11a Delayed Transfusion n=95

Definition:

Where a transfusion of blood/blood component was clinically indicated but was not undertaken or non-availability of blood components led to a delay with impact on patient care (not restricted to emergency transfusion).

Delays in transfusion of patients with antibodies

One death (Case 11a.1) and 2 other cases of delay (Cases 11a.7 and 11a.9 below) were caused by the presence of antibodies.

Key SHOT messages

- Guidelines must not be oversimplified and made into rules. While it may be safer not to transfuse at night, the patient's clinical need for transfusion must override this (Bolton-Maggs et al. 2014). However, transfusion should not be undertaken without adequate trained staff on duty to monitor the patient and react appropriately to any complications, and this would be particularly important at night
- Desire to follow good transfusion practice in some areas, if taken out of context, may risk patient death or morbidity due to delays in transfusion in major haemorrhage scenarios. This includes withholding any blood when the patient's antibody screen is positive, but antibody identification is not yet completed:
  - There are safety concerns regarding a possible delayed haemolytic transfusion reaction (DHTR) due to an antibody (with poor haemoglobin (Hb) increment, jaundice and renal failure) but if clinical harm to patients from withholding blood outweighs these, then emergency blood is essential and should be offered. Patients should not die from lack of blood
  - If antibody investigations have not been completed, or the patient has known antibodies for which compatible blood is not readily available:
    - ABO-, full Rh- and K-matched blood may be given, with intravenous (IV) methylprednisolone 1g and/or IV immunoglobulin (Ig) cover if required
    - Discuss with a clinical haematologist regarding the need for IV methylprednisolone and/or IVIg and monitoring for DHTR (including urine output), in light of any alloantibodies subsequently identified, and if any incompatible blood has been transfused
    - If full Rh and K phenotypes are not known, give ABO- and D-matched blood, with cover as above; if ABO and D groups not known, give O D-negative blood (or O D-positive blood may be given to males and post-menopausal women) with cover as above

For further key messages on delays in massive haemorrhage, see SHOT Bite No. 8 www.shotuk.org/resources/current-resources/.

Delays are often additive since there are several points in the transfusion pathway where there may be hold-ups. These are illustrated in Figure 11a.4.

Overview

Delayed transfusion was reported for 95 patients, age range newborn to 100 years (median age 30 years); 49 were female and 45 male (1 not specified). There was 1 near miss delay related to laboratory testing.

