transport of crossmatched blood from the laboratory to theatres following issue. Uncrossmatched group O blood was available but not used by clinicians despite the biomedical scientist's (BMS') advice to do so. Transfusion was delayed for 2 hours 20 minutes after laboratory received the sample. The patient sustained a cardiac arrest during the procedure; at this stage he had been transfused with 3 units of red cells. The major haemorrhage protocol was activated only when the estimated blood loss was 3 litres. Other components of the major haemorrhage pack were not issued for an additional hour because of conflicting messages regarding the request received in the laboratory.

Case 6

Delay in patient transfusion during AAA surgery caused by a BMS error and IT malfunction

A 75 year old man was bleeding in theatre during repair of AAA. The massive haemorrhage protocol was activated, and 6 units of group-specific blood were issued to the theatre refrigerator using the electronic blood-tracking system. This was the wrong procedure for major haemorrhage (the required products should have been packed by a BMS into a cool box for immediate transportation). The units were retrospectively crossmatched and results added to the laboratory information management systems (LIMS) which sent a message to the theatre refrigerator to quarantine the units, possibly because the system had received two conflicting messages about the units. Nobody knew what to do. Uncrossmatched blood was placed into the issue refrigerator via the electronic blood-tracking system. When these units were subsequently crossmatched the blood-tracking system quarantined them in main theatre blood refrigerator so staff did not have access to them. Eventually the refrigerator was unlocked remotely and the blood obtained after a 25 minute delay. It was subsequently confirmed that the blood-tracking system had not been properly configured.

Minor morbidity from delayed transfusion n=2

Case 7

Delayed provision of emergency blood due to communication breakdown

A 33 year old woman was admitted as an emergency, hypotensive due to a leaking intra-abdominal aneurysm. There was a 4 hour delay in providing emergency red cell transfusion due to communication breakdown between the emergency department and the laboratory. The patient made a full recovery.

Learning points

- Surgery for aortic aneurysm is associated with a high risk of morbidity and mortality (65% for emergency surgery when ruptured, but 4.3% for elective repair)[42] (www.vascularsociety.org.uk 'outcomes after elective repair of infra-renal abdominal aortic aneurysm'. March 2012). The quality improvement programme for abdominal aortic aneurysm (AAA) repair mandates the availability of cell salvage during surgery and careful pre-operative work-up including a group and antibody screen.
- For emergency AAA repair the laboratory should be informed immediately so that the staff are ready to supply components rapidly. Good communication channels are essential and additional laboratory or portering staff may be required.

Cases of delayed transfusion in obstetrics

Obstetric emergencies can result in dramatic and major blood loss. As well as the death described above, there were 6 other cases with delay due to a variety of causes:

Poor communication:

- A porter failed to read his instructions and collected a single unit of red cells whereas two were required.
- There was a delay in a courier collecting urgent samples for analysis and transport of components back to the obstetric department where the laboratory was off-site.
- There was a delay when the laboratory informed the obstetrician that the time to obtaining crossmatched blood would be 30 minutes but it took 90 minutes by which time the mother had both hypovolaemia and a coagulopathy.

Wrong sample:

Blood was requested for emergency transfusion but provision of red cells was delayed because a previously sent sample already in the laboratory was labelled with the wrong patient details.

No provision of plan for emergencies during a fire alarm

Case 8

Obstetric major haemorrhage with delay in transfusion caused by a fire alarm.

A 40 year old woman was undergoing elective caesarean section and started to bleed excessively. At the same time, the fire alarm sounded. The obstetrician and theatre staff were aware of the alarm, but management of the bleeding continued. Urgent bloods were sent to haematology via the tube system and the laboratory was telephoned to alert them to the need for urgent analysis and a need for blood components. However, there was no answer so an assumption was made that the laboratory had been evacuated. The general manager (outside the building with evacuated staff) was contacted and located haematology staff who were cleared to return to the laboratory. Blood samples were analysed and major haemorrhage pack was requested. Once samples had been received in the laboratory there was a delay in sending blood products to theatre as additional paperwork was requested for use by porters.

The root cause analysis of this case was very useful with several learning points which led to changes in practice.

a) There was a lack of communication between the fire co-ordinators and the pathology services, with no understanding of the impact of evacuating the laboratory. Senior laboratory staff were unable to obtain information or updates about what was happening.

b) The maternity staff could have used the bleep system to update laboratory staff, as they knew that pathology had been evacuated.

c) The review also demonstrated that the medical staff asking for the major haemorrhage pack had little understanding of how it should be used or collected indicating a need for training.

