Avoidable, Delayed, or Undertransfusion (ADU) n=246

11

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Overall, 246 reports are included in the analysis. Eight of these were transferred in from other categories, one from handling and storage errors, three from wrong component transfused and four from the right blood right patient category.

- Avoidable transfusions n=114 (48.3%)
- Delayed transfusions n=101 (42.8%)
- Under or overtransfused n=21 (8.9%)

Ten cases relate to issues with prothrombin complex concentrate (PCC) alone (excluded from the percentages above), and in two further cases, a delay in PCC administration was in the context of other blood component delays, so are included in the numbers for the section on delays. These cases are analysed separately.

Note: one patient who was overtransfused was also a case of delay.

Deaths n=10

There were 9 deaths related to delays, and 1 related to an avoidable transfusion. These are discussed in more detail in the relevant sections.

Major morbidity n=1

There was 1 case of major morbidity related to a delayed transfusion (Case 11a.6).

11a Delayed Transfusions n=101 (an increase from 94 in 2015)

Definition:

Where a transfusion of blood/blood component was clinically indicated but was not undertaken or was delayed with impact on patient care (not restricted to emergency transfusion).

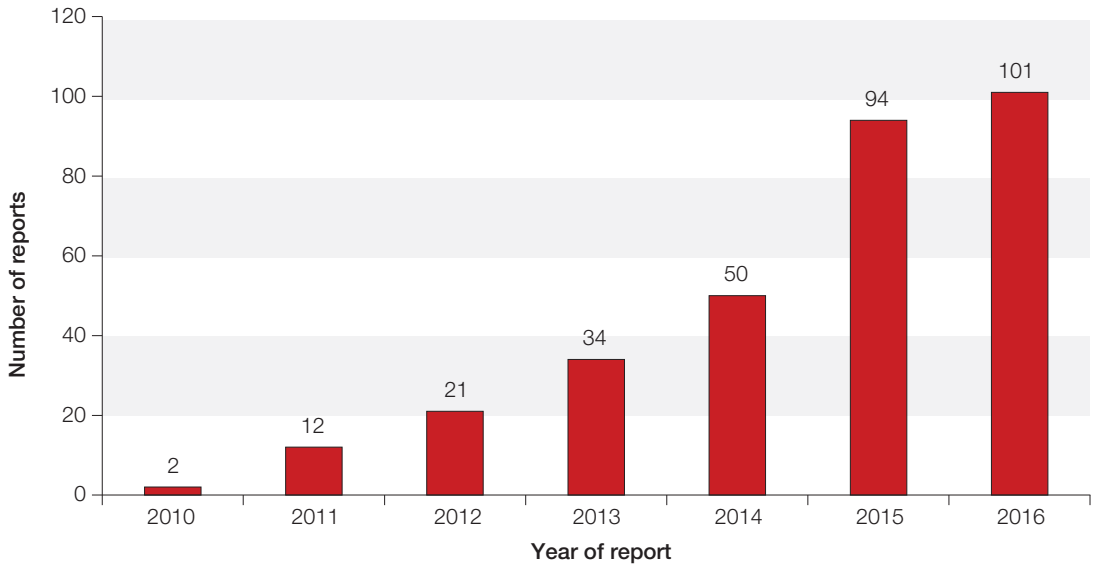
Key SHOT message

- Delays most often result from failures in communication and poor handovers. Clinicians need to ensure the urgency of component requirements is clearly transmitted to laboratory staff, and to understand how rapidly red cells can be provided to their area (immediate, urgent group-specific or crossmatched). If a suitable sample is recorded in the laboratory red cell units may be immediately released electronically in organisations where the laboratory IT systems have the capability for electronic issue

Learning points

- Ensure that staff know how rapidly components can be made available. Use a simple aide memoire as shown in Appendix 11.1 (page 97) which could be laminated and displayed in relevant clinical areas
- Communication failures occur when departments cannot contact each other. The transfusion laboratory should have a dedicated telephone for urgent requests and a fixed reciprocal contact point in the emergency department
- Transfusion education should ensure that clinical staff understand that fresh frozen plasma (FFP) will take about 30 minutes to thaw unless pre-thawed FFP is available (in some trauma centres)

Figure 11a.1: Delayed transfusion reports by year 2010-2016



Overview

The ages ranged from 2 days to 91 years; 32 were older than 70 years of age. In 57/101 (56.4%) reports the transfusions were emergency n=30, or urgent n=27 (Figure 11a.2). The location was theatres in 18, the emergency department in 15 and intensive therapy units in 10 (5 from neonatal intensive therapy units).

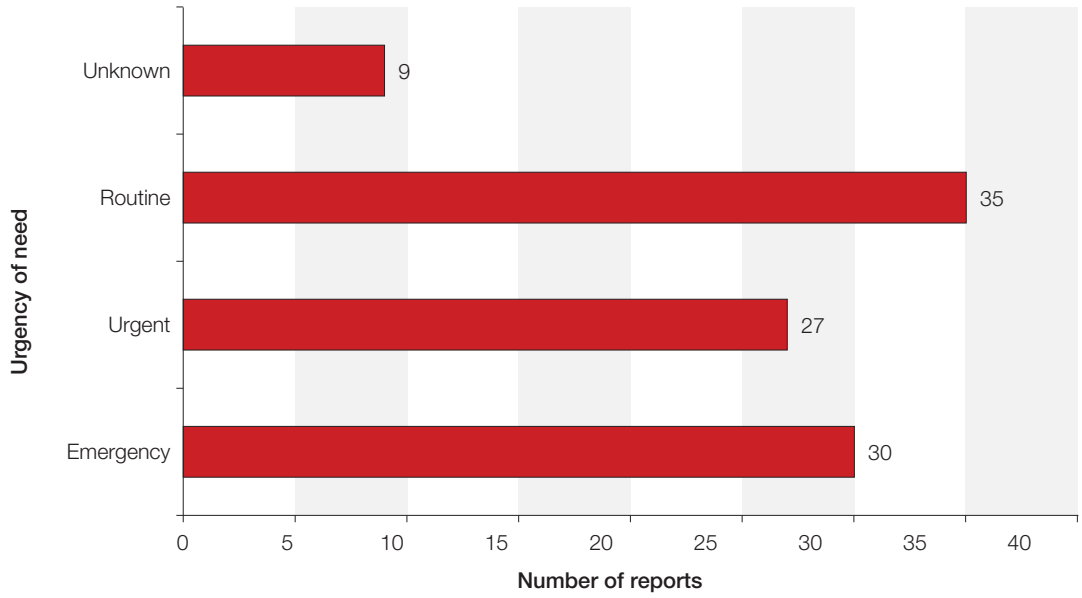


Figure 11a.2: Urgency of delayed transfusions

Review of cases

Eighteen patients died with the following imputability (with or without major haemorrhage protocol (MHP) activation). The delay was implicated in 9/18 deaths. In the years 2010-2016, 25/115 deaths were due to delayed transfusion (21.7%).

