

GUIDELINES
REACTIONS
CHECKLISTS
VIGILANCE
ENCOURAGE
IMP
NEAR
INES

ANNUAL SHOT REPORT 2015



working with

SERIOUS HAZARDS OF TRANSFUSION

Affiliated to the Royal College of Pathologists

SHOT

TEAMWORK
IMPARTIAL
RECOMMENDATIONS
SAFETY
EXPERIENCE
TRAINING
LESSONS
PATIENT SAFETY
RECOMMENDATIONS
PRACTICE SAFETY
VIGILANCE
GOOD PRACTICE
PARTICIPATION
COMMUNICATION
CHECKLIST
VIGILANCE
TRAINING
LESSONS
PATIENT SAFETY
RECOMMENDATIONS
PRACTICE SAFETY
VIGILANCE

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Foreword and SHOT Update

1

Welcome to the Annual SHOT Report for events reported from across the United Kingdom (UK) in 2015. It is encouraging that the level of participation remains high. We are pleased to note that serious adverse reactions, (SARs) i.e. those reactions resulting in serious harm or death, are rare. We continue working towards a closer alignment with the Medicines and Healthcare Products Regulatory Agency (MHRA) and reporting to the European Union (EU). From October 2015 the SHOT Working Expert Group (WEG) took over assessment of adverse reactions, forwarding to the MHRA those that required inclusion in the returns to the EU. The MHRA serious adverse events have been integrated together with the SHOT data into a single chapter and the full MHRA report can be found in the 2015 Annual SHOT Report: Web Edition.

Some topics and additional material will be found in the SHOT Web Edition. Subjects include those where reports are few and there are no new observations, and include post-transfusion purpura (PTP), transfusion-related acute lung injury (TRALI), complications related to cell salvage (CS), handling and storage errors (HSE), errors associated with the right blood nevertheless being transfused to the right patient (RBRP), the full report on incidents related to anti-D immunoglobulin administration (anti-D) and anti-D immunisation in pregnancy study, alloimmunisation data and an update of events in patients with haemoglobin disorders.

Medical practice is under pressure. More than a third of NHS staff reported work-related stress in the 2015 staff survey. Emergency departments are struggling, 2 in 5 new consultant physician posts were not filled in 2015, a third of general practitioner training places remain vacant, and overall funding is tight. Once again, the majority of SHOT reports follow mistakes (often multiple) in the transfusion process (77.7%) related to human factors. We have observed a worrying number of adverse reactions and events related to poor communication and poor clinical decisions. Laboratory errors have increased and there are concerns that local investigations and root cause analyses are not being fully completed. The UK Transfusion Laboratory Collaborative survey completed in March 2015 confirmed that many laboratories are under pressure with vacancies (some very longstanding) and increased workloads. Clinical reports also note similar issues. Information technology when properly set up can be a significant safety improvement but some of our incidents demonstrate inadequate validation resulting in dangerous errors.

We are extremely grateful to our working expert group who complete the analysis and writing around their already busy jobs. Tony Davies, who has been an excellent ambassador for SHOT, retired in December 2015 and has been succeeded by Jayne Addison.

This year for the first time we include a chapter with data on donor vigilance provided by the four UK Blood Services. This was compiled by a new working group and demonstrates the full reach of haemovigilance, from donor to recipient.

We hope you find this report useful and are always very pleased to receive comments and feedback.



Paula Bolton-Maggs
Medical Director



Dafydd Thomas
Chair, Steering Group

2 Participation in UK Haemovigilance Reporting

Authors: Debbi Poles and Paula Bolton-Maggs

Reporting organisations 2015

Participation in United Kingdom (UK) haemovigilance reporting remains high, with 100% of National Health Service (NHS) organisations registered to report directly, or indirectly, to SHOT. There were 4 NHS Trusts/Health Boards that made no reports during 2015. These included 2 very low users, 1 low user, and 1 high user (based on the 2014 SHOT benchmarking data usage categories). Both the low and high user organisations that did not report during 2015 had made regular reports each year from 2010–2014.

There were 16 non-NHS organisations that made reports during 2015.

Number of SHOT reports by UK country

Table 2.1:
Total number of reports to SHOT by UK country 2012–2015

	2012		2013		2014		2015	
	Number	%	Number	%	Number	%	Number	%
England	2860*	80.7	2975	83.4	3119	85.0	3431	86.5
Northern Ireland	156	4.4	129	3.6	98	2.7	100	2.5
Scotland	326	9.2	285	8.0	278	7.6	259	6.6
Wales	203	5.7	179	5.0	173	4.7	175	4.4
United Kingdom	3545	100	3568	100	3668	100	3965	100

*Includes reports from Ministry of Defence overseas

Table 2.2:
Total issues of blood components from the Blood Services of the UK in calendar year 2015

	Red cells	Platelets	FFP	SD-FFP	MB-FFP	Cryo	Totals
NHS Blood & Transplant	1,611,984	273,695	200,780	78,569	8,256	39,955	2,213,239
Northern Ireland Blood Transfusion Service	49,244	9,157	4,593	2,320	412	1,135	66,861
Scottish National Blood Transfusion Service	162,088	24,610	17,446	2,420	1,288	2,208	210,060
Welsh Blood Service	70,496	3,211	10,083	2,979	0	347	87,116
Total	1,893,812	310,673	232,902	86,288	9,956	43,645	2,577,276

Paediatric/neonatal MB-FFP are expressed as single units; Cryoprecipitate figures are expressed as pools and single donations as issued; all other components are adult equivalent doses

FFP=fresh frozen plasma; SD=solvent detergent-sterilised; MB=methylene blue-treated; Cryo=cryoprecipitate

SD-FFP data supplied by Octapharma

Table 2.3:
Total number of reports per 10,000 components issued by UK Blood Services 2012–2015

	2012	2013	2014	2015
NHS Blood & Transplant	11.7	12.7	13.7	15.5
Northern Ireland Blood Transfusion Service	21.3	18.7	14.6	15.0
Scottish National Blood Transfusion Service	13.2	11.8	12.4	12.3
Welsh Blood Service	18.4	17.2	18.2	20.1
Total	12.3	12.9	13.8	15.4

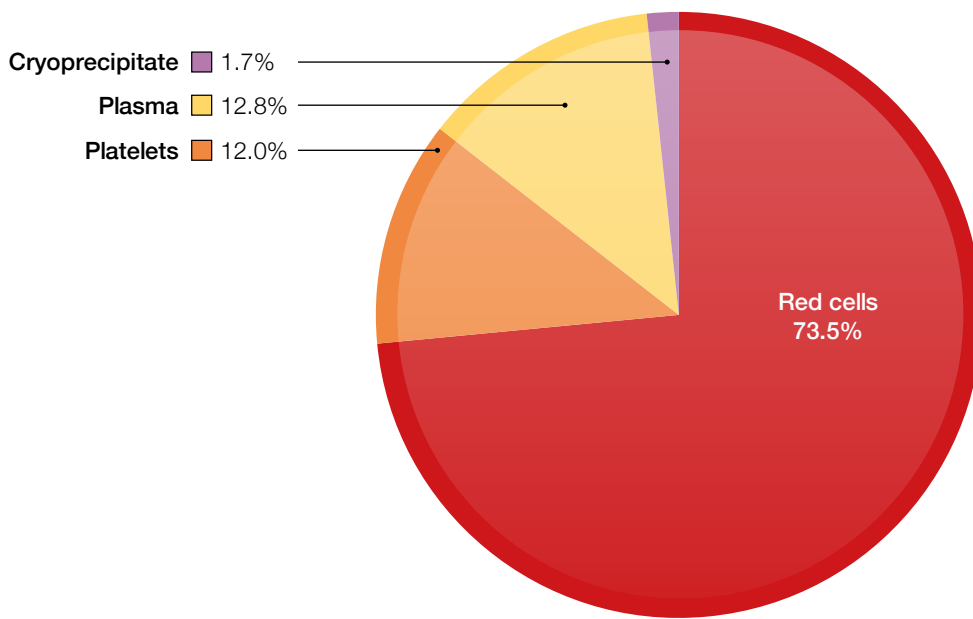


Figure 2.1: Proportions of issues by components UK 2015

Cases included in the 2015 Annual SHOT Report n=3288

The total number of reports analysed and included in the 2015 Annual SHOT Report is 3288. This is a small increase from 3017 reports analysed in the 2014 Annual SHOT Report. The number of reports excluding ‘near miss’ and ‘right blood right patient’ is 1858 (1681 in 2014).