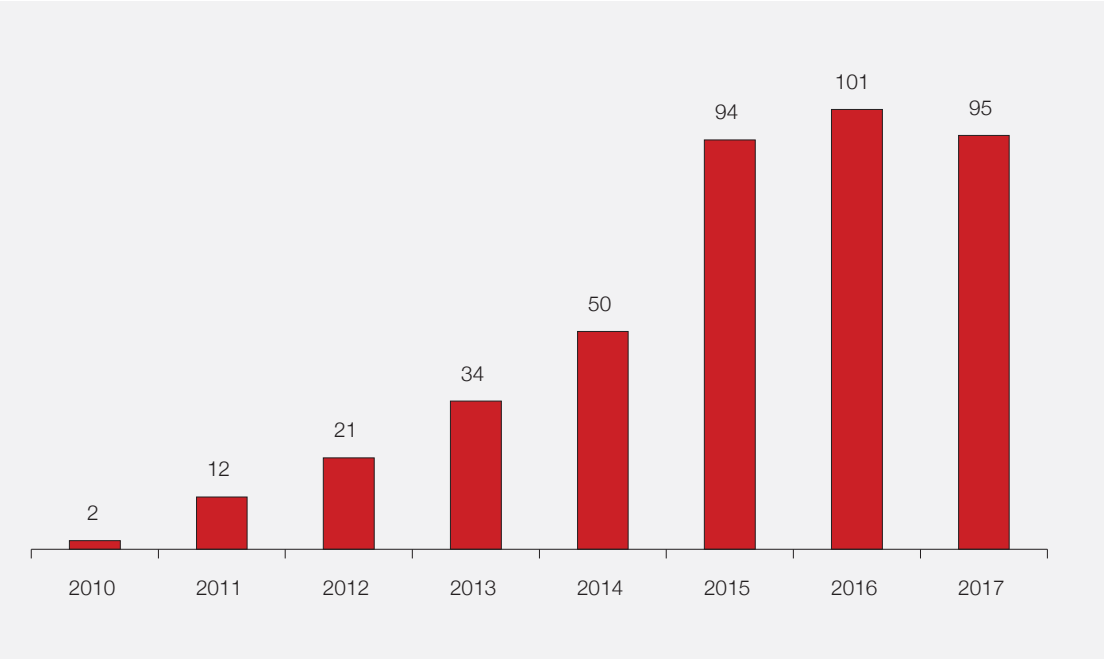


Figure 11a.1: Delayed transfusion reports by year 2010-2017

Figure11a.2: Urgency of delayed transfusions n=95

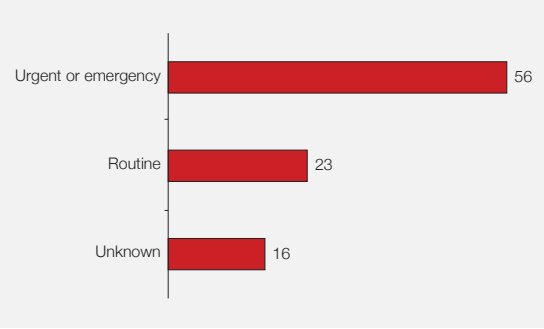
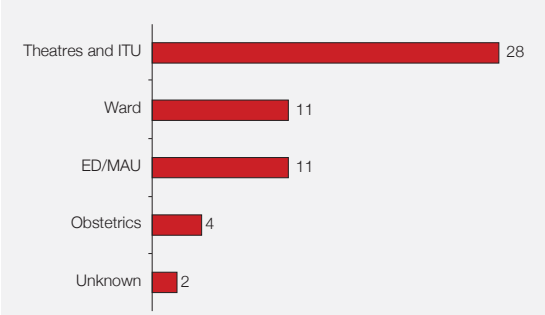
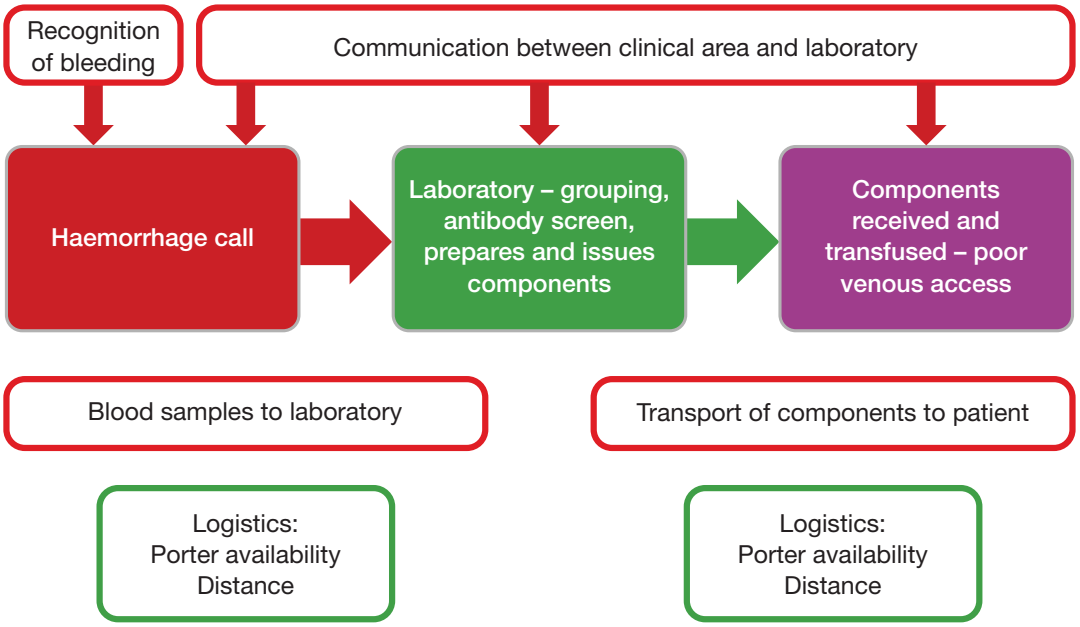


Figure 11a.3: Location of emergency and urgent transfusions n=56



ED=emergency department; MAU=medical admissions unit; ITU=intensive therapy unit (all types)

Figure 11a.4: Potential hold-up points in the transfusion pathway



Deaths n=6

Overall 14 deaths were reported. One death was directly attributable to the delay. Three deaths probably resulted from delayed transfusion and in 2 there was a possible relationship. Eight deaths were not thought to be related to the delay in transfusion.