There was one instance of major morbidity discussed below (Case 11a.6).

Imputability	Number	MHP activations
Definitely related	2	1
Probably related	2	
Possibly related	5	1
Unrelated	9	5*
Totals	**18**	**7**

**See Case 7.7 in Chapter 7, Laboratory Errors*

Table 11a.1: Deaths showing imputability related to delay, and relationship to MHP activation

Deaths n=9

Imputability: deaths definitely related to delay n=2

Case 11a.1: Death after haematemesis due to delay in transfusion

A 76-year-old man admitted with haematemesis and on anticoagulants for atrial fibrillation died associated with failure to activate the MHP and 5-hour delay in transfusion. His haemoglobin (Hb) was 69g/L at 00:15. The biomedical scientist (BMS) was lone working and had attempted to contact the emergency department (ED) to inform them of the abnormal blood result, but did not get an answer.

Several issues with poor communication were identified:

- The urgency of the situation was not communicated to the BMS in the laboratory
- The clinicians did not inform the BMS that the patient was on warfarin
- The medical registrar assumed that red cells had been ordered for the patient; however this was not the case. The red cells were ordered approximately 3 hours after the patient was admitted to the ED. When the red cells were ordered, the clinical staff did not request the blood urgently and therefore fully crossmatched blood was issued (rather than group O emergency or group-specific units)
- Policies were not followed: The MHP was not followed by the clinical staff in the ED, the BMS in the laboratory advised the doctor to obtain haematology consultant approval before requesting PCC for warfarin reversal, but this is not policy and further delayed the patient's care

Outcome of the review: Teaching in the ED has been revised to include:

- The need for accurate and comprehensive information on the request forms that are sent to the laboratory to ensure that BMS staff are fully informed of the clinical situation
- How to manage a major haemorrhage, clinically and strategically. Staff to be given training on the MHP
- Training to be given to all BMS staff to ensure they are familiar with correct procedure for issuing PCC

Case 11a.2: Death in a patient with coagulopathy who failed to receive FFP

A 71-year-old man presented with a month-long history of constitutional symptoms and jaundice. Investigation raised the suspicion of pancreatic malignancy with blockage of bile drainage and he was admitted (day 1) for planned endoscopic retrograde cholangiopancreatography (ERCP). An initial attempt at ERCP failed on day 4 and he was then listed for a radiologically guided attempt at decompressing the biliary obstruction (percutaneous transhepatic cholangiogram - PTC). ERCP was attempted but failed again on days 5 and 6. A decision was made to perform PTC under general anaesthetic. In parallel the patient had deteriorated with hospital-acquired pneumonia, a fall, worsening liver function tests and the development of a coagulopathy. On day 7 a further ERCP failed and the PTC under general anaesthesia was organised. The complex coagulopathy was noted on the morning of day 7 which was not reversed by vitamin K. The consultant arranged for FFP to be administered to the patient prior or during the attempt at PTC under anaesthetic. Despite the FFP being ordered from the transfusion laboratory, (issued at 12:54) and being prescribed this was not administered prior to the PTC on the ward, during the procedure (in the radiology department) or in the immediate post-procedure period (in theatre recovery). The FFP was returned to stock at 16:17. The patient was transferred to the ward without having received blood components and deteriorated later that evening. He became moribund and despite attempts at fluid resuscitation and the administration of blood components he died. The coroner noted that the cause of death was intra-abdominal haemorrhage and that the failure to administer FFP was an important factor in the cause of death of the patient.

The incident investigation noted that there had been multiple opportunities to hand over the need for blood and FFP transfusion and focussed on ways to improve handover. The electronic prescribing system does not include blood components which are prescribed on paper but the electronic system can be set with a prompt to flag the need to administer blood components which was not used in this case. The Bloodhound tracking system has been introduced which has a reminder function. The report suggested that failure to administer FFP ordered for a patient with a coagulopathy should lead to questions from the laboratory staff to the clinical area and a revised standard operating procedure will include this.

Imputability: deaths probably related to delay n=2

Case 11a.3: Delayed transfusion contributes to death

An elderly man with shortness of breath was admitted to the ED at 11:45. He had a suspected posterior myocardial infarction. Blood samples were taken at 12:30. A low Hb was confirmed at 15:00, a tentative diagnosis of acute myeloid leukaemia was made, and decision to transfuse. At 16:00 blood tests were repeated and discussed with the haematology consultant. The patient was difficult to crossmatch and the laboratory staff did not advise the clinical team that they could have used emergency O D-negative units. The blood group was put on the analyser at 14:57 but suitable units were not issued until after 20:40 (a delay of more than 5 hours).The transfusion laboratory was contacted at 19:35 and 20:20. The patient suffered a cardiac arrest at 21:14.The first unit of blood was begun at 21:24 and the second at 21:45 but death occurred shortly afterwards at 22:15.

The hospital review noted that clarity was required for transfusion requests where the need was urgent but not requiring trigger of the MHP. Verbal communication of transfusion requests to the general laboratory telephone was noted not to be a robust system. A transfusion laboratory emergency telephone number is to be used for all 'very urgent' requests with a log of calls kept in the ED. Staff were reminded how to access the emergency group O red cells. A named clinical leader should take responsibility for very sick patients in the resuscitation area until their transfer.

Case 11a.4: Death related to leaking abdominal aortic aneurysm (AAA) where transfusion was suspended during transit

An elderly man was transferred by ambulance from the ED to another hospital with a 9cm leaking AAA. Red cell transfusion stopped in transit as there was no nurse or doctor present on the transfer due to insufficient staffing levels. The patient arrived with systolic blood pressure (BP) of 47mm/Hg and a Glasgow coma score (GCS) of 10. The patient was taken immediately to theatres at the receiving hospital where he subsequently died. The reporter noted staffing issues which contributed to the need to suspend the transfusion during transfer.

Imputability: deaths possibly related to delay n=5

Case 11a.5: Delay in acting on abnormal blood results contributes to patient death

An elderly lady was admitted with Hb 33g/L at 13:30. There were several communication failures. The staff noted at 22:20 that no sample had been taken (9 hours from admission). The patient had a cardiac arrest and died at 00:31.

The internal review noted that the ED was very busy on that day and stressed the importance of detailed handovers even when the unit is busy, and the importance of chasing up and acting on blood test results. A new dedicated telephone number was set up for results in the ED.