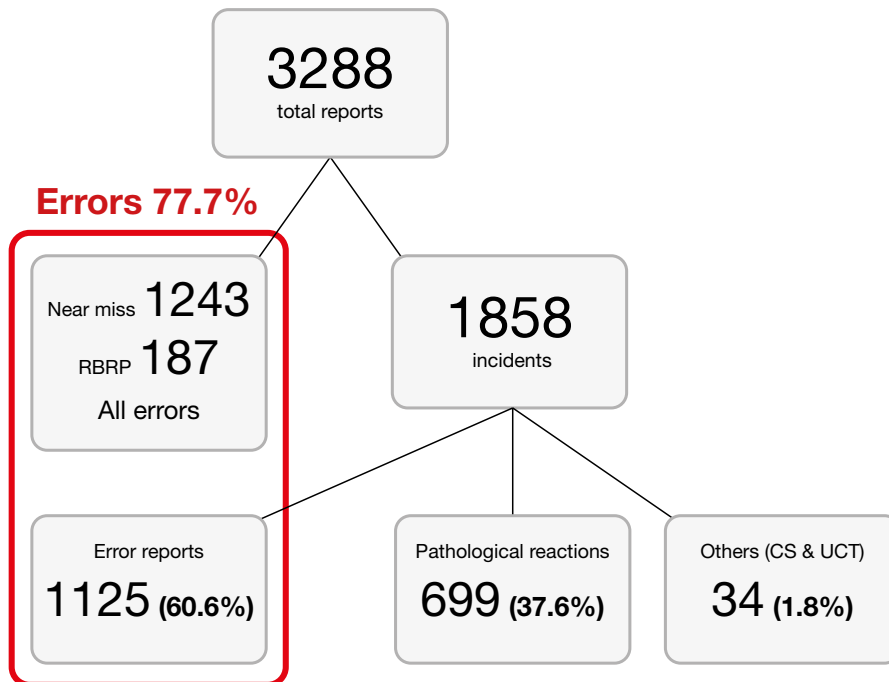
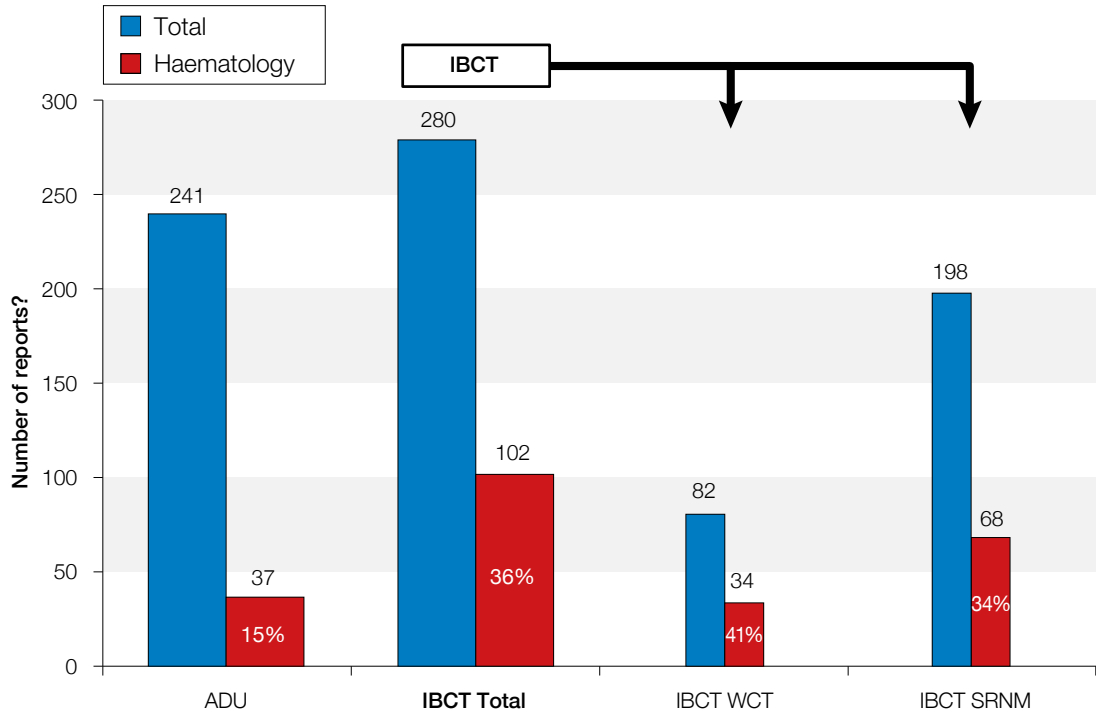


Figure 2.2: Categorisation of reports analysed in 2015

A survey of red cell use in England and North Wales was published in 2014 (NHSBT 2014). This covered 74% of all red cells issued during the two study periods. Transfusion to medical patients accounted for 67%, surgery 27% and obstetrics and gynaecology for 6%. Within medicine, haematology patients accounted for 40.3% and medical anaemia, excluding haematological use for another 40.3%. It is notable that sickle cell disease features in the top ten indications for using red cells within medicine at 4.3% of medical use (counted within haematology).

SHOT data for 2015 show that haematology is the largest single specialty reporting incidents, in keeping with the recognised high transfusion use. The distribution of some of these compared to all incidents is shown in Figure 2.3. Avoidable or delayed transfusions (ADU) are 15% of all, but within incorrect blood component transfused (IBCT) wrong components transfused (WCT) were 41% and instances where specific requirements were not met (SRNM), most commonly failure to transfuse irradiated cellular components and phenotype-selected red cells when indicated, were 34% of all cases of SRNM.

Figure 2.3:
Number of incidents
in haematology
for selected
SHOT categories
compared with all
reports



Reference

NHSBT (2014) **National survey of red cell use**. <http://hospital.blood.co.uk/media/27581/anonymous-nrcs.pdf>
[accessed 30 April 2016]

Headlines: Deaths, Major Morbidity and ABO-Incompatible Transfusions

3

Author: Paula Bolton-Maggs

Key SHOT messages

The four most serious adverse reactions:

- **Haemolysis** contributed to death in 5 cases, including one caused by anti-Wr^a, one ABO-incompatible transfusion, and an infant died related to exchange transfusion for D-related haemolytic disease of the fetus and newborn
- **Transfusion-associated circulatory overload** contributed to death in 7 cases, and major morbidity in 34
- **Delayed transfusion** contributed to death in 6 cases and major morbidity in 5
- **Acute transfusion reactions** were associated with severe reactions (major morbidity) in 86 patients

Deaths related to transfusion reported in 2015 n=26

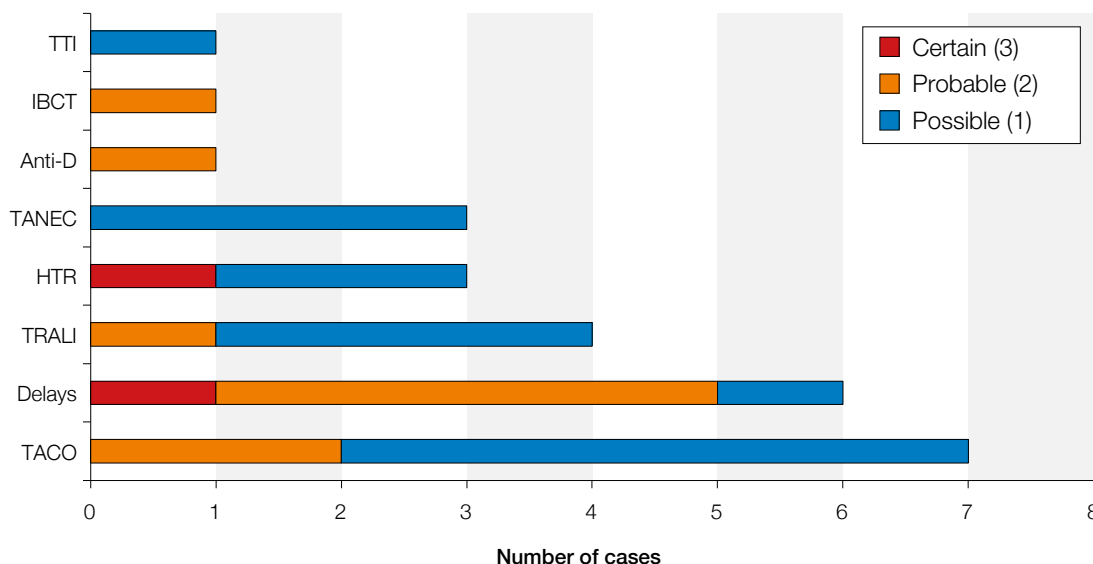
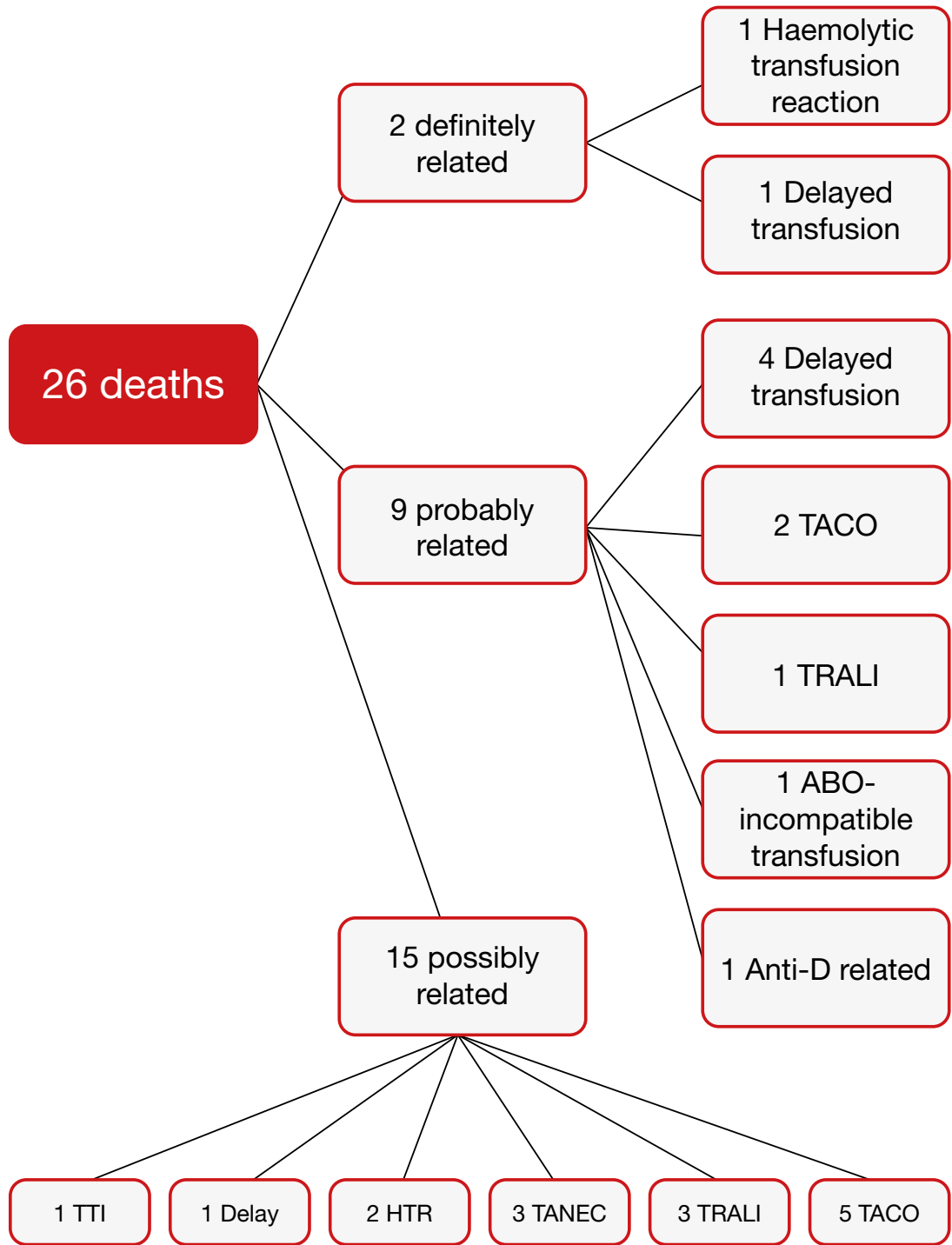


Figure 3.1: All deaths (imputability 1-3) by category

TTI: transfusion-transmitted infection; IBCT: incorrect blood component transfused (ABO-incompatible transfusion); Anti-D: anti-D immunoglobulin error; TANEC: transfusion-associated necrotising enterocolitis; HTR: haemolytic transfusion reaction; TRALI: transfusion-related acute lung injury; TACO: transfusion-associated circulatory overload

Figure 3.2:
Transfusion-related deaths reported in 2015 by imputability



Imputabilities: definite=3; probable=2; possible=1

Review of transfusion-related deaths, imputability 1-3, for 6 years 2010 to 2015 shows that pulmonary complications and delayed transfusion are the most prevalent causes, Figure 3.3.