A new policy is now in place in blood transfusion for actions on hearing a fire alarm, particularly that the transfusion section was not to be evacuated unless absolutely necessary.

Delay associated with new working practices

Case 9

Delay due to main laboratory being offsite

*A 61 year old woman suffered a post-operative haemorrhage. Blood was requested but the BMS found a mixed field (and could not determine the correct group) and was unable to authorise electronic release of red cells. A blood sample was sent out to a hub laboratory and red cells were provided after 2 hours. There was poor communication from the BMS to the surgical team. Emergency O RhD negative units were available***.**

This case illustrates three problems, lack of understanding of the BMS in the local laboratory, failure to keep the clinicians informed, and delay caused by the main laboratory being off site. This is further discussed in the Errors Related to Laboratory Practice chapter (Chapter 7).

Transfusions based on erroneous results

Table 9.2
Transfusion based on incorrect haemoglobin result n=53

Clinical causes of falsely low Hb value	No
Falsely low Hb due to phlebotomy from drip arm, or "diluted sample"	16
Unexplained low Hb result not queried prior to transfusion	11
Substitution of white cell count for Hb (transcription error)	4
Wrong results from point of care testing	
Blood gas machine Hb used	7
Erroneous result from POCT Hb estimation device	2
Incorrect POCT device used (measured glucose rather than Hb)	1
Faulty sample (clotted, short etc)	3
Result from an older pre-transfusion sample used after a transfusion had taken place	2
Sample tubes transposed in lab	2
Hb result belonged to another patient	2
Transfusion based on an old Hb result despite a more recent result being available	1
Hb transcription error	1
Verbal miscommunication of results	1
TOTAL	**53**

Table 9.3
Causes of false low platelet count n=8

Causes of a false low platelet count	No
Platelet clumping	3
Clot in sample	4
Analyser error	1

Case 10

Inaccurate platelet count leads to inappropriate transfusion

The analyser in the haematology laboratory gave inaccurate platelet counts over a period of 3 weeks due to a laser lens being coated in debris. A haematology patient was subsequently transfused 2 units of platelets based on an inaccurate platelet count reported as 9x10^9/l.

Transfusion of two adult doses of platelets for a count <10x10^9/l does not comply with British Committee for Standards in Haematology (BCSH) guidelines[43]. It is not clear how the problem with the analyser came to light, but this demonstrates a failure of appropriate quality management. A problem persisting for 3 weeks is likely to have impacted on the care of many other patients.

Table 9.4
Causes of incorrect coagulation results n=2

Causes of incorrect coagulation results	No
Sample from drip arm (also gave false Hb result)	1
Transcribed wrong results from another patient	1

Case 11

Wrong results for Hb and coagulation tests – sample from drip arm

A 33 year old man was admitted with collapse and hypotension. The first blood sample gave Hb 3.3g/dL and very abnormal coagulation results. The BMS queried the results suspecting a diluted sample but was told it was not. The man was transfused with red cells, FFP and cryoprecipitate. Repeat testing then gave dramatically different results and the conclusion was that the initial sample was from a 'drip' arm and was erroneous.

A repeat sample should have been sent before transfusion.

Learning points

- There are 53 reports shown in table 9.2 where a low Hb result was incorrect resulting in an inappropriate and unnecessary transfusion. SHOT has previously noted the problems associated with samples from 'drip' arms or dilution after sampling from central lines[24 27]. There were more instances of this reported this year than in each of the two previous years.
- There are 10 instances this year related to near patient testing. Seven of these relate to use of blood gas analysers which have been shown to be unreliable by UK National External Quality Assessment Service (UK NEQAS) Haematology. Again this year on one occasion a Hb result was taken from a blood glucose machine.
- All near patient testing equipment must be fully quality assured for any test undertaken and all staff who use it must be appropriately trained and competency assessed[27].

Table 9.5 Inadequate clinical knowledge or prescribing n=63

Categories of poor knowledge or prescribing (excluding use of erroneous Hb)	No
Excessive volume/rate of red cells transfused to infant or child	3
Excessive red cell transfusion resulting in Hb above the normal range	2
Transfusion of red cells for chronic iron deficiency	5
Hb result not monitored for patient with GI bleed	2
Hb result not checked between transfusion episodes	3
Incorrect component requested and given	1
Duplicate prescription	1
Components prescribed despite normal results	6
Use of emergency O RhD negative units when crossmatched units or valid group and screen were available	2
Use of neonatal emergency O RhD negative blood for adult patient	2
Red cells transfused which were not prescribed	1
Over-transfusion resulting in circulatory overload	2
Prescription unclear* (including misunderstanding over 'units' of cryoprecipitate)	4
Known unexplained erroneous/spurious result used despite repeat sample being taken	6
Unexplained erroneous/spurious result used – not queried prior to transfusion	4
Repeat sample taken but transfusion took place before result available	7
Inappropriate transfusion of FFP to patient with acquired haemophilia (2 episodes)	1
Inappropriate transfusion of platelets to patient with immune thrombocytopenia	3
Unnecessary transfusion of red cells to a patient in sickle crisis	1
Paediatric red cell prescription in 'units' not mL	1
Others	6
Total	**63**