Another patient died related to delay in recognition of the severity of gastrointestinal bleeding. Her Hb was noted to be falling. Reaction was slow, and she died three hours following her deterioration, before emergency group O D-negative units were transfused. The most senior doctor on site was foundation year 2 and the escalation policy had not been effective.

Delay in release of emergency O D-negative units n=3

In three cases staff in the ED refused to release O D-negative emergency units. These were from the same hospital, one in January, the second in September and the third in November.

Case 11a.6: Major morbidity in relation to delayed access to emergency O D-negative units

At 19:15 a porter attempted to collect a unit of emergency O D-negative blood from the ED blood refrigerator for a 39-year-old woman who was bleeding complicated by cardiac arrest but was informed that he was not allowed the blood as it was for ED patients only. The porter then proceeded to the main theatre blood refrigerator and collected an emergency unit there. This patient was admitted to intensive care and made a full recovery. She received five units of red cells and two of FFP.

The staff member who refused to release emergency blood was not aware that the blood should be available to all patients in the hospital. Following this incident a communication was sent out to all ED staff informing them that the emergency O D-negative blood in their blood refrigerator should be available for all patients. Despite this, two further incidents were reported.

Several actions were taken by the consultant haematologist responsible for transfusion after the first event.

- Removal of some of the 15 emergency O D-negative units from the ED to the issue refrigerator in the transfusion laboratory
- Change activation of the MHP to go through the emergency switchboard number alerting the transfusion laboratory, porters (with a nominated porter) and clinical site team
- Update the training across the site as investigation revealed some senior staff did not know about the MHP or where the emergency O D-negative units were located

The reporter noted that delay in resolving these issues in this large hospital site (with 26,000 units of red cells issued per year) was hampered by having no dedicated transfusion practitioner. The issue of emergency provision of blood featured in the consultant's list of patient safety concerns presented to the medical director.

Issues with major haemorrhage protocols resulting in delay n=16

In 16/101 cases the MHP was implicated in delay. Six of these were associated with obstetric haemorrhage. Delay in provision of FFP was noted in 10/16 cases. Some of these resulted from misunderstanding by clinical staff about the time taken to thaw FFP and others from poor communication between the clinical and laboratory staff.

Case 11a.7: Failure to follow MHP with misunderstandings and ambiguity in the protocol

A 43-year-old trauma patient was admitted to the ED with major haemorrhage at 22:00. The BMS failed to respond to the MHP activation but the root cause analysis noted that several aspects of the MHP were unclear (including the role of the haematology registrar and the porter's role in collection and delivery), and this was the second incident within a month. The patient received 3L of red cells, 2750mL of FFP, two adult doses of platelets and 479mL of cryoprecipitate but died with delay in transfusion as a contributory factor. The MHP was revised and all BMS staff were reminded of their roles and responsibilities.

Cases associated with obstetric haemorrhage n=6

In one case of postpartum haemorrhage (PPH) staff were unable to release emergency O D-negative units from an information technology (IT)-controlled satellite blood refrigerator. In another case activation of the massive obstetric haemorrhage (MOH) protocol failed to trigger the porters to attend. A similar case is described below demonstrating the importance of logistics. In another instance the MOH was not followed correctly.

Case 11a.8: Blood components were delayed for 40 minutes from MOH activation

A 27-year-old woman had a major PPH of 2.5L with ongoing bleeding. The MOH protocol was activated and she was transferred to obstetric theatre to obtain haemostasis. There was a 40-minute delay in receiving O D-negative blood from the transfusion laboratory. The patient was hypotensive and required vasopressors to maintain her blood pressure while waiting for blood transfusion. She quickly improved once the blood was transfused.

There were misunderstandings and miscommunications. The obstetric staff should have sent someone straight away for pack 1 or the emergency O D-negative units. The porters were not contacted for 23 minutes to collect blood from the laboratory. The delay meant that electronic issue of compatible components could have taken place. The BMS was told that the clinical team were only interested in FFP and not the blood. However, the FFP was not used.

Case 11a.9: Communication failure and misunderstandings resulting in delayed supply of FFP - MOH activation did not result in the BMS in transfusion being informed

An obstetric patient delivered (forceps) at 02:06 but then developed a PPH with estimated blood loss 3.5L at around 03:15; an initial PPH call was made by the clinical team at 03:33 and escalated to MOH at 03:57. The theatre nurse contacted the transfusion laboratory to inform the BMS that two O D-negative units had been used but did not have the patient details or location. Activation of the MOH did not include contact with the laboratory and clinical staff were unaware they needed to contact the laboratory to inform them of requirements for transfusion support.

Two further O D-negative units were removed at 04:10; then the BMS telephoned the delivery suite to find out who the patient was. When the MOH pack A (six units of red cells and four FFP) was requested at 04:15 with the patient details the BMS had no transfusion sample for grouping. Once the group was established at 04:40, FFP could be thawed out. This was received 1 hour 15 minutes after the MOH call. The BMS was lone working and had not had time to process the full blood count (FBC) and coagulation samples. The patient developed a coagulopathy (results at 05:00) and received FFP, platelets and cryoprecipitate, and was transferred to the intensive care unit. She had evidence of acute kidney injury but recovered well and was discharged on the 5th day. The root cause analysis (RCA) noted that there were staff shortages.

Case 11a.10: Delayed provision of FFP due to poor practice by BMS

A 41-year-old woman with a massive PPH had a delay of 20 minutes in provision of FFP during MHP due to poor communication between the BMS in the hospital transfusion laboratory. The BMS who put the FFP in the plasma thawer finished their work shift and did not handover to the next shift. When theatre staff came to collect the FFP for the emergency the units were not ready and were found to be in the plasma thawer and there was a delay until the FFP was labelled and issued.

The BMS involved in this incident is under monitoring for poor practice and has been offered intensive mentoring and supervision. The BMS did not record any outstanding actions on the shift hand-over sheet as indicated by departmental policy.

Information technology (IT)-related delay cases n=19

IT systems or equipment failure led to transfusion delays in 19 patients.

Electronic blood management systems (EBMS) n=4

Four patients experienced delayed transfusions because of problems with EBMS. During normal working hours, no-one on the ward was trained to collect blood using the EBMS which resulted in a delayed red cell transfusion. On one occasion, when the EBMS was relatively new and not all staff trained, there was some confusion about collection using a pick-up slip and on another occasion despite using the correct log-on details and following instructions, staff could not access emergency blood in a satellite refrigerator because the default setting was 'locked'.