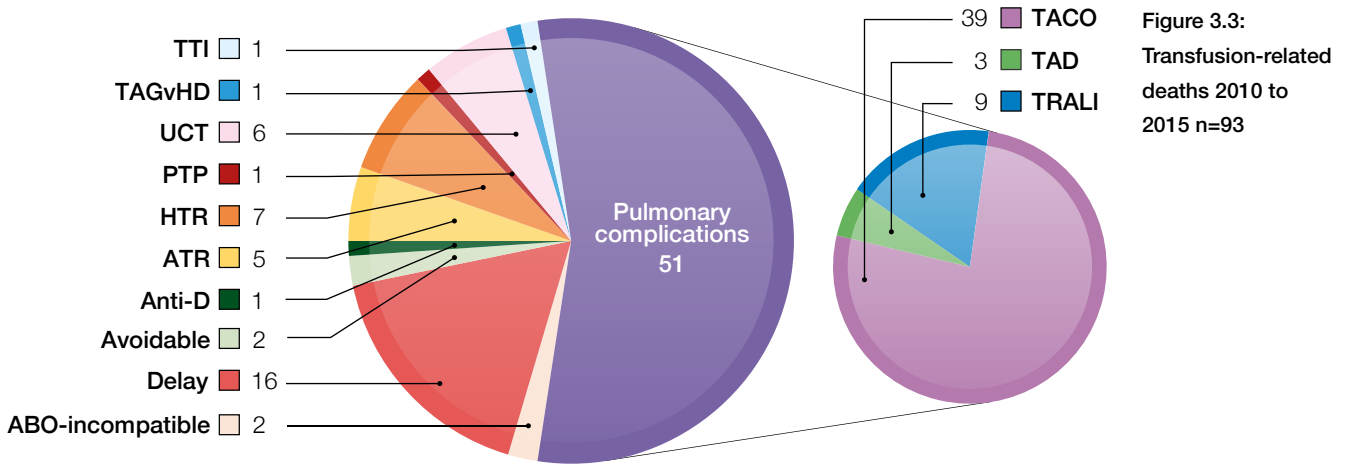


Figure 3.3: Transfusion-related deaths 2010 to 2015 n=93

For key to abbreviations please see Figure 3.5

Headline: Laboratory errors have increased from 334 in 2014 to 455 in 2015

It should be noted that the number is disproportionately increased by 12 reports affecting multiple patients (n=88), receiving components that had been out of temperature control.

A United Kingdom Transfusion Laboratory Collaborative (UKTLC) survey in March 2015 in partnership with the National Blood Transfusion Committee provided evidence of several issues including reorganisations in 100/178 (56.2%) laboratories, inability to fill vacancies, reduced resources both financial and in personnel for training and 35.7% of the workforce aged 50 years or more (UKTLC Bark et al. 2015) whose serological expertise will be lost on retirement.

Summary of main findings and cumulative results

Errors account for 78% of all reports and some of these contributed to patient deaths.

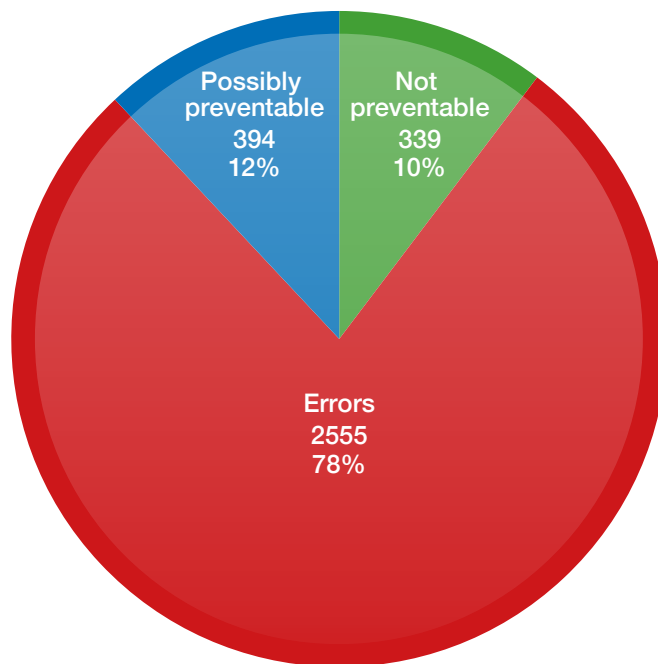


Figure 3.4: Errors account for the majority of reports

Figure 3.5:
Summary data for
2015, all categories
n=3288 (including
near miss n=1243
and right blood
right patient n=187)

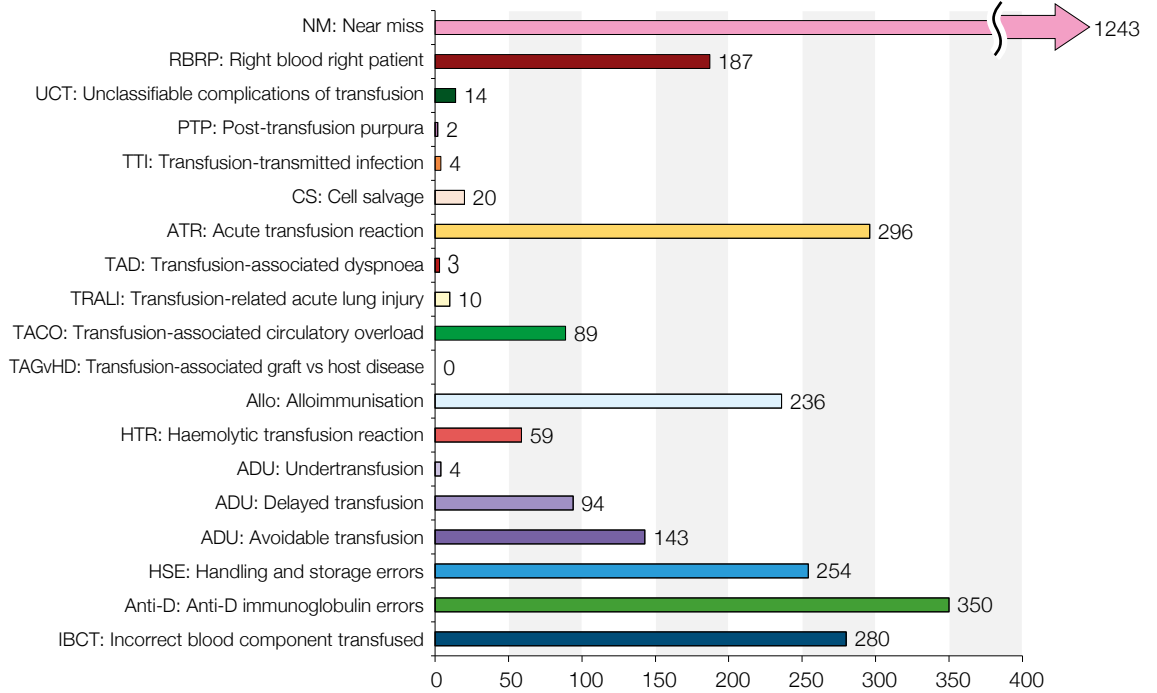
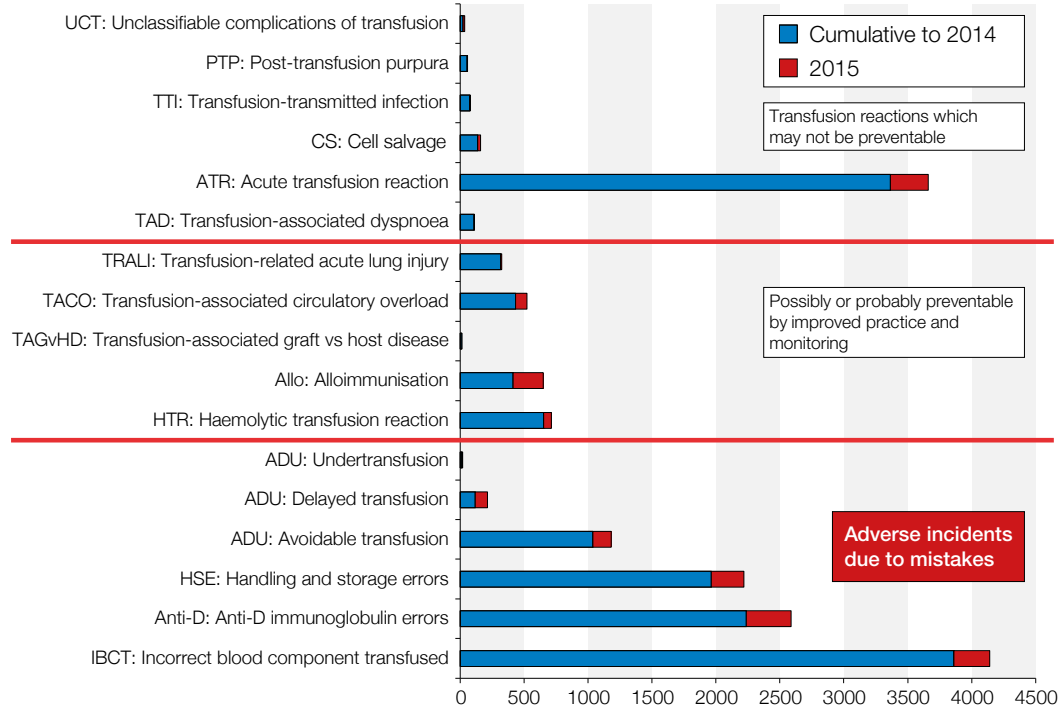