Table 11a.1: Relationship of transfusion priority to deaths in delayed transfusions

	Imputability				
Transfusion priority	Definite	Probable	Possible	Unrelated	Total
Emergency	0	2	1	4	**7**
Urgent	1	0	1	2	**4**
Routine	0	1	0	0	**1**
Unknown	0	0	0	2	**2**
Total	**1**	**3**	**2**	**8**	**14**

Death definitely related to delay n=1

Case 11a.1: Death as a result of delayed transfusion for autoimmune haemolytic anaemia

A man in his 60s presented with Hb 38g/L secondary to autoimmune haemolytic anaemia (AIHA). The hospital laboratory referred the sample to an external reference laboratory (2 hours away) for further analysis due to the presence of a strong pan-reactive autoantibody. The patient died before the results were issued and without receiving any red cells. There had been an opportunity for a group and screen (G&S) sample to be sent a day earlier when the patient first presented. It was noted that there was no haematology consultant on site overseeing the patient's care out-of-hours due to centralisation of specialist services.

A G&S sample should have been sent at the earliest opportunity in anticipation of difficulties that would be encountered with full serological compatibility testing in a patient with AIHA. AIHA is caused by an autoantibody which reacts against non-specific red cell antigens. The presence of a pan-reactive autoantibody can mask additional alloimmune antibodies and therefore extended (and time-consuming) testing is required to exclude or identify these.

The mainstay of treatment for AIHA is immune suppression avoiding transfusion unless absolutely necessary. In cases with life-threatening anaemia blood transfusion is necessary and may be lifesaving. The primary risk of transfusing a patient without the results of an alloantibody panel would be the potential for a haemolytic transfusion reaction if a clinically significant alloantibody is present. When

anaemia is life-threatening, transfusion with ABO-, full Rh- and K-matched blood is more appropriate than delaying until full serological investigations have been completed (BSH Hill et al. 2017). Incompatible red cells may be transfused where the anaemia is life-threatening. Alert the transfusion laboratory staff early when transfusion may be required for patients with irregular antibodies. Where incompatible red cells are transfused, monitor the patient carefully, including renal function and urine output, and consider use of IVIg (see also Chapter 19, Haemolytic Transfusion Reactions (HTR), 3 cases).

Deaths probably related to delay n=3

Case 11a.2: Delayed transfusion contributes to death from haematemesis

A non-English-speaking man in his 40s with a history of alcohol dependence, hepatitis C and substance misuse (on a methadone programme) attended the ED with haematemesis after a 999 call by his friends at 03:20. The patient was not triaged appropriately (ambulance records of vomiting blood, pulse 130 beats per minute (bpm), blood pressure (BP) 94/60mm Hg) and his clinical state was not monitored adequately in accordance with hospital guidelines (no hourly observations and no early warning score monitoring). He should have been seen within 10 minutes but was seen after 1.5 hours. At 04:28 the Hb was 56g/L. The laboratory contacted the ED to report this result and later at 05:45 to offer emergency O D-negative blood. This advice was declined and fully crossmatched red cells were requested at 05:09 with 'routine' priority. The patient's clinical deterioration was not detected by nursing or clinical staff. The major haemorrhage protocol (MHP) was not activated.

The patient died at 08:06 following cardiac arrest with further large haematemesis and melaena prior to receiving any blood components.

Poor clinical judgement by both nursing and medical staff was noted with failure to recognise the severity of the patient's clinical state and failure to activate the MHP. These contributed to the death of the patient. Hospital procedures were not followed and it was noted on review that both the doctor and nurse involved in the case were agency staff (3/7 nurses were agency staff) and therefore not required to attend mandatory training. The medical and nursing shifts changed over at 07:00 so that the patient was seen by a succession of different staff. The case review resulted in improved arrangements for orientation for agency staff to ensure that the correct triage procedures are followed.