Case 11a.11: Providing a new but unnecessary sample causes delay

A large number of units of blood were issued electronically to a remote satellite refrigerator for a patient at high risk of bleeding intraoperatively. To be sure a current valid sample was available, a new sample was sent by the anaesthetist at the beginning of the list. The first unit was collected without any problems but on collecting the second unit, access was blocked and no other units could be removed from the refrigerator. This was because the unnecessary sample became the new 'valid sample' and remote electronic issue could not take place until a new result was available on the laboratory information management system (LIMS).

Delays were caused by problems with the LIMS or the LIMS/patient administration system (PAS) interface in five cases and two of these cases were new IT systems that did not perform as expected – one where the analyser did not transmit results to the LIMS and another where the LIMS did not transmit results to a general practice (GP) surgery.

There were discrepancies between the PAS and LIMS resulting in blood delays in four cases and one case where the wrong pack of a 2-pack apheresis platelet donation had been recorded as issued so the remaining pack could not be issued either.

Case 11a.12: Electronic prescribing does not include blood components and this causes confusion (Case 11a.2 above)

Prophylactic fresh frozen plasma (FFP) was not given to a patient undergoing a difficult endoscopic retrograde cholangiopancreatography (ERPC) procedure for obstructive jaundice and this was thought to have contributed to the peri-procedural bleeding. One cause of this omission was the fact that fluids and drugs were prescribed electronically but blood components were not so the prescription was overlooked and the component, thawed for use by the laboratory, was not transfused.

The remaining five cases were mainly errors due to specific requirement flags being absent, inaccessible or incorrect.

Learning point

- New ways of working may improve patient safety but if incorrectly implemented they may pose a risk. Electronic prescribing of blood is increasingly being used where ordercomms and an electronic patient record are in place. This is an area where shared experience between organisations could be beneficial and perhaps encourage implementation of blood prescribing in line with other drugs and fluids

Commentary

It is disappointing that 7 years after the National Patient Safety Agency notice about provision of blood components in an emergency (NPSA 2010) patients continue to be put at risk because the MHP are not working well, most often due to failures in communication or misunderstandings. Delays may be exacerbated by short-staffing as demonstrated in some of these cases, and this should be discussed with managers. Emergency protocols should be practised to ensure they function as intended. At least three instances are noted where porters were not appropriately available after MHP activation, and in another the clinical staff did not appreciate the need to inform the laboratory.

Learning point

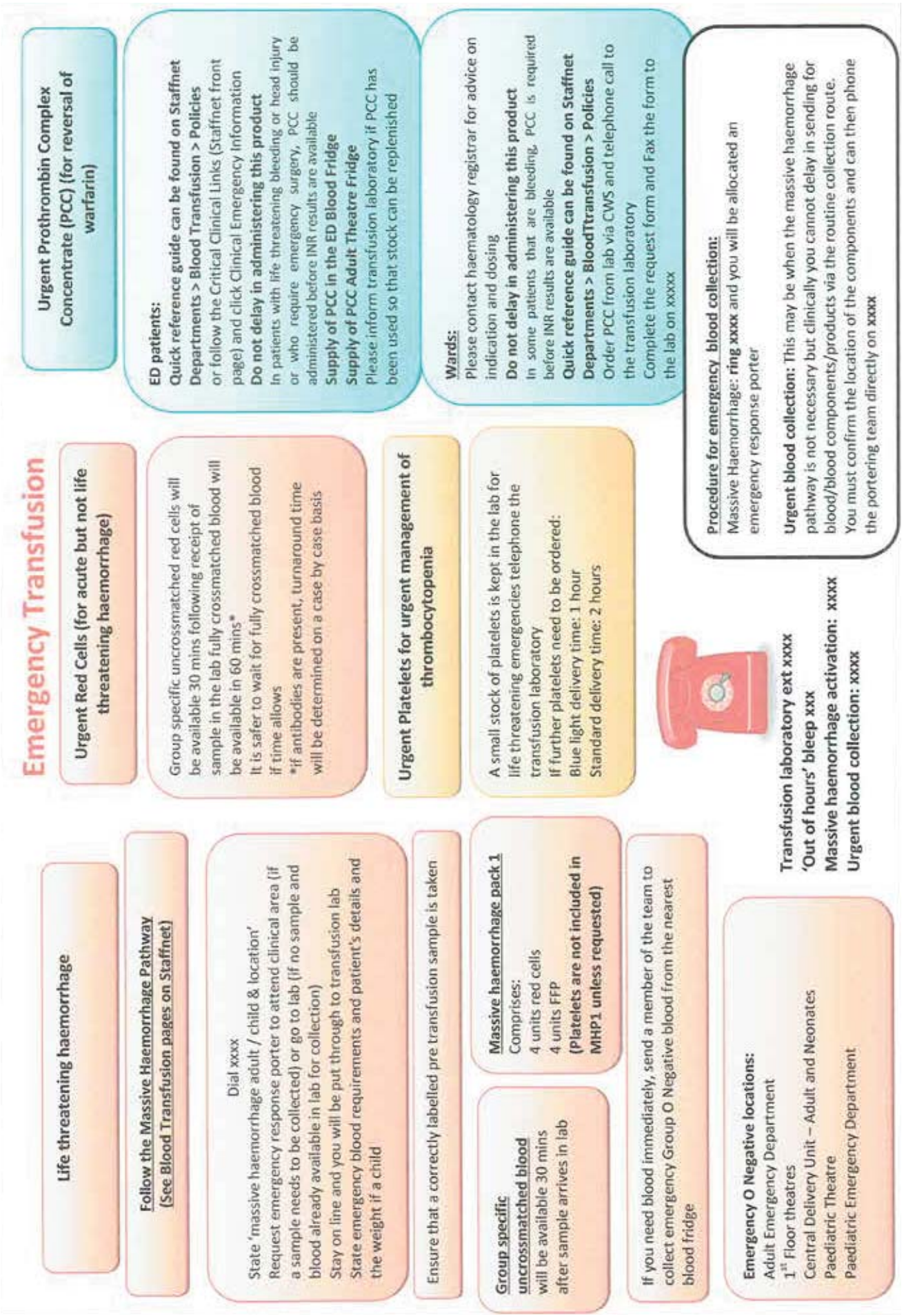
Every hospital should clarify the delivery times for emergency O D-negative, group-specific or crossmatched units as shown in the example at Appendix 11.1

References

NPSA: Rapid Response Report NPSA/2010/017 **The transfusion of blood and blood components in an emergency.** http://www.nrls.npsa.nhs.uk/alerts/?entryid45=83659 [accessed 17 March 2017]

NPSA: Rapid Response Report NPSA/2010/017 **The transfusion of blood and blood components in an emergency. October 2010, Supporting information.** http://www.nrls.npsa.nhs.uk/EasySiteWeb/getresource.axd?AssetID=83689& [accessed 17 March 2017]

Appendix 11.1: Example of a transfusion aide memoire (Manchester Royal Infirmary)



11b Avoidable Transfusions n=114 (n=116 in 2015)

Definition:

Where the intended transfusion is carried out, the blood/blood component is suitable for transfusion and compatible with the patient, but where the decision leading to the transfusion is flawed. This includes transfusions based on poor knowledge, communication failures, incorrect decisions or poor prescribing.