Figure 3.6:
Cumulative data for
SHOT categories
1996 to 2015
n=16677



Major morbidity (serious harm) reported in 2015 n=166

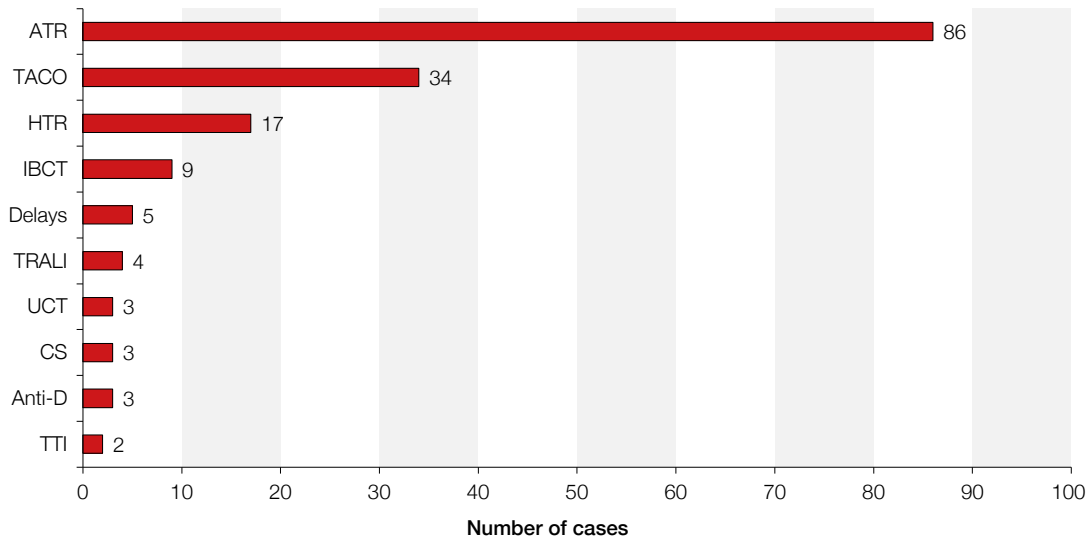


Figure 3.7:
Ranking of
categories to show
number of serious
incidents in 2015

ABO-incompatible red cell transfusions n=7

These are 'never events' in England; in Scotland these would be reported as 'red incidents' through the Scottish National Blood Transfusion Service clinical governance system and/or those of the Health Board. ABO-incompatible red cell transfusions were associated with one death and one serious reaction in a patient with sickle cell disease. Further details can be found in Chapter 6, Incorrect Blood Components Transfused (IBCT).

There were also **6 ABO-incompatible red cell transfusions administered to patients who had undergone allogeneic haemopoietic stem cell transplants** (discussed in Chapter 23, Summary of Incidents Related to Transplant Cases).

Although these are small numbers, near miss reporting shows that 288 additional patients were put at risk since the blood sample was either taken from the wrong patient (wrong blood in tube), or the wrong unit was collected but these errors were detected before an ABO-incompatible transfusion took place.

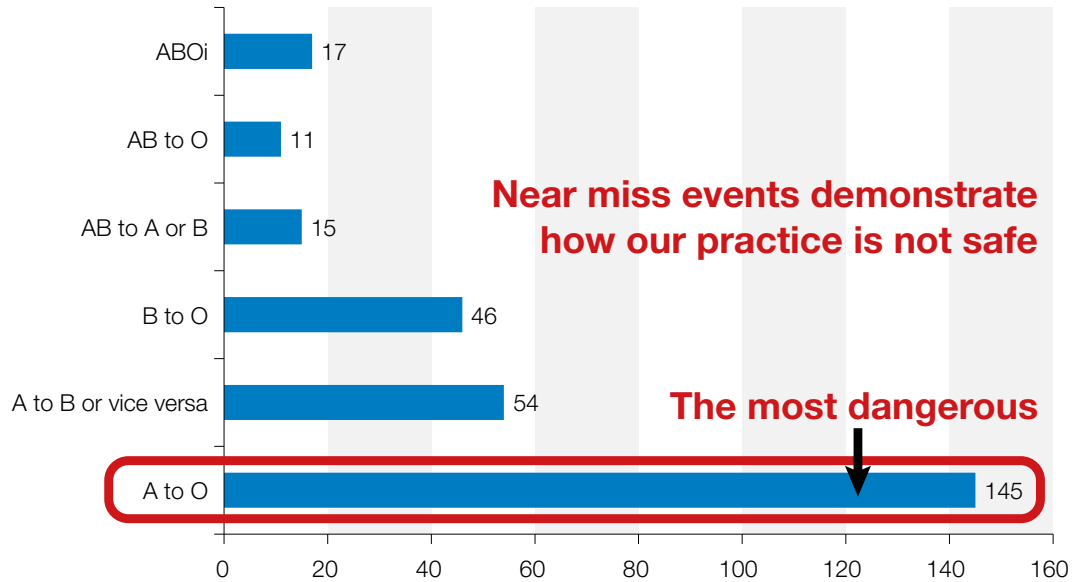
Such errors are serious whether or not they result in a clinically important outcome, for example 'if catnapping while administering anaesthesia is negligent and wrongful, it is so whether harm results or not' (quoted in Dekker 2012). The possible outcome for these near miss incidents where the blood groups would have been incompatible are shown in Figure 3.8.

Figure 3.8:
Possible impact
if 288 near miss
events (detected)
had led to red cell
transfusions

Near miss incidents: potential outcomes
Total 288 possible ABO-incompatible transfusions

Cumulative SHOT data show that about 33.3% of ABO-incompatible red cell transfusions cause death or serious harm

So a third, 96/288, of patients potentially harmed



(ABOi=report stated the blood groups would be ABO-incompatible but did not specify.
A to O=donor unit group A to recipient of group O etc.)

Total number of errors n=2555

Errors with no harm to patients n=1430 (near miss, and right blood to right patient reports).

Other errors with actual or potential harm n=1125 (handling and storage errors, avoidable and delayed transfusions, anti-D immunoglobulin errors and incorrect blood components transfused).

Irradiation of cellular components was missed in 101 cases, and in 88/101 (87.1%) the clinical areas were responsible. The cumulative number of reports of missed irradiation since 1999 is now 1215.

Risks of transfusion UK 2015

Total major morbidity	6.44
Total mortality	1.01

Table 3.1:
Risks 2015
per 100,000*
components issued
2015

	Mortality	Major morbidity	Total cases
All errors	0.31	0.66	436.5
ATR	0.0	3.34	114.8
HTR	0.12	0.66	22.9
TRALI	0.116	0.16	3.9
TACO	0.27	1.2	34.5
TAD	0.0	0.0	1.2
TAGvHD	0.0	0.0	0.0
PTP	0.0	0.0	0.8
CS	0.0	1.2	7.8
TTI	0.04	0.08	1.6
UCT	0.12	0.12	5.4
Paediatric cases	0.23	0.85	62.5

*Note this is a change from per million components issued used in previous years

This equates to a risk of serious harm of 1 in 15,528 components issued and an overall risk of death where transfusion was contributory is 1 in 99,010 components issued, but the risk of death from an error is 1 in 322,581.

Haemovigilance data from the European Union for 2013 demonstrate 9.8 serious adverse reactions per 100,000 units transfused based on data from 22 countries, and there were 22 deaths (imputability 2 and 3), 11 (50.0%) from pulmonary complications (6 TACO and 5 TRALI) (European Commission 2014). The report notes that about 55% of all serious adverse events are a result of human error.

A recent report from the International Surveillance of Transfusion-Associated Reactions and Events database (ISTARE) notes 409 transfusion-related deaths (imputabilities 1-3) reported from 28 countries 2006 to 2013, an estimated rate of 0.3 per 100,000 issues (Politis 2016). Note that ISTARE does not incorporate all the categories which are included in SHOT, e.g. delayed transfusions.

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4 Key Messages and Recommendations

Authors: Paula Bolton-Maggs and Dafydd Thomas

ICE: identification, communication, education

Key SHOT messages

- There is no substitute for **correct patient identification** at all stages in the transfusion process
- The severity of the outcome is not the determinant of the seriousness of the error. Near miss reporting demonstrated 889 errors which could have resulted in incorrect blood component transfusions, of which 288 were known to be potentially ABO-incompatible
- **Delay** in appropriate transfusion contributes to death in sick patients
- **Risk assessment** before transfusion. Transfusion-associated circulatory overload (TACO) is the most common cause of death and of major morbidity and may be preventable. Patients should be properly assessed prior to transfusion to identify those at particular risk and to ensure the transfusion is required
- **Information technology (IT) systems** depend on correct set up and validation to ensure they are fit for purpose and contribute to patient safety rather than impede it
- **Errors in the administration of anti-D immunoglobulin** remain disappointingly high; clear local guidelines and thorough training of all staff involved is essential
- **Checking means checking** with no short cuts
- **Laboratory error reports** to SHOT have increased and human error accounts for 96.7% of serious adverse events reported to the Medicines and Healthcare Products Regulatory Agency

In 2015 SHOT staff reviewed all recommendations made since the beginning of SHOT reporting. Many of these have been actioned and SHOT data have also contributed to 14 different British Committee for Standards in Haematology (BCSH) guidelines. In particular, changes to Blood Service practices were followed by a reduction in transfusion-related acute lung injury and bacterial infections from blood components. Some recommendations have been repeated many times; this is because they are still necessary, particularly the need for correct patient identification at the time of blood sampling and at transfusion. This was identified in the first Annual SHOT Report and triggered transfusion training and competency assessments, and the widespread appointment of transfusion practitioners. However, this is still a source of dangerous error and fatal outcome. Good patient blood management means full individual assessment for every transfusion to ensure it is really indicated. Transfusion may contribute adversely to immune and inflammatory activity (and be associated with transfusion-associated pulmonary complications) and tip the balance in patients of all ages, but particularly the elderly and frail, into circulatory overload.

We recommend the use of a checklist for the critical point in transfusion, the final bedside check. In addition to their successful use in the airline industry, a simulation-based trial of surgical checklists (17 teams, 106 scenarios) demonstrated a reduction of steps missed from 23% without checklists to 6% when available (Arriaga et al. 2013).

Key recommendations

Be WARM – work accurately and reduce mistakes

- A formal pre-transfusion risk assessment for transfusion-associated circulatory overload (TACO) should be performed whenever possible as TACO is the most commonly reported cause of death and major morbidity. An example is given in Chapter 13, Pulmonary Complications (Figure 13b.5)
- Use a 5-point practice improvement tool (checklist) at the patient's side immediately prior to connection of the transfusion. Never do this away from the patient. Two examples are illustrated below. Practice should be audited prior to introduction and regularly afterwards to demonstrate improved and safer practice

Action: Trust/Health Board Chief Executive Officers and Medical Directors responsible for all clinical staff

Additional new topic-related recommendations can be found in the following chapters: Chapter 11, Acute Transfusion Reactions (ATR) (n=1), Chapter 16, Paediatric Summary (n=2), and Chapter 26, Cell Salvage (CS) (n=5).