Case 11a.3: Delayed transfusion for severe anaemia related to gastrointestinal (GI) haemorrhage contributes to death

A man in his 70s presented with a 2-day history of bilateral leg pain and was found to have a Hb of 49g/L at 08:00. He had multiple comorbidities including a history of angiodysplasia and ischaemic heart disease with multiple stents with atrial fibrillation for which he was on aspirin and rivaroxaban. Blood was requested (although the first sample was rejected due to incorrect date of birth) and available for collection at 11:49. The plan (at 13:54) was to transfuse to Hb >90g/L cautiously given a high risk of transfusion-associated circulatory overload (TACO).

However, the patient was not transfused until the following day, when found unresponsive with an unrecordable BP, metabolic acidosis and Hb 34g/L. He was transfused four units of red cells (post-transfusion Hb 73g/L) and three units of fresh frozen plasma (FFP) (international normalised ratio (INR) >2.5) and admitted to the ITU. The patient died 24 hours after admission from cardiogenic shock related to profound anaemia in the context of cardiomyopathy.

There was a delay of more than 18 hours from the decision to transfuse. The incident report noted that there were concerns about transfusing the patient while in transit between wards and transfusing overnight but there was also evidence of poor handover at several points and excessive workload for junior doctors leading to lack of clinical review and documentation overnight. Concerns regarding TACO were valid but should have been overcome with close monitoring and use of diuretics if required. It was also noted in the case review that pressures to meet waiting targets in the ED may have led to an initial delay. It may have been appropriate for the patient to have received part of the planned transfusion prior to moving to the medical ward, regardless of targets. There were several recommendations for change in practice as a result including transfer checklist from ED to ward, teaching on transfusion to medical and nursing staff, a review of overnight medical cover and the importance of good handover.

Learning point

- A patient should not die from anaemia. The guidance to not transfuse at night has been translated into a rule which it is not. Patients may need urgent transfusion at any time in 24 hours and this should not be delayed

Case 11a.4: Access to the laboratory refrigerator contributed to delay in provision of emergency blood

A man in his 60s, managed on ITU for ongoing variceal bleeding, deteriorated acutely with a further massive haemorrhage. Two units were issued at 02:56, the first was collected at 03:31. He became unstable with resistance to fluids and two units of red cells. The MHP was activated at 03:38; units were available by 03:47 but it took 36 minutes for further red cell units to reach the ward. The patient was profoundly hypotensive throughout this period and was not suitable for resuscitation by the time the blood components arrived.

Several problems contributed to the delay: a reduced number of porters, distance and problems with the issue refrigerator. The main issue refrigerator was awaiting repair and the blood was stored in another refrigerator in the laboratory requiring additional steps to access blood that would not have occurred if the main issue refrigerator was in operation. The procedural review recommended an increase in porters and giving them access codes for the laboratory. A designated cool box was made available for immediate collection. The review also noted that there was delay in implementation of barcoded identification bands due to funding issues.

Death possibly related to delay n=2

Case 11a.5: Failure to follow MHP correctly contributes to delay and death

A man in his 80s was admitted to the ED with massive haemorrhage (no further details). The MHP was activated. Emergency O D-negative units and pre-thawed FFP were available and issued for use by the laboratory in a timely manner. The blood components were available to collect but the clinical staff were not aware of this and another doctor contacted the laboratory 20 minutes after the components had been issued. The patient was then transferred to the radiology department but the components were delivered to the ED. The patient died the same day.

Poor communication and lack of understanding of the MHP led to delays in transfusion that possibly contributed to this patient's death. MHP drills and retraining have been implemented in the ED as a result of this incident. In a second case suboptimal communication between laboratory and clinical staff led to a 2-hour delay in transfusion after activation of the MHP in association with the laboratory information management system being down for a long period.

Major morbidity n=1

In 1 case delayed transfusion was a contributory factor to major morbidity.

Case 11a.6: Delayed transfusion in a patient with cardiac ischaemia contributes to major morbidity

A man in his 50s was admitted from the endoscopy unit with chest pain confirmed due to non-ST-elevation myocardial infarction (NSTEMI). The Hb was 43g/L at 10:45 (he had a previous history of GI bleeding). At 13:37 red cells were available for collection but were not transfused until 16:25. The reason for the delay is unclear, although there was likely inadequate communication as a contributory factor. The patient was admitted to ITU and made a full recovery.