Key SHOT messages

- Transfusion can usually be avoided in iron, B12 and folate deficiency. Oral iron for iron deficiency is usual, however, where this cannot be tolerated, single dose intravenous (IV) iron is safe and very effective, and is now a recommended treatment for iron deficiency (Auerbach and Deloughery 2016) particularly before surgery (NICE 2015). Anaphylaxis may occur but is uncommon with currently available preparations. Adrenaline should be available where IV iron is used (McCulley et al. 2016). B12 and folate deficiency should be treated with the missing vitamin
- It is important to ask patients about their beliefs (religion) to avoid transfusion of blood components to those to whom they are not acceptable, particularly Jehovah Witnesses
- Group O D-negative red cells are not safe for everybody particularly patients with irregular antibodies. They will always be incompatible for patients with anti-c. If the emergency is so great that there should be no delay, the consultant in charge of the patient should make the decision. The patient should not die from exsanguination. See SHOT Bite 8 available on the SHOT website (https://www.shotuk.org/wp-content/uploads/SHOT-Bites-No8-Massive-Haemorrhage-Delays-1.pdf). If the antibody screen subsequently shows that incompatible red cells have been transfused, discuss with a haematologist whether to give IV methylprednisolone 1g and/or intravenous immunoglobulin (IVIg) cover. In addition, follow up and observe for haemolysis including deterioration in renal function and further alloimmunisation
- Unexpected thrombocytopenia should always prompt film examination and review of previous results. Biomedical scientists should not release results which they know or suspect to be inaccurate. Clinical staff should make a diagnosis before transfusing platelets as there may be specific contraindications

Overview

There were 11 deaths in this group only one of which was possibly related to the transfusion. No instances of major morbidity were recorded although there was one case of transfusion-associated circulatory overload which is reported in Chapter 18b, Transfusion-Associated Circulatory Overload (TACO).

The age range was from one day to 94 years.

This section includes avoidable use of emergency O D-negative blood where group-specific or crossmatched blood was readily available for the patient. Three cases are reported in Chapter 18b, Transfusion-Associated Circulatory Overload (TACO).

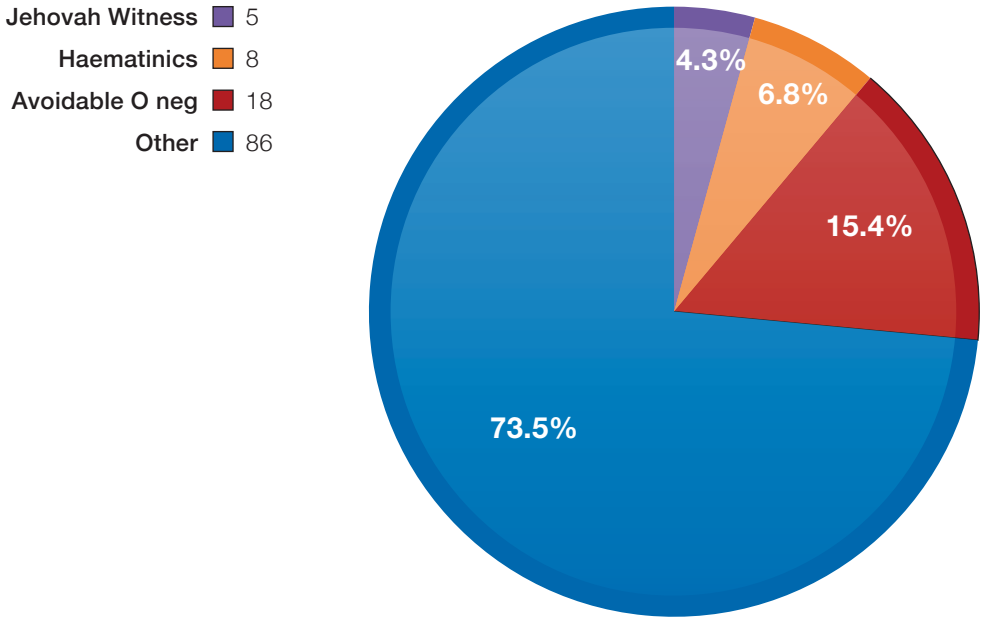


Figure 11b.1: Reasons for avoidable transfusions n=117 (3 cases added from TACO*)

**Additions from TACO: megaloblastic anaemia n=1; inappropriate FFP for anticoagulant reversal n=2*

Deaths n=1

Case 11b.1: Unnecessary use of two units where one would do, associated with cardiac decompensation

A 94-year-old lady attended the ED unable to manage at home and with malnutrition. Her Hb was 76g/L and she had a low potassium. She had no symptoms or signs of anaemia or bleeding. The ED junior doctor wrote a care plan to transfuse two units, correct potassium and transfer to the elderly care unit off site. The patient weighed 50kg. The transfusion plan was not reassessed at the treating unit. Following transfusion the Hb was 160g/L. More than 24 hours post transfusion the patient developed fast atrial fibrillation (AF), cardiac failure and subsequently died. The transfusion was considered possibly contributory but there were other medical factors.

The reporter considered that one unit at a time with a check Hb would have been appropriate given her age, weight and additional risk factors. Poor communication between the two locations was identified as a factor. Although medical and nursing staff at the community hospital receive annual blood transfusion training from the transfusion practitioner, it was noted before this incident that there was generally poor attendance by doctors, which had been notified to the matron.

Case 11b.2: An avoidable transfusion (where specific requirements were not met) to a transplant patient who then needed repeat stem cell harvests

An 11-year-old girl with a recurrent malignant tumour was scheduled for autologous haemopoietic stem cell transplant (HSCT). She was admitted on a Sunday evening and an irradiated unit of red cells ordered for the next day. A different BMS issued two units of non-irradiated red cells electronically (despite the need for irradiation noted in three places on the request). These were transfused with a two-person check at the bedside in relation to two stem cell collections on the Monday and Tuesday. When it was noted that these were non-irradiated cells, the stem cell harvests had to be wasted and the child underwent repeat harvesting six weeks later following further stimulation with granulocyte-colony stimulating factor.