SHOT
SERIOUS HAZARDS OF TRANSFUSION

Human factors in hospital practice
Be safe! Use the bedside checklist

- ✓ Positive patient identification
- ask the patient to state name and date of birth
- ✓ Check identification of component against patient wristband
- ✓ Check the prescription
- has this component been prescribed?
- ✓ Check the prescription
- is this the correct component?
- ✓ Check for specific requirements
- does the patient need irradiated components or specially selected units?

Figure 4.1:
Modified 5-point
checklist
recommended by
SHOT in the Annual
Report for 2013

NHS
Blood and Transplant

Blood Transfusion Bedside Checklist

Before each unit of blood is transfused, ensure you:

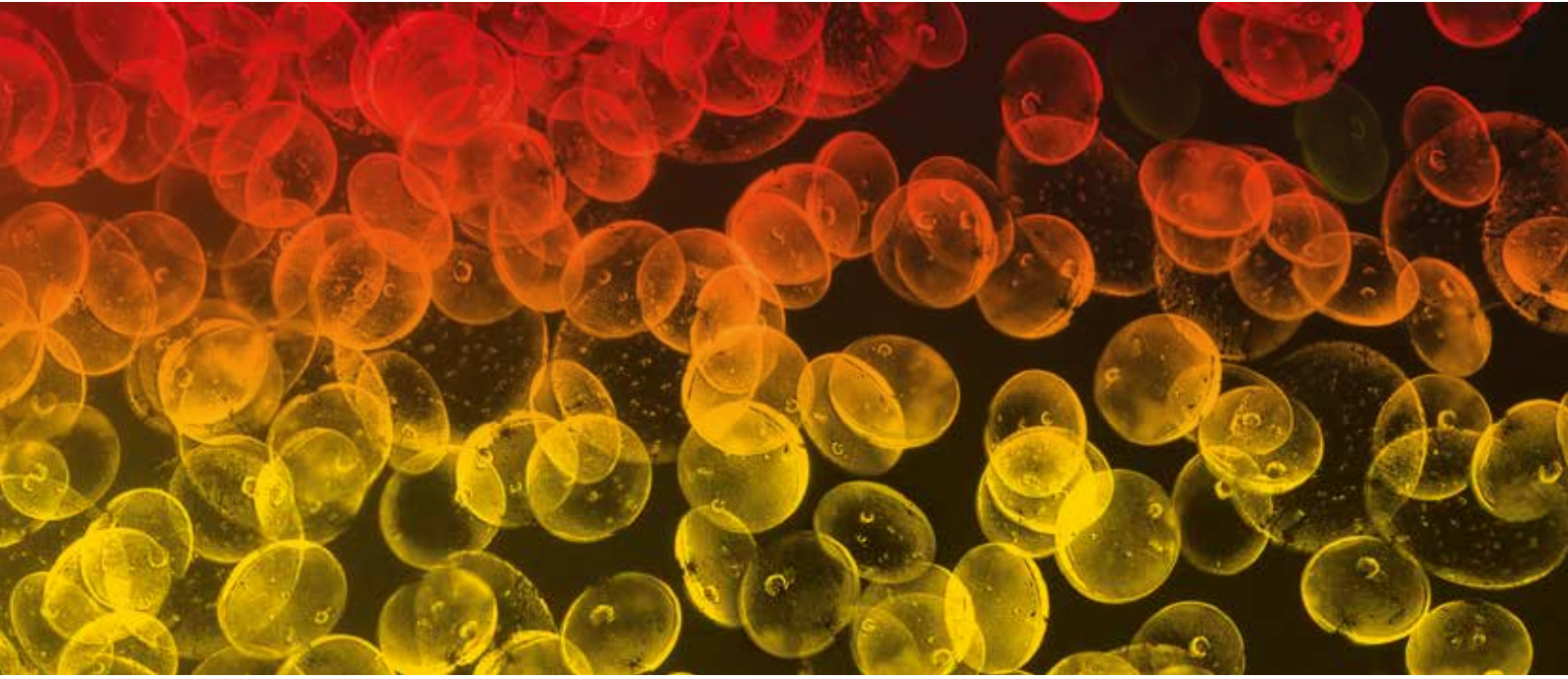
- 1) Check for blood component integrity
– No clots, leaks, damage, discolouration or expiry
- 2) Check informed consent is documented
– Reason & risk/benefits explained? Alternatives? Information given?
- 3) Confirm Positive Patient Identification (PPID)
– Ask your patient to tell you their full name and DOB
- 4) Check unit tag against unit label, prescription, patient ID band and PPID
– Are there any specific transfusion requirements?
- 5) Perform Observations
– Baseline, after 15 minutes, end of transfusion & as per local policy

Now you may set-up your safe transfusion

Figure 4.2:
Bedside checklist
piloted in London
and available
throughout England

Reference

Arriaga A, Bader A et al. (2013) **Simulation-based trial of surgical-crisis checklists**. *New Engl J Med* 368, 246-253





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ERROR REPORTS: Human Factors

Authors: Paula Bolton-Maggs and Alison Watt

In the Annual SHOT Report for events in 2014 we drew attention to the role of 'human factors' in medical errors. Again in 2015, 77.7% of all reported incidents resulted from errors, often multiple, and similar data emerge in the reports to the Medicines Healthcare Products Regulatory Agency (MHRA), where 96.7% of serious adverse events were attributable to error.

There is increased recognition of the importance of speaking up when things go wrong (Dalton and Williams 2014; Francis 2016). The recommendations from these reports and the establishment of an independent patient safety investigation service with a healthcare safety investigation branch (HSIB) expert advisory group will contribute to a better reporting culture and improved patient safety (Public Administration Select Committee 2015). Recently Health Education England (HEE) published its report on education and training for patient safety (HEE 2016). Twelve recommendations are made, the first of which is to 'ensure learning from patient safety data and good practice'. This emphasises the importance of participation in reporting to confidential enquiries such as SHOT. Recommendation 5, 'supporting the duty of candour.', notes the importance of a 'culture of openness and transparency'. Recommendation 11 notes that 'principles of human factors and professionalism must be embedded across education and training'. The findings of the 2015 NHS Staff Survey reported that 25% of staff reported witnessing an error or incident that could have harmed patients or service users but many did not feel their organisation treated staff involved in such incidents fairly, only 23% felt action was taken to stop this happening again, and only 19% reported adequate feedback (NHS Staff Survey 2015).

SHOT-reported incidents were probably among the 49,000 incidents of moderate harm and 4,500 of severe harm reported to the NHS in 2013/14. Half of patient safety incidents are thought to be avoidable, and SHOT data show that for transfusion more than three quarters of incidents result from errors. Is reporting complete? Almost certainly not and overall may be as low as 5% (Yu et al. 2016, Shojania 2008). Multiple errors contribute to many events, as we have recorded with incidents of incorrect blood component transfused over the past 3 years. The case below illustrates several points but it is notable that it was not reported to SHOT as a transfusion-related death. Indeed there may be a reluctance to report the most serious events, but it is recognised that it is essential to do so in order to learn.

Case 1: Failure to recognise a complication of pregnancy, with poor communication and followed by neonatal death

A baby was born with unexpected jaundice and haemolytic disease of the fetus and newborn (HDFN) due to anti-D antibodies which had not been anticipated. The baby required urgent red cell exchange transfusion during which a cardiac arrest occurred, and the baby subsequently died.

This was the second pregnancy in a D-negative woman. There were multiple errors in the first pregnancy. Anti-D antibody was detected prior to the administration of routine anti-D immunoglobulin (Ig) but was misinterpreted on two separate occasions and not followed up. The first baby was born with HDFN requiring exchange transfusion, but there was then 'no mechanism for ensuring that information was fed into future pregnancies'.

At booking for the second pregnancy the history of jaundice and transfusion at birth for the first baby was noted but this was not identified as indicating a risk for the current pregnancy. The laboratory then misinterpreted the presence of anti-D in the booking bloods at 10 weeks as being due to prophylactic anti-D Ig administration but the midwife did not pick up this error. The woman

was reviewed by an obstetric registrar at 20 weeks who noted that the first baby had required phototherapy for jaundice but missed the history of exchange transfusion. Anti-D was again detected in blood samples at 28 weeks and was again wrongly assumed to be due to anti-D Ig administration (which had not been given) 18 weeks before.

Five hours after birth (39 weeks' gestation) the baby was jaundiced (group O D-positive) and required exchange transfusion. The baby suffered complications and subsequently died (January 2015). The hospital review of this case was signed off by the hospital in June 2015. The post-mortem report had not been available so the review was unable to determine the cause of death.

Comment: There were at least 10 different errors and missed opportunities across two pregnancies. The incident review noted task factors, individual staff and several communication factors (wrong assumptions, failure to pass on messages, shift changes, misinterpretations). It concludes 'the lack of a robust system led to the mother and baby not being managed appropriately'.

This case demonstrates how 'patient safety incidents...are mostly a result of a complex interaction of human factors and system or organisational problems' (HEE 2016). Similar features are present in the following cases:

- Case 2 below
- Case 7.1 in Chapter 7, Avoidable, Delayed or Undertransfusion (ADU), delayed transfusion resulting in death
- Case 6.1 in Chapter 6, Incorrect Blood Component Transfused (IBCT), an ABO-incompatible transfusion to a patient with sickle cell disease due to a combination of biomedical scientist error, a computer system that had not been set up properly and compounded by poor clinical care
- Case 16.1 in Chapter 16, Paediatric Summary, describes severe deterioration (with survival) after neonatal exchange transfusion (for severe HDFN) performed using an incorrect component

Dismissing staff or taking cases through the adversarial legal system are unlikely to foster confidence and a good reporting culture (Dekker 2012). Dekker notes that 'a nurse was criminally convicted for a medication error of a kind that was reported to the regulator more than 300 times in that year alone'. Note also that '...a lack of transparency around mistakes and a culture of victimisation undermine patient and staff wellbeing. Eradicating the current blame culture is key to improving transparency' (HEE 2016). Despite this and the need for transparency and our duty of candour over untoward incidents, Vaughan notes an increasing trend for criminal investigation into 'potentially avoidable patient deaths' with 10 instances of health professionals facing criminal charges over a 12 month period (December 2014 to December 2015); two were convicted of manslaughter by gross negligence, one acquitted and the others not yet concluded (Vaughan 2016).