It is uncertain whether failure to recognise the severity of the patient's condition, or lack of clarity as to the urgency of transfusion, caused the delay in this case. Patients with cardiac chest pain should have their anaemia managed as a matter of urgency.

In the following case a patient was put at risk of serious harm due to delay.

Case 11a.7: Delayed transfusion in a patient with chest pain due to lack of knowledge about how to manage critical anaemia in the presence of pan-reactive antibodies

A woman in her 50s with chronic significant gynaecological haemorrhage was admitted from clinic with Hb 56g/L at 16:00. She was clinically stable. A G&S sample was not sent until 08:58 the following morning. She was found to have a pan-reactive antibody which required further testing and the sample was sent to the local external reference laboratory. At 14:00 the patient became acutely unwell with crushing central chest pain and a respiratory rate >40 breaths per minute (/min), thought to be secondary to cardiac ischaemia. A repeat blood count showed Hb 46g/L. Blood was not available until 17:00, 3 hours after the development of cardiac symptoms.

This case demonstrates several areas for improvement. There should not have been a lengthy delay sending transfusion samples, particularly in a patient considered high enough risk to warrant inpatient admission. There was failure to communicate the change in the patient's clinical status, and urgency of blood requirement, to the laboratory. The sample had been sent to the reference laboratory as a 'routine' case as had the delivery of blood components 'when available'. This is another instance where the patient could have received ABO group-specific, full Rh- and K-matched red cells when it became apparent there was going to be delay. The risk of leaving a severely anaemic patient with cardiac chest pain is likely higher than the risk of transfusing blood with a potential alloantibody.

Delays involving the management of MHP n=19

Poor communication was a common cause of delays. There were logistical issues in notifying laboratories of activation of the MHP in 5 cases and 4 further cases in which porters were not alerted. It is essential that there are dedicated lines of communication to the transfusion laboratory and that porters are included in the alert and updated as to any changes in patient location (Case 11a.5 above: death possibly related to delay).

Case 11a.8: Wrong patient details supplied to laboratory in a major obstetric haemorrhage

A woman in her 20s had a postpartum haemorrhage leading to MHP activation. The midwife gave the wrong patient details to the laboratory staff which was not recognised until the red cells (incompatible ABO group) arrived in the maternity unit. They were returned and correct details applied but this resulted in a 25-minute delay to provision for the group O patient.

The review noted that this was an unusually busy evening with complicated cases causing demands of the staff and service. The error was detected because of correct checking processes prior to transfusion.

Case 11a.9: Lack of knowledge about emergency blood provision in patients with alloantibodies leads to delayed transfusion

A man in his 50s with variceal haemorrhage related to alcoholic liver disease was admitted to the ED. A MHP call was instigated at 01:40. The patient had alloantibodies, anti-K and anti-C^w. The biomedical scientist (BMS) was reluctant to issue the shock pack (four units of red cells and four of FFP) and informed the ED not to use the emergency O D-negative blood in the local refrigerator. A consultant haematologist was contacted 25 minutes after the MHP call and authorised the transfusion. Blood was collected at 02:16. The patient was admitted to ITU and eventually made a full recovery.

An unnecessary delay in issuing emergency blood components resulted from a lack of knowledge by the BMS, who was working alone at night, and failure to follow the standard operating procedure (SOP) for patients with known irregular antibodies (to issue group O K-negative units and immediately contact the haematologist on call).

Case 11a.10: Change in status of the patient and poor communication compound the delay

A young man was admitted with trauma from a road traffic accident with closing speed of 70 miles per hour. He was initially stable; four units of blood were requested urgently to be available at 18:55. The BMS acknowledged that these would be available in 10 minutes. However, the blood sample was not taken until 19:00, was booked into the laboratory at 19:20 but had to be reprocessed at 19:47 as the antibody screen had not been done. During computerised tomography (CT) scanning the patient started to deteriorate with an increase in pulse rate to 135 beats/min such that the internal bleeding was now thought to be greater than it seemed at first.