Another instance was reported under specific requirements not met (SRNM). A 4-year-old child with neuroblastoma received non-irradiated platelets three days prior to stem cell harvest. At the time of autologous harvest the specialist nurse noted that red cells provided to prime the machine were not irradiated. These units were returned to the hospital transfusion laboratory (near miss) and irradiated red cell units issued. It was then discovered that non-irradiated platelets had been transfused three days previously.

Red cell transfusion to Jehovah Witness patients n=5

These were emergency (1) or urgent (4) transfusions to older patients (62, 72, 83, 90 and 94 years of age) who were not always able to understand (language or clinical state) or give consent. In some cases the information was available in the case notes but not seen by the staff or prescriber in an urgent situation. One patient had been in hospital for 3 months; another was transferred from a care home where the information about his religion was available. Another report commented that staff find it intrusive to ask patients about their religion and that this box on the admissions form is frequently not completed. An audit noted that religion had been recorded as 'unknown' in 31% of admissions and that this is a 'routine violation'.

Learning point

- Clerical staff need to understand the importance of recording a patient's religion and realise how this may affect their management

Transfusion of patients with haematinic deficiency n=8

There were 2 cases with megaloblastic anaemia and 6 with iron deficiency. One of these was a postnatal woman with Hb 78g/L not tolerating oral iron and the transfusion was prescribed by the general practitioner in the community. There is evidence that IV iron is more effective than oral iron for treatment of fatigue after postpartum haemorrhage (Holm et al. 2017).

Case 11b.3: Inappropriate treatment of megaloblastic anaemia

A haematology registrar authorised transfusion of four units to a 51-year-old woman with megaloblastic anaemia due to lack of knowledge. Her Hb was 42g/L and she was generally unwell with development of sepsis.

This case demonstrates a surprising lack of knowledge. Patients with megaloblastic anaemia are best treated with haematinics to which they respond rapidly. Transfusion is rarely required and should be limited http://www.transfusionguidelines.org.uk/transfusion-handbook/8-effective-transfusion-in-medical-patients/8-1-haematinic-deficiencies. Excessive transfusion puts the patient at unnecessary risk; patients with B12 deficiency have increased mortality from pulmonary oedema compared with those with iron deficiency (Lawson et al. 1972). Cardiac muscle is also B12-deficient. Another patient with megaloblastic anaemia who was transfused developed TACO and is discussed (and counted) in Chapter 18b, Transfusion-Associated Circulatory Overload (TACO).

Learning point

- In a normal setting haematinics, in particular oral iron for iron deficiency, can be effective. However, where this cannot be tolerated, single dose intravenous (IV) iron is safe and very effective, and is now a recommended treatment for iron deficiency (Auerbach and Deloughery 2016) particularly before surgery (NICE 2015). Anaphylaxis may occur but is uncommon with currently available preparations. Because of this risk, adrenaline should be available where IV iron is used (McCulley et al. 2016). B12 and folate deficiency should be treated with the missing vitamin

Avoidable use of emergency O D-negative units n=18

Sixteen of these were either emergency (n=13) or urgent (n=3 transfusions. The priority was not known for two cases. The majority were in theatre (n=7), the ED (n=4) and wards (n=4) with two in intensive care units and one in a neonatal unit, Case 11b.5 below.

The reasons for these transfusions were:

- Delayed provision of correct components due to earlier errors n=5
- O D-negative units used when crossmatched (n=6) or type-specific (n=2) units were available n=8
- Other n=5

Case 11b.4: Obstetric patient with anti-Jk^a transfused emergency O D-negative unit that might have been incompatible

A woman presented with an antepartum haemorrhage and required urgent caesarean section. The transfusion laboratory was advised that red cells would be required. The first blood sample was haemolysed, and the second sample received 30 minutes later had an incorrect date of birth. The woman had a known anti-Jk^a so theatre staff were advised that the emergency O D-negative units may not be compatible. Due to misunderstanding of the consultant haematologist's advice one unit of emergency O D-negative red cells was used one hour after the initial telephone call. Crossmatched blood was available within 30 minutes of this. Fortunately, as 76% of Caucasian donors are Jk(a+), retrospective matching of this unit confirmed it was compatible. Three units of red cells were transfused in total.

When a patient with known antibodies requires emergency transfusion this should, if possible, be authorised by a consultant haematologist. It may be possible to rapidly select a compatible unit from the transfusion laboratory as several additional antigen specificities are noted on the labels (depending on the antibody). In this instance there was miscommunication between the consultant haematologist and the anaesthetist as to whether this blood was to be given and whether it was needed in an emergency. The consultant haematologist had advised that the blood could only be used in an emergency but this had been misinterpreted as him giving the go ahead to transfuse the unit.

This case is a reminder that group O D-negative red cells are not safe for everybody particularly patients with irregular antibodies. They will always be incompatible for patients with anti-c and laboratory staff can provide a more suitable unit very quickly. If the emergency is so great that there should be no delay, the consultant in charge of the patient should make the decision. The patient should not die from exsanguination. This is discussed in SHOT Bite 8 available on the SHOT website (https://www.shotuk.org/wp-content/uploads/SHOT-Bites-No8-Massive-Haemorrhage-Delays-1.pdf).

Case 11b.5: An infant with haemolytic disease of the fetus and newborn (HDFN) due to anti-c was transfused with emergency O D-negative red cells

A pregnant woman presented at 39 weeks because of reduced fetal movements. She was sent home, but was found to have new anti-c. She was readmitted and underwent emergency section later that evening. The baby was unwell, Hb 65g/L and was transfused with emergency O D-negative blood. The maternity staff had not handed over to neonatal unit staff that the mother had anti-c. The baby then received exchange transfusion with appropriate red cells.

Learning point

- Group O D-negative red cells are not safe for everybody. They may or may not be compatible with other irregular antibodies and are not compatible with anti-c which is a risk in pregnancy and may result in haemolytic disease of the fetus and newborn (HDFN)

Generally (where there are no known irregular antibodies), use of emergency O D-negative units has a low risk of adverse outcomes and transfusion should not be delayed in an emergency. If the antibody screen subsequently shows that incompatible red cells have been transfused, discuss with a haematologist whether to give IV methylprednisolone 1g and/or IVIg cover. In addition, follow up and observe for haemolysis including deterioration in renal function and further alloimmunisation.

Case 11b.6: Avoidable transfusion of O D-negative units to a pregnant patient with sickle cell disease due to misunderstanding

A pregnant woman known to have sickle cell disease with a low Hb (69g/L) (normal for her) was taken to theatre. She was not actively bleeding. The doctor wanted two units of O D-negative blood for the patient and did not want to wait for crossmatched units. The first unit was started but was stopped by a haematology registrar after approximately 20mL had been transfused. She did not need transfusion at all.