Human factors is defined simply as 'anything that affects an individual's performance' (HEE 2016) and includes the working environment, layout, staffing, team working and many other aspects including the individual's sense of value in the work being undertaken. Human error can be seen as a symptom rather than a cause. This approach is the opposite of the tendency to amplify the individual's role while shrinking the role of other contributors and context (although this does not exclude individual accountability). Health service staff are under increasing pressure exacerbated by understaffing and low morale (e.g. 2 in 5 consultant physician posts not filled in 2015, gaps in trainee rotas (Dacre 2016) and a third of general practitioner training posts unfilled; there is also evidence from the United Kingdom Transfusion Laboratory Collaborative (UKTLC) survey of transfusion laboratory staff 2015). Under these circumstances errors are more likely and those who make mistakes need support and the confidence to share what happened and to learn from it. Much can be learned from 'patient stories' and the case vignettes in the Annual SHOT Reports are a much valued source of educational material. A recent publication looks forward to consider how patient safety can be improved in future (Yu et al. 2016) at a time when overall patients are older with more complex needs and an increasing number of comorbidities. This report summarises a safety strategy which has four pillars:

1. A systems approach

2. Improving the culture ('Culture counts') through 'an inspiring vision and positive reinforcement, not through blame and punishment'
3. Patients as true partners
4. Bias towards action

The following chapters of this 2015 Annual SHOT Report (5 to 10) are all concerned with errors in transfusion practice, some resulting in death of the patient or serious harm. The working environment plays an important part in transfusion safety. Staff take short cuts and do not follow the safe procedures. This was evidenced by the case described below (Case 6.3 in Chapter 6, an ABO-incompatible transfusion).

Case 2: Error made in a stressed environment results in staff blame

A patient had been 'identified' by two registered nurses against the transfusion chart at the nurses' station. The registered nurse on the night shift offered to start the transfusion because the ward was very busy and other patients were requiring attention. She was interrupted and distracted on her way to the patient.

The final bedside check was not done so the wrong patient was transfused with part of an ABO-incompatible red cell unit (1.5mL). A nurse practitioner quickly realised blood was being given to the wrong patient and stopped the transfusion. The patient recovered.

Comment: Additional information from the staff statements gives a better picture of the circumstances that led to the error:

- A senior nurse was working with two newly qualified nurses and two healthcare assistants on a shift from 07:00 to 19:30. The staff statement noted that the correct staffing levels were in place
- The ward had 15 patients, a number of them with high dependency, and 8 were confused
- Nursing staff lacked confidence in a locum doctor, who had to be shown how to complete the form to request blood
- Blood samples were taken at approximately 12:30, but by 16:00 it was discovered the patient needed a second sample before crossmatching, so the blood for transfusion was not ready until 18:00
- When the blood was ready, collection was delayed as a bariatric patient was admitted to the ward requiring 6 staff for transfer
- The blood for transfusion was delivered at approximately 18:45, although staff were aware of the policy that transfusion should not be given overnight
- A night shift nurse arrived 15 minutes early and started her shift, because she had worked the previous night and knew the ward was busy with confused patients. She offered to help with the transfusion as day staff needed to do the shift handover
- When the transfusion was about to be started the telephone rang and was answered by one of the day nurses involved in checking the blood. She began talking about a different patient in 'bed three'
- While walking to the patient to begin the transfusion one of the nurses who had checked the component was needed to help an unsteady patient to the toilet and back to bed
- The night nurse incorrectly went to set up the transfusion on the patient in bed three (the wrong patient) and did not start patient identification checks, as she knew the patient from previous shifts
- The patient in bed two became agitated which distracted the night nurse from completing the wristband check on the patient in bed three, who then received an incorrect transfusion

The outcome of the review was to apportion blame solely to the staff involved and to require them to attend retraining and further education. That may improve the practice of those individuals, but it does nothing to change the environmental aspects associated with this case which were:

- An institutional acceptance of poor levels and mix of staff for the number of high dependency patients, e.g. newly qualified nursing staff, a locum doctor and the night nurse starting early

- A shift pattern of over 12 hours, so some staff involved were in their 12th hour of working when the incident happened
- Lack of communication between the laboratory and the ward about the need for a second sample, which led to delays and contributed to the transfusion being scheduled at an inconvenient time
- An acceptance by more than one member of staff that it was appropriate to amend standard procedures, e.g. two staff doing the 'bedside check' away from the patient, all staff prepared to transfuse overnight against their policy
- Multi-tasking and being distracted when involved in a critical task, e.g. answering the phone, dealing with agitated or dependent patients
- Insufficient time and resource to do a shift handover

Procedures may be in place but not followed when there are staff changes as evidenced in Case 3 below where several transplant patients were put at risk of wrong transfusions.

Case 3: Systems failures in a transplant centre

A patient was incidentally noted at a laboratory meeting to have had an allogeneic haemopoietic stem cell transplant (HSCT) ten days earlier but no information had been supplied to the laboratory about the change in ABO group or specific requirements (irradiation of cellular components). A second case was identified a week later. As a result, the transfusion laboratory manager undertook a retrospective review (8 month period) and found 17 HSCT had taken place that were not known to the laboratory of which 6/17 were allografts. Four had received incorrect blood components selected by electronic issue which should have been serologically crossmatched. One patient received incompatible red cells. Fortunately no patients were harmed.

The root cause analysis noted 'complete breakdown in the previously robust system for notifying the transfusion laboratory of prospective transplant patients'. The co-ordinating team consists of a clinical nurse specialist, an administrator and a middle-grade doctor. During this period the transplant unit had been relocated and there had been 5 temporary administrators and 4 different doctors. Several different errors were identified including admission checklists not completed, filing of transplant documentation not done and the medical and nursing staff were not sufficiently competent to identify the specific requirements for transplant patients. The investigation resulted in immediate changes in practice (total 17 actions) including a new standard operating procedure for notifying the transfusion laboratory and increased staffing for the transplant unit.

Errors categorised as near miss are no less serious than those that cause actual harm. Two examples are given below.

Case 4: Distraction leads to error

A sample was taken from Patient 1 while inserting a cannula, so the midwife handed the syringe to another member of staff to decant into a tube and label. The second midwife took a telephone call about Patient 2 at the same time, which resulted in the sample from Patient 1 being labelled with Patient 2 details, because the midwife had been distracted by the interruption.

This was discovered because of a grouping discrepancy, but could have led to a transfusion of group A red cells to a group O patient.

Case 5: Sample taken from incorrect patient after satellite navigation (satnav) system error

A community healthcare assistant (HCA) working out of a general practice was supposed to take a group and crossmatch sample from Patient A. The patient's address was entered into the satnav system but the directions led to Patient B's address which was very similar to Patient A's address. The HCA greeted Patient B using Patient A's name outside the house and the patient beckoned her to come inside. The HCA did not perform correct positive patient identification, so did not check the patient's name or date of birth before taking the blood or labelling the bottles. The general practitioner (GP) noticed the patient's haemoglobin was too high for the expected patient and contacted Patient A who said they had not had a sample taken.



Why don't people learn from mistakes?

The world is seen as a simple place

Humans have a tendency to construct stories around facts, which serves a purpose in making sense of the world that might otherwise be seen as too complicated. The natural instinct is to make patterns in order that the world is seen as a simple place, so a narrative is often constructed to explain the facts. Humans are hard-wired to try and turn chaos into order, so they can feel in control of their world. However, this can be termed 'narrative fallacy' (Taleb, 2007) because these rationalisations come after the effect and are not based on empirical data. Scientists are always warned to avoid hindsight bias, but humans have an innate tendency to such bias with the use of the narrative fallacy. By creating a story, the individual may feel comforted and safer, but they are not learning from the event.

Narrative fallacy means that against all logic, individuals often do not learn from adverse events. Instead of seeing the error as a learning opportunity, the event is rationalised in a more comforting way and the bias of the narrative fallacy means they convince themselves of a less personally threatening story or narrative, including blaming others or over-emphasising the rarity of the danger. Errors are more likely to continue if there is greater belief in the stories instead of a dispassionate examination of the facts and data.

Case 6: Three narrative fallacies add to confusion when grouping a patient after an allogeneic haemopoietic stem cell transplant (HSCT)

Narrative fallacy 1: The patient was a known original group O, but the transfusion sample gave a mixed field (MF) result with the anti-A antisera several times on the same analyser suggesting the presence of group A red cells. Further testing on a second analyser gave the same MF result, but there appeared to be fibrin on the top of the reaction well, so the sample was manipulated to remove any fibrin and re-centrifuged. It then gave a negative result with anti-A. The staff concluded (narrative fallacy) that fibrin had been responsible for the MF results, and were satisfied with the clear group O. The result from this analyser agreed with the patient's historical group, so the group O result was authorised. The patient was transfused group O red cells, which was correct, and group O platelets, which is incorrect for a group O patient receiving a group A HSCT, but that was unknown at this point.

Narrative fallacy 2: When it was later established that this patient was post-transplant, the analyser manufacturer was asked to explain the discrepancy of a MF group A in instrument 1, but an eventual straightforward group O using instrument 2. The manufacturer introduced another narrative fallacy by concluding that repeat centrifugation of the sample might have concentrated pure donor cells lower in the tube. That might be expected in many cases, because transfused donor cells would usually be older and heavier than patient cells. That could cause the O grouping result if the sampling tip adjustment of instrument 2 was lower than instrument 1 thus sampling cells at a different level. This is the most common explanation for failure to find expected post-transfusion MF groups on

analysers, but this narrative does not fit the facts. It is now known that when those disparate groups occurred the 'donor' cells would have been from the engrafting group A HSCT and were not group O blood donation cells, because the group O cells were the patient's original group.

Narrative fallacy 3: Three days after the first incident a fresh sample was received, but the laboratory staff were still unaware of the patient's HSCT. A MF result occurred again with the anti-A antisera, but this time the expected explanation by the person doing the grouping procedure, i.e. the narrative fallacy, was that the MF result would be due to the group O red cells known to have been transfused over the weekend. Therefore, the result was modified to a 3+ positive, giving a group A result. However, authorisation failed, because the patient was historically group O, but the amended result was a group A. Another repeat sample also grouped as A with a MF result. The laboratory staff eventually discovered that the patient had received an ABO-incompatible HSCT at another Trust, which had not been communicated to them. This was the true reason for the MF result, as the transplant was engrafting, so donor origin group A cells were mixed with the patient's own group O cells. The narrative fallacy on this occasion could have led to a patient being mis-grouped as A, transfused with O cells, instead of being a post-transplant group O patient in the process of engrafting to become group A.