**In 2 cases where the patient was intended to receive 1 litre of FFP, only 1 pack (approx 250mL) was given (one failure to follow the prescription and the other a failure to prescribe more than one pack after a verbal instruction to give 4 packs)*

Case 12

Consultant continues to sign regular prescription for transfusion without checking any Hb levels

An elderly male patient with myelodysplastic syndrome attended the outpatient department for monthly transfusion. A post-transfusion Hb was eventually found to be 17.4 g/dL. The consultant had continued to sign a regular prescription for 2 units of red cells at each visit without reference to Hb results. The last Hb result available was prior to treatment being commenced 8 months previously. The patient received 16 units during this period without any repeat Hb measurements despite samples being taken regularly for grouping.

Every patient should have a Hb check prior to transfusion. No doctor should sign a prescription without confirming that it is clinically indicated. This case demonstrates a breakdown in communication within the team and incorrect assumptions.

Case 13
Inappropriate treatment for iron deficiency
An 85 year old woman with iron deficiency anaemia received an unnecessary blood transfusion. She was prescribed 3 units of red blood cells by her general practitioner (GP); she only however received one of the units after the GP was contacted and the request challenged. Oral iron was started.

This was particularly inappropriate since a patient of this age is at risk of transfusion-associated circulatory overload. Oral or IV iron are preferred treatment.

Case 14
Inappropriate management of iron deficiency in pregnancy
A 27 year old lady had a Hb 8.1 g/dL at 39 weeks gestation. A junior doctor agreed a transfusion of 2 units of red cells with a consultant haematologist but this was outside the obstetric guideline threshold of 7.0 g/dL. The known iron deficiency had resulted in a prescription for iron tablets, but her Hb continued to fall (booking Hb 12.2 g/dL). It transpired that she had been taking folic acid instead of iron.

It is disappointing that 5 patients received transfusions to treat iron deficiency. Two of these were treated prior to elective surgery where they could not wait for a response to oral or intravenous iron. Intravenous iron preparations are now safe and a very good alternative for patients who cannot tolerate or adhere to oral iron therapy.

Patients with haematological disease (iron deficiency, immune thrombocytopenia and acquired haemophilia in 9/62 (14.5%) cases) could have been managed differently if advice had been sought from a haematologist.

A patient of low weight, <40kg, with Hb 5.1 g/dL was transfused in excess, with 5 units of red cells resulting in a post-transfusion Hb of 15 g/dL and respiratory compromise.

Learning points

- All patients receiving regular transfusions should have regular clinical review and assessment of their needs. Every clinician who signs a transfusion prescription should satisfy him/herself that the reason for every transfusion is known, evidence-based, and documented in the case notes.
- At the time of transfusion it is essential that the patient is properly identified, and that the component is verified as the one that has been prescribed for that patient.
- It is particularly important to assess patients carefully when an unexpected result is reported. The result may be erroneous for a variety of reasons. If the results do not fit the clinical situation the test should be repeated prior to transfusion.
- Blood transfusion is not an appropriate treatment for iron deficiency. Elderly patients are particularly at risk for transfusion-associated circulatory overload (TACO see Chapter 16).
- Patients with a low body mass index (BMI) will have a smaller blood volume and require a smaller transfusion to achieve the same increment in Hb, and are at risk of TACO.

Table 9.6 Avoidable use of emergency O RhD negative units n=8

Avoidable use of emergency O RhD negative blood	No
Emergency blood used when crossmatched available	1
Grouping sample taken but not sent to the laboratory	1
Sample lost	1
Wrong blood in tube	2
Hb 9.7g/dL with no active bleeding	1
No ID band in situ at sampling or transfusion	1
Antibody detected but elective patient already in theatre and bleeding	1

Case 15

Late request for blood to cover surgery leads to inappropriate use of emergency O RhD negative blood.