The use of O D-negative rather than an appropriately selected phenotyped unit could have resulted in alloantibody formation. The patient did not require any blood following the surgery.

Avoidable transfusion of platelets n=23

The reasons included inaccurate results: 14/23 had wrong full blood count (FBC) results; 7/14 had platelet clumping on the film which had not been detected prior to release of the FBC result; in one case a flag on the LIMS was ignored. Four other samples were clotted, one transfusion was based on the result from another patient and reasons were not given in two. Clinical indications for at least six of these transfusions were not justified and were against platelet transfusion guidelines.

Learning point

- Unexpected thrombocytopenia should always prompt film examination and review of previous results. Biomedical scientists should not release results which they know or suspect to be inaccurate. Clinical staff should make a diagnosis before transfusing platelets; there are three conditions where platelet transfusions should not be given (immune thrombocytopenia, heparin-induced thrombocytopenia and thrombotic thrombocytopenic purpura)

Miscellaneous n=3

Three patients received inappropriate transfusions due to failure of patient identification, being identified only by their bed number.

Case 11b.7: Avoidable transfusion where patient identified by bed number

A 60-year-old man received red cells as a result of a prescription based on a FBC result from another patient. The patient's bed number was used to communicate which patient needed a transfusion. However, the patients' beds had changed. An incorrect patient was crossmatched and prescribed two units of blood. This patient was then given one unit of red cells, but when the error was recognised no further blood was given.

Near miss avoidable cases n=4

There were 4 near miss cases related to avoidable transfusions. These included 2 requests based on erroneous results, 1 FBC wrong blood in tube (WBIT), and 1 where the transfusion was not prescribed.

Information technology (IT)-related avoidable transfusion cases n=6

Transfused on the wrong result n=6

IT systems or equipment failure contributed to the following unnecessary transfusions.

In three patients the platelets were low due to clumping or clotting but these spuriously low results, which should not have been transmitted to the ward results enquiry system, resulted in patients being given unnecessary platelet transfusions. On another occasion a short neonatal coagulation sample gave an incorrect fibrinogen result and cryoprecipitate was given unnecessarily. Another patient was transfused based on a wrong Hb following an autologous stem cell harvest where the timing of the sample was not clear.

Commentary

It is surprising that patients with megaloblastic anaemia were transfused as this carries a particular risk of TACO due to cardiac dysfunction. Low platelet counts should always be investigated, initially by examination of a film to confirm that this result is not due to clumping. It is important to make a diagnosis of thrombocytopenia as there are conditions where platelet transfusion is inappropriate (e.g. immune thrombocytopenia) or contraindicated (thrombotic thrombocytopenia purpura and heparin-induced thrombocytopenia.

Group O D-negative red cells are not safe for everybody, particularly those with anti-c and other irregular antibodies. The transfusion laboratory may be able to immediately issue more appropriate units where the antibody is known.

11c Under or Overtransfusion n=21

Eleven of these were children under the age of 16 years (6 less than a year of age), 9/11 were transfused excessive amounts of red cells or platelets (based on a wrong weight or wrong calculations) and two received less than planned (a one-unit exchange transfusion where only one suitable donation was available, and one error in the calculation for the infusion pump).

Ten adults received inappropriate amounts: 5/10 received inadequate amounts of FFP. Another was given excessive cryoprecipitate because a consultant haematologist (locum) did not accept advice that the current packs of cryoprecipitate are pools from 5 donations and prescribed 10 bags (equivalent to 50 single donor units).

Four adult patients received excessive transfusion of red cells. One of these was an elderly patient with a haematological condition who was transfused regularly over several months without checking Hb measurements and who developed iron overload.

Near miss incorrect volume cases n=3

There were 3 near miss cases related to incorrect volumes. These included 2 where the incorrect volume was requested, and 1 case where an incorrect dose was prescribed. All 3 patients were babies under 6 months old, that could have been overtransfused.

Information technology (IT)-related undertransfusion cases n=1

Case 11c.1: Undertransfusion because blood label specification was incorrect

A neonatal exchange transfusion was required because of maternal red cell antibodies causing haemolytic disease of the fetus and newborn (HDFN). The volume required to undertake the exchange was calculated by the clinical area and this amount was ordered from the transfusion laboratory. Unfortunately, when the unit was re-processed by the Blood Service to provide the correct specification for the procedure, the initial volume was printed on the label, not the new (lower) volume with the result that the neonate received an exchange transfusion with insufficient blood.

Incidents Related to Prothrombin Complex Concentrates (PCC) n=10

11d

Ten cases related to PCC alone. A further 2 cases also involved delays of other blood components and have been counted in the numbers in the section on delays, however, all 12 cases are described in this section.

Key SHOT messages

- Delay in administration of prothrombin complex concentrate (PCC) for bleeding, particularly intracranial haemorrhage, puts patients at risk
- PCC is a blood product which should be carefully prescribed to ensure that the treatment is appropriate and traceable
- Junior medical staff should be trained in the indications for and use of PCC

Twelve cases were reported, 6 with delayed administration, 3 avoidable infusions, 2 that were given to the wrong patients, and one with misunderstanding (Case 11d.5 below). In two instances PCC was used because vitamin K was not available. Two cases had delayed administration due to inadequate supplies in the hospital. Several of the reported cases demonstrate delay in prescription, confusion about where to prescribe, delay in release from the laboratory with consequent excessive interval between decision and treatment in vulnerable elderly patients (8/12 aged >70 years) on warfarin in emergency settings. PCC should be administered immediately (NICE 2015) and certainly within an hour of the decision being made, particularly in cases of intracranial haemorrhage (ICH) or major bleeding. A research study from Germany (19 centres) noted reduced rates of haematoma enlargement in ICH (853 cases analysed) where the INR was reduced to <1.3 within 4 hours of admission (Kuramatsu et al. 2015). A simplified dosing algorithm was associated with more rapid international normalised ratio (INR) reversal in a small series using a fixed low dose of 25IU/kg (Appleby et al. 2017).

Many patients who need anticoagulation are now being treated with direct oral anticoagulants (DOAC). While there is some evidence that PCC may be of benefit in a bleeding emergency (Makris et al. 2013; Makris 2014; Keeling et al. 2016), specific antidotes are becoming available. In particular idarucizumab is a specific reversal agent for dabigatran (Glund et al. 2015; Pollack et al. 2015). This is licensed and should be available in any hospital likely to treat such emergencies. Reversal agents for the anti-Xa inhibitors (such as rivaroxaban) have been developed and are expected to be licensed soon (Connolly et al. 2016a; Connolly et al. 2016b).