A porter was sent to collect the blood and a telephone request was made for platelets and plasma as indicated by thromboelastogram (TEG) testing. Although there was an agreed TEG protocol in place for a 1:1 red cells to plasma ratio the BMS noted that this request would require authorisation by the haematology registrar (as this had not triggered the MHP). The BMS did not inform the ED staff that there had been a problem with the antibody screen. The MHP was called at 20:37 when blood and plasma were issued and collected. Plasma was infused at 21:15 and platelets at 22:15. The ED staff could have used the emergency O D-negative units.

This case demonstrates that it may be difficult to determine the severity of bleeding in closed injuries. If there is a change in urgency for blood component delivery this should be clearly communicated to the transfusion laboratory staff; the BMS is likely to have had several actions in progress and will need to know if the priority has changed. It would be normal practice to require haematology authorisation for platelets requests but not once the MHP has been activated. The outcome of the case was to ensure that communication between the ED and transfusion laboratory is clear and concise.

Case 11a.11: Telephone check prior to high risk surgery detects failure of process

A woman was scheduled for elective caesarean section for placenta praevia; blood samples were sent for group and crossmatch four units of red cells 2 days prior to the procedure. At the time of surgery, after the spinal anaesthetic had been placed, a telephone call to the laboratory established that no units were available due to a laboratory error in processing the request. The request form had been put in the wrong location for crossmatch requests at the time of a shift changeover. The four units were made available within 40 minutes. The start of surgery was delayed but the red cells were not used.

Preparation for surgery where blood loss is high risk requires red cells to be available at the time of surgery. It was fortunate that the staff chose to check prior to starting the surgery in this case.

Information technology (IT)-related delayed transfusions n=11

Equipment failure n=2

In one case the printers failed and then blood components issued manually were returned due to a transcription error. In another the MHP was not correctly activated because the bleeps do not work throughout the hospital.

Electronic blood management systems (EBMS) n=7

In all 7 cases blood could not be accessed from a satellite refrigerator under the control of an electronic blood management system and this caused delay in 6 emergencies and 1 urgent clinical situation.

Case 11a.12: Refrigerator incorrectly stocked for remote electronic issue (EI)

Two high-risk cases, both blood group A, were anticipated to require significant amounts of blood during surgery. The group A drawer of a remote electronic issue refrigerator was full so additional units were put in the 'crossmatched blood' drawer. As expected the group A blood was rapidly depleted and the clinicians were warned by the EBMS that the supplies were low. However, the BMS viewing the stocks remotely could see that there were plenty of group A units remaining. These were not available for remote electronic issue and had to be issued from the laboratory.

In two critical situations where blood was required immediately, the clinical staff removing blood from the satellite refrigerator did so incorrectly. In one case all the units were scanned out at the same time and became 'invalid' for use so had to be reissued from the laboratory causing delay. On the other occasion neonatal emergency blood was required. The first collector used the wrong programme so a second trained operator removed the blood correctly but left the refrigerator drawer and door open. The process was therefore incomplete and no further blood could be safely removed without intervention from the laboratory.

In two other cases blood was not available because the refrigerator locked closed. This was as a result of a motherboard failure in one and because the screen froze on the kiosk in another. Downtime procedures were available, but were not always followed immediately.

Training is essential for all EBMS operation and training against routine and emergency procedures could have prevented all the cases mentioned above. Training is particularly important during implementation of a new system and when new staff join the organisation. There was one delay because porters did not have the necessary barcodes to collect blood and another because there were both new and old systems in place during a transition to an EBMS and the completion of two collection processes caused unacceptable delay.

Others n=2

In one case a laboratory information management system (LIMS) flag stating the need for a serological crossmatch was not heeded.

In another case there was a delay to transfusion, and to transfer to a specialist unit, because methylene-blue-treated FFP could not be issued to a neonate. The component choice (and component code) had not been set up on the LIMS so this had to be issued manually.

References

Bolton-Maggs PHB, Poles D et al. on behalf of the SHOT Steering Group. The 2014 Annual SHOT Report (2015) www.shotuk.org pages 26-27.

BSH Hill Q A, Stamps R et al. Guidelines on the management of drug-induced immune and secondary autoimmune, haemolytic anaemia. *Br J Haematol* 2017;**177(2):** 208-220.