An elderly lady was admitted on the morning of surgery for major abdominal surgery and a sample was sent for grouping with request for a crossmatch. She was taken to theatre without waiting for results. The antibody screen was positive. The BMS phoned theatre, but surgery was already underway. Four units of O RhD negative emergency blood and 4 units of FFP were transfused. The antibody was anti-E and fortunately the O RhD negative units used were compatible.

This case demonstrates worrying lack of understanding concerning the use of O RhD negative units. These may not be safe in the face of possible unidentified irregular antibodies. A pre-transfusion screen should have been carried out in advance.

A root cause analysis was carried out and the outcome was to ensure that nursing staff in preassessment and surgical wards are trained to take transfusion samples so that patients can be sampled earlier than day of surgery.

Case 16

Wrong blood in tube

A 40 year old woman undergoing surgery required urgent transfusion. The sample received in the transfusion laboratory was labelled for Patient A. The sample was analysed and a group discrepancy was identified when compared to the historical record. The BMS contacted theatre staff who identified that Patient B was the one in theatre for whom urgent transfusion was required, but her samples had been labelled as Patient A (the previous patient in theatre). Patient B was given emergency O RhD negative blood due to a delay in receiving the correct sample.

Learning points

- As noted in the 2010 Annual Report[12] patients with gastrointestinal bleeding are sometimes inadequately monitored during transfusion, leading to excessively high haemoglobins.
- Several instances of delayed transfusion were due to communication breakdown.
- Careless practice, where results are misread, or short cuts are taken including the use of point of care machines not validated for the purpose, results in inappropriate or unnecessary transfusion.
- Emergency situations are particularly prone to error and miscommunications.

COMMENTARY

The 36% rise in reported inappropriate, unnecessary and delayed or under-transfused cases is likely to be due in part to increases in reporting such cases to SHOT. Last year only 2 delayed transfusions were reported. This year the number is 12, one of which resulted in a death. Many cases of inappropriate and unnecessary transfusion continue to occur due to poor communication, understanding and knowledge.

Major haemorrhage protocols are essential but are not always activated in a timely manner. Staff are often unaware of the protocol, who calls it, and how it should run.

The management of ruptured aortic aneurysm is fraught with difficulty and requires close collaboration between clinical and laboratory teams with good communication as already recommended in anaesthetic guidelines for this condition[42].

Appropriate component therapy, especially platelets, should be ordered immediately when the decision is made to operate. It is not yet clear whether point of care-directed component replacement (eg TEG/ROTEM) is superior to conventional protocols where red cells and clear fluids are employed until surgical blood loss ceases, followed by FFP/platelet replacement prior to closure.

Point of care machines, including blood gas analysers, must be quality-assured regularly, as recommended by SHOT in 2009[27]. Blood gas machines are not always reliable for Hb estimation and must be considered a rough guide at best. Dedicated devices such as the HemoCue® are more accurate but should be regularly compared to local laboratory results.

Blood gas machines must not be used for Hb estimation unless they are designed and calibrated to produce accurate, reproducible results with external quality assessment in place[27]. A NEQAS pilot survey has demonstrated significant variation in Hb results from blood gas analysers and an EQA scheme is proposed (B. De la Salle, Scheme Manager, UKNEQAS Haematology, personal communication, 2011).

Recommendations

- Hospital Transfusion Committees (HTCs) should review the arrangements for the management of aortic surgery in line with the Vascular Society Quality Improvement Programme http://www.aaaqip.com

  Action: Hospital Transfusion Committees (HTCs)

- Hospital laboratories should review their arrangements for fire and other alarms regarding emergency telephone calls and the delivery of results and blood products.

  Action: Transfusion Laboratory Managers, Pathology Directors

- Hospitals/Trusts/Health Boards should review the arrangements for management of massive blood transfusion and to ensure that practice drills take place.

- Hospitals/Trusts/Health Boards should develop practice drills for activation of major haemorrhage protocols to ensure that all staff know what to do in an emergency.

  Action: Transfusion Laboratory Managers. Clinical Risk Managers. Medical Directors

- Blood transfusion is not an appropriate treatment for iron deficiency. Elderly patients are particularly at risk for transfusion-associated circulatory overload (TACO see Chapter 16). Iron deficiency must be diagnosed and treated with iron supplements.

  Action: General practitioners, Hospital doctors, Medical Schools, Hospital Transfusion Teams (HTT)

Several recommendations from previous years have still not permeated into practice, particularly the need for education and training on the subject of transfusion safety and triggers.

For active recommendations from previous years and an update on their progress, please refer to the SHOT website