Case 11d.1: Delay in administration of PCC to a patient with ICH (1)

A 77-year-old man on warfarin had ICH confirmed on a computerised tomography (CT) performed at 20:26. PCC was requested at 22:15 but not issued until 23:06; collected by the ward at 23:50 and given at 00:05, a delay of about 3.5 hours. The INR was repeated at 01:00 and recorded as 1.4. The laboratory standard operating procedure (SOP) has been revised.

Case 11d.2: Delay in administration of PCC to a patient with ICH (2)

An elderly man on warfarin suffered a fall resulting in an ICH (INR 2.8). He was prescribed 3000IU of PCC but only 1000IU was given initially. Further stock was obtained from another hospital and given 4.5 hours later. He recovered and survived. The PCC stock had not been re-ordered when getting low. As a result of this incident the base stock level was increased and an increased number of staff were authorised to reorder it.

Case 11d.3: Communication issues cause delay in release of PCC

A patient was in theatre for a heart transplant. The consultant anaesthetist requested PCC for emergency reversal of warfarin. The BMS on duty asked that this be authorised by the haematology registrar. This registrar cover is provided by another organisation, which often results in delays in communication. The request for PCC was appropriate, and according to the laboratory SOP, authorisation by a haematology doctor was not required. Thus the PCC should have been issued in a matter of minutes, but as a result of delays trying to make contact with the haematology team the issue was delayed by 30 minutes. The BMS on duty was relatively new to the department, having previously worked in an organisation which required authorisation of PCC by the haematology team.

The turnaround time for patients undergoing transplantation (being informed, admitted and proceeding to surgery) is very short so that there was unlikely to be time to plan warfarin reversal in advance.

Case 11d.4: Administration of PCC to the wrong patient

A request form for PCC was completed for the wrong patient. The product was issued by the laboratory for the patient on the request form but was given to a different patient (who was the intended recipient) by the anaesthetist despite all paperwork and labels having details for the patient on the request form.

Case 11d.5: Misunderstanding of the indications for and use of PCC

A 66-year-old lady was readmitted via the ED 7 days after total abdominal hysterectomy and salpingo-oophorectomy for malignancy. She had developed postoperative pulmonary embolism and was on warfarin for this. PCC 2750IU was given prior to theatre (for a second look) to reverse the warfarin which was stopped. Postoperatively she was treated with low molecular weight heparin. The following day a junior doctor requested further PCC and was informed by laboratory staff that the patient had had a dose the day before to reverse the warfarin. The doctor stated he had discussed it with the haematologist who agreed. A dose of 3000IU PCC was collected but 5 days later was found in the patient's drawer. The transfusion practitioner discussed the incident with the consultant haematologist who stated he was not informed of the full facts.

This alerted ward and department managers to ensure that their staff are up to date with transfusion training including giving information as handouts about PCC. Blood transfusion is now on the reporting organisation's training matrix and is updated monthly with reports sent to managers and clinical leads.

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11e Reflections on Blood Component Wastage in the Emergency Department in the UK

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Blood component transfusion is a very important part of resuscitation of critically unwell patients. The indications for blood transfusion range from major trauma needing a massive transfusion, upper gastrointestinal (GI) bleeding, lower GI bleeding, haemoptysis, obstetric emergencies, catastrophic bleeding from tonsillectomy etc.

One of the key areas in hospitals requiring blood components on a regular basis is the emergency department (ED). Many factors lead to blood components wastage for example unnecessary transfusion, incorrect indications, blood not being returned to the refrigerator within thirty minutes. The Annual SHOT Report for 2015 (Bolton-Maggs et al. 2016) included 3288 reports of adverse events relating to transfusion of which 77.7% had errors as an underlying cause. The complicating factor in the ED is the fact that on many occasions, there is either very little history of what is going on and/or minimal warning of the patient arriving to the ED. In these situations, whenever blood is requested urgently or as part of the major haemorrhage protocol (MHP), on most occasions, the blood is used appropriately but given the complexity of the situation and resuscitation of critically unwell patients, sometimes blood gets wasted. This adds not only to the financial burden to the healthcare but also raises an ethical issue about the wastage of blood which is generously and willingly donated by people. 'Blood cannot be made, it has to be donated' (from a talk by Alister Jones 2014).

Over the years there has been a significant improvement in the practice of blood component usage in hospitals mainly due to teaching and training of healthcare professionals highlighting the importance of the blood component wastage. Other changes include the introduction of MHP in many hospitals. Despite those measures, it is well-known that there is still a significant amount of blood component wastage. It is acceptable that some blood component wastage will occur for unavoidable reasons, for example if the patient dies before components are administered. However, there is room to improve avoidable wastage. NHS Blood and Transplant (NHSBT) provide wastage target levels to help hospitals measure their performance. This is measured as 'wastage as a percentage of issues' (WAPI) and is set for red cells at <2.3% and platelets at <3.8%. According to Blood Stocks Management Scheme (BSMS) data, over a 2-year period almost 10,000 units were taken to clinical areas but not used and then wasted (BSMS 2014). The most common reason for red cell wastage in the clinical area was given as 'out of temperature control outside of the laboratory.' For platelets the reasons were components 'ordered (medically or surgically) but not used.' Further avoidable wastage occurred for laboratory reasons.

A retrospective case note review of patients requiring blood component usage in one ED prior to 2007 (Kelly et al. 2013) demonstrated that out of the total number of blood components requested, only 66.4% were transfused, 24% were recycled, 8.7% were discarded and 0.9% were unaccounted for. Following the study, various improvement measures were introduced including staff education, use of online e-learning modules, having a dedicated ED transfusion consultant and an ED transfusion link nurse together with availability of an ED resuscitation refrigerator. Their practice was reviewed again in 2011 and they demonstrated a significant reduction in the ordering of blood components by 64% and a 96% reduction in the unaccounted units.

Another group conducted a retrospective case note review of blood component usage and wastage over a 12-month period in their ED in 2007 (Beckwith et al. 2010). They showed that out of all the blood components ordered only 39.5% were used, 47.8% were recycled, 3.2% wasted and 9.5% were unaccounted for.

A review of literature identified various studies looking at blood component wastage in hospitals but very few specifically focussing on the ED. There have been significant improvements in dealing with blood wastage but reviewing current transfusion practices and blood component usage and wastage in various ED in UK will give a better and wider picture of the scale of the problem. Various suggestions for improvement of practices to avoid wastage already exist and could be better applied if we can demonstrate the seriousness of the situation.

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