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5 Laboratory Errors n=455 and MHRA Serious Adverse Events n=765

Authors: Peter Baker, Joanne Bark, Hema Mistry and Chris Robbie

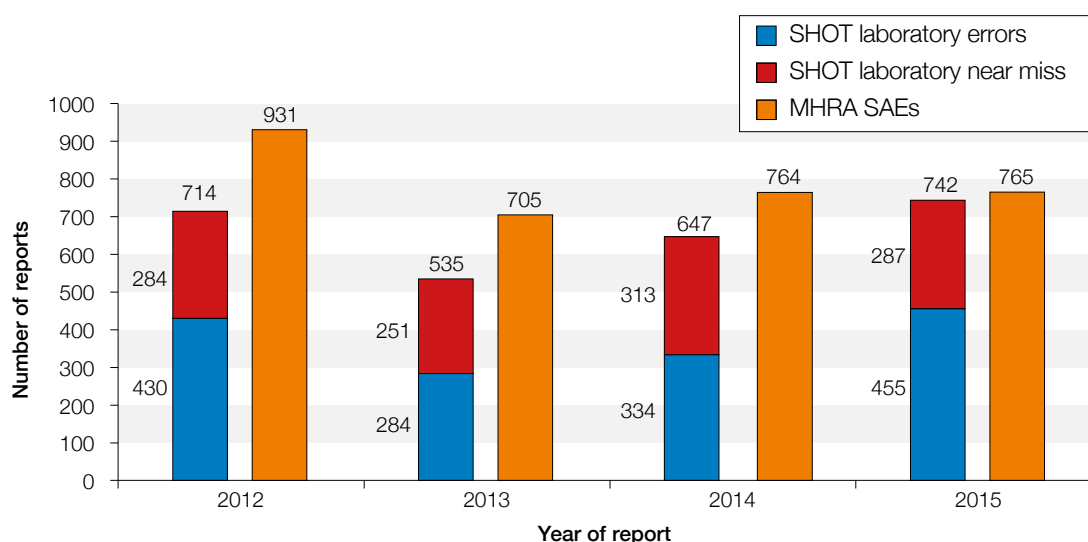
Introduction

This year the SHOT laboratory chapter has been written in conjunction with the Medicines and Healthcare Products Regulatory Agency (MHRA). The chapter highlights laboratory errors reported to SHOT and the serious adverse event (SAE) that have been reported to the MHRA as required by the Blood Safety and Quality Regulations (BSQR) (2005) (as amended). This joint chapter gives a unique opportunity for the data to be analysed independently by SHOT experts and the MHRA, but to provide a joint conclusion.

When comparing Serious Adverse Blood Reactions and Events (SABRE) and SHOT numbers there are significant, recognised differences. These differences include, but are not limited to:

- MHRA data are based on reports made strictly under the BSQR
- The same report to each organisation may be completed in a different calendar year
- MHRA data do not include errors in clinical practice and administration of blood e.g. wrong blood in tube (WBIT), inappropriate transfusions and errors in anti-D immunoglobulin (Ig) issue and administration
- SHOT does not include laboratory error cases where the component does not leave the laboratory e.g. expired components left in the refrigerator
- MHRA data do not include the issue data or reactions to blood products which are classified as medicines rather than blood components such as Octaplas® (solvent-detergent fresh frozen plasma (SD-FFP)) and immunoglobulins (both anti-D immunoglobulin and intravenous immunoglobulin)

Figure 5.1:
A comparison
of reports over
a 4 year period
2012–2015



The BSQR require that SAEs and serious adverse reactions (SAR) related to blood and blood components are reported by Blood Establishments and hospital blood banks to the MHRA, the UK Competent Authority (CA) for blood safety. This requirement is enabled by the SABRE reporting system. In 2015 60/765 SAE reports were made from Blood Establishments.

SHOT laboratory errors

The total number of laboratory incidents reported to SHOT in 2015 (n=455) has increased from 2014 (n=334) Figure 5.2, particularly component labelling, availability and in handling and storage. Errors in equipment e.g. refrigerator failures resulted in several patients receiving units that had been out of temperature control, many related to failure to notice alarms at satellite refrigerators, or inappropriate use. Miscellaneous cases have also increased. These included cases of inappropriate administration of anti-D immunoglobulin (Ig). Staff shortages are a recurring theme in several of these miscellaneous reports (see the increasing number of cases of delayed transfusion, Chapter 7, Avoidable, Delayed or Undertransfusion (ADU)).

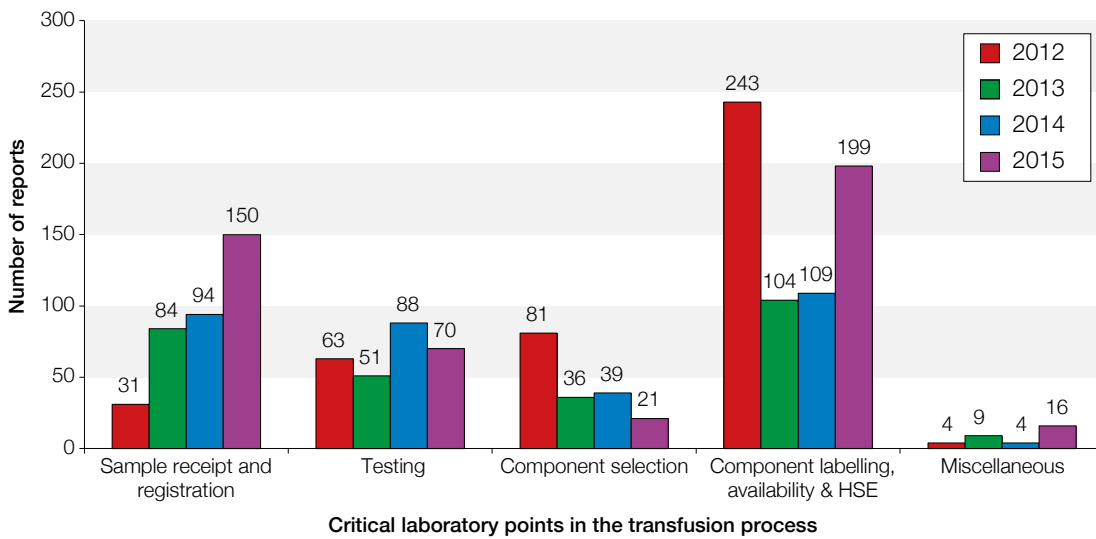


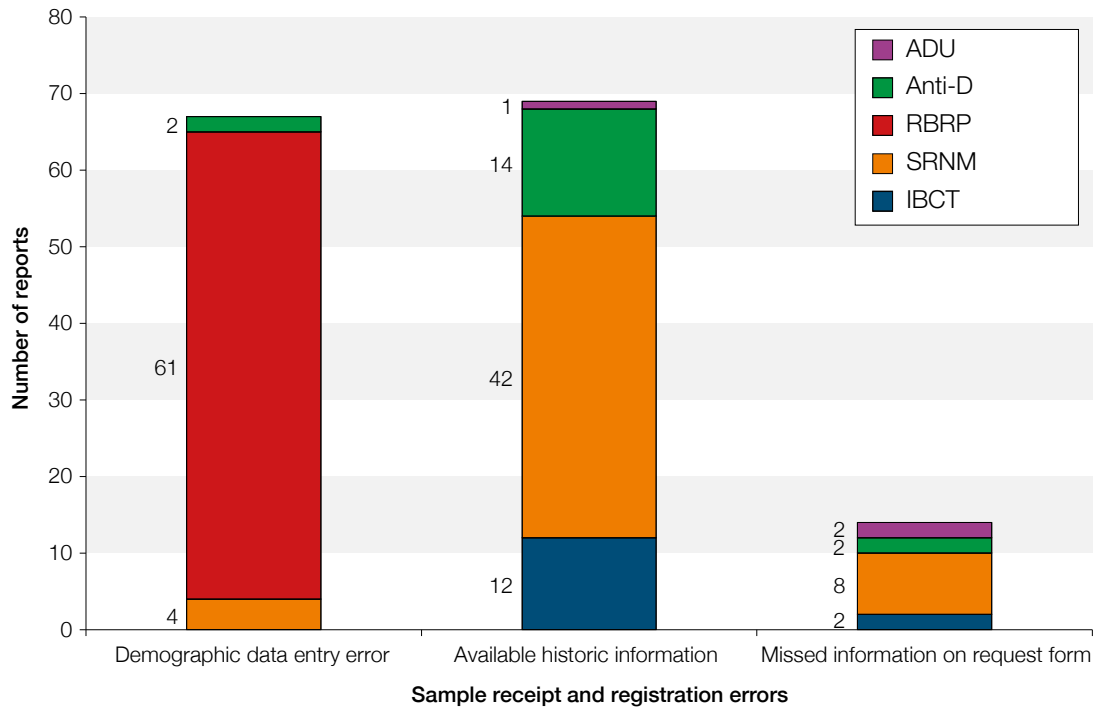
Figure 5.2: SHOT data 2012–2015 showing 4 year trends indicating the critical points in the laboratory processes where errors occur

SHOT data have been categorised into critical points that are undertaken in the laboratory and these are described below:

Sample receipt and registration n=150

Sample receipt and registration errors are increased compared to 2014 (n=94)

Figure 5.3:
Sample receipt and
registration errors
n=150



Key: ADU: avoidable, delayed and undertransfusion; RBRP: right blood right patient; SRNM: specific requirements not met; IBCT: incorrect blood component transfused

In 67/150 cases the wrong information or details had been transcribed onto patients' records. It is important that a robust procedure is in place to ensure that patient records are maintained and information updated accurately. In 69/150 cases laboratory staff could have prevented the error had they taken note of the patients' records thoroughly where correct information was available prior to issuing blood components.

Case 5.1: D-mismatched red cells transfused to a haemopoietic stem cell transplant (HSCT) patient on 3 occasions

A 59 year old female group O D-positive was transplanted with group A D-negative haemopoietic stem cells and as a result should have received O D-negative red cells. There were clear notes in the laboratory information management system (LIMS), however on 3 separate occasions, 3 different biomedical scientists (BMS) issued group O D-positive red cells which were transfused. The first BMS made the error by issuing the patient's group rather than the group indicated in the LIMS. The subsequent BMS staff referred back to the original error and selected red cells of the same incorrect group.

Good practice points

- The corrective action would be to state in the individual patient HSCT protocols the ABO and D type of red cells required for transfusion including the date(s) from which changes need to be made
- BMS staff should be vigilant and check LIMS information carefully, particularly in transplant patients (now also including hepatitis E (HEV)-screened blood components for allogeneic HSCT)
- Nursing staff should be reminded to check discrepant blood groups with the transfusion laboratory
- Preventative action would be to issue patient information 'warning cards' to transplant patients similar to those issued to patients requiring irradiated blood components

Testing errors n=70

Testing errors have decreased in 2015 (n=70) compared to 2014 (n=88)

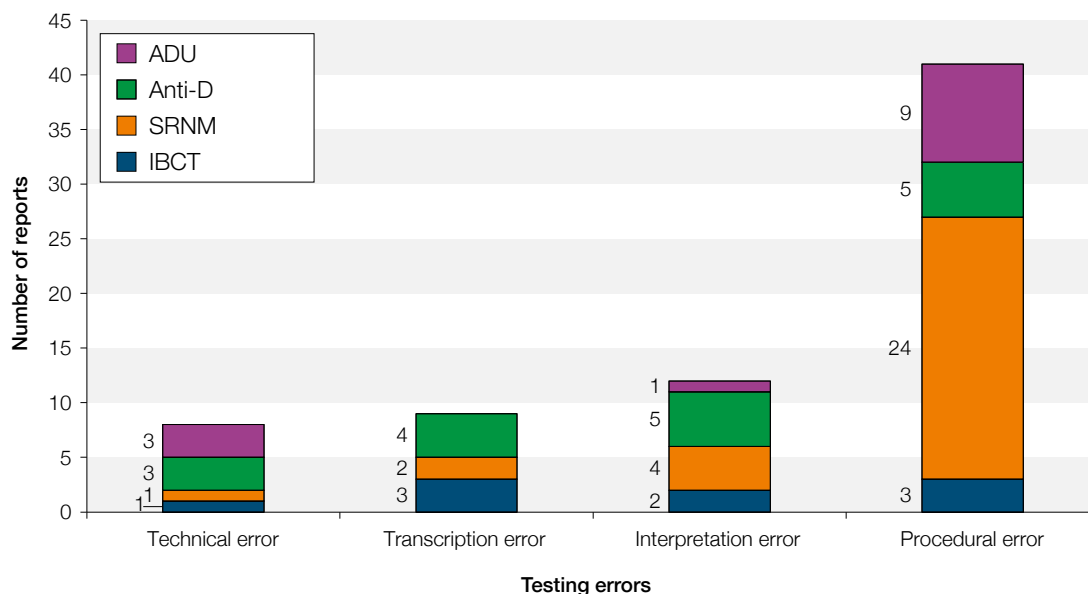


Figure 5.4: Testing errors with their outcome n=70

Case 5.2: Testing error leads to transfusion of incompatible red cells

Two units of red cells were requested for a 70 year old female patient. The crossmatch was incompatible and so the result was rejected on the blood grouping analyser and 2 further red cell units were crossmatched. Instead of returning the incompatible units to stock, the BMS (X) left these in the ‘under test’ refrigerator. This was verbally communicated to BMS (Y) who was taking over the shift. Due to staff shortages and having to deal with other emergency crossmatches, the incompatible units were overlooked and on completion of the testing, a third BMS (Z) issued the 2 incompatible units to the patient. The root causes were a breakdown in communication and failure to adhere to procedures. No symptoms or signs of a transfusion reaction were reported.

Good practice points

- Timely communication between staff is essential
- Components no longer required for a patient should be moved back to general stock
- Staff involved should complete reflective practice statements
- The learning outcomes need to be clearly identified (ask for help when under pressure, prioritisation of non-urgent work)

Component selection errors n=20

A variety of component selection errors were reported resulting in:

- 10 incorrect blood components transfused
- 6 inappropriate/late administrations of anti-D Ig
- 3 specific requirements not met
- 1 expired unit given to a patient

These cases could have been prevented if laboratory staff had adequate knowledge especially about the differences between certain components i.e. cryoprecipitate and FFP. An increasing number of SHOT reports note difficult laboratory conditions and the United Kingdom Transfusion Laboratory Collaborative (UKTLC) survey has confirmed this (UKTLC 2015). These issues include:

- Increasing workloads
- Working under pressure

- Inadequate staffing levels
- Staff competencies

Component labelling, availability and handling and storage errors (HSE) n=199

This category includes labelling issues, availability of blood components and HSE. HSE are subdivided as shown below:

- Expired components transfused
- Cold chain errors i.e. equipment failures and documentation errors

Miscellaneous n=16

Five of sixteen are summarised below:

- One delay in transfusion was due to lack of staff available to answer the telephone. A robust procedure must be in place to ensure that adequate staffing levels are maintained at all times, especially during periods where staff are more likely to have holidays i.e. during school holidays, public holidays, weekends and also during lunch times (UKTLC Bark et al. 2016)
- In 4 cases anti-D Ig was given inappropriately to D-positive women:
 - 2 cases where the anti-D Ig was given to a women who had immune anti-D
 - 2 cases where anti D Ig was given outside the 72 hours time limit postnatally

MHRA data (see also full MHRA Chapter 18 in the 2015 Annual SHOT Report: Web Edition)

2015 SABRE data have been analysed by the MHRA haemovigilance team in order to identify common errors and to make recommendations for improvements in corrective and preventive action (CAPA) plans.

Human error accounts for 96.7% (740/765) of SAE reports received. SABRE confirmation reports mostly record that individuals are aware of their local standard operating procedures (SOPs) and that those SOPs are complete and up to date. Human factors play an important part in any total quality system and as such it is key that the appropriate root cause is identified so the appropriate CAPA can be implemented. For example, where a BMS issued the incorrect components because of distraction, although the distraction is relevant it is not the root cause. It is important to identify what caused the distraction and the CAPA should reflect that. The failure to address the appropriate root cause is a recurring problem in some SABRE confirmation reports.

Serious adverse events (SAE)

Definition: Any untoward occurrence associated with the collection, testing, processing, storage and distribution, of blood or blood components that might lead to death or life-threatening, disabling or incapacitating conditions for patients or which results in, or prolongs, hospitalisation or morbidity.

SABRE report data

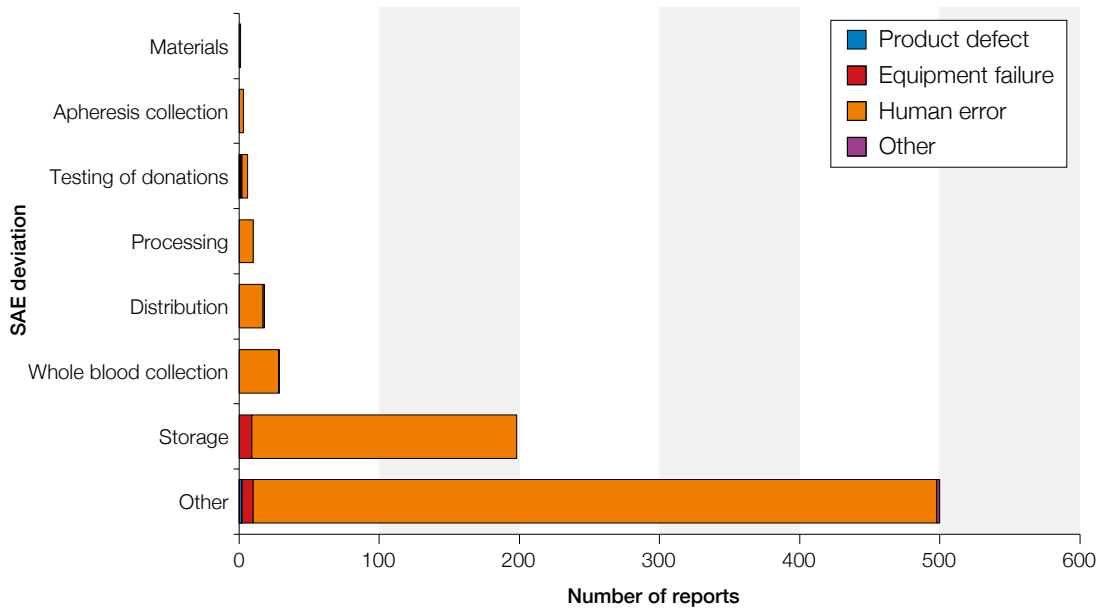


Figure 5.5: 2015 SAE confirmation reports by deviation (what part of the process) and specification (type of report)

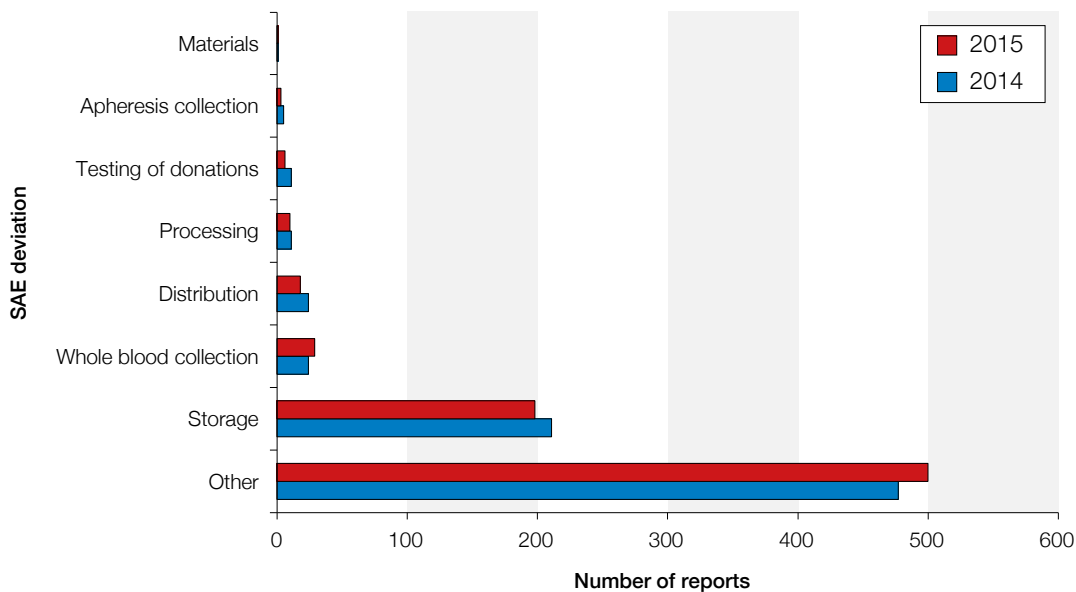


Figure 5.6: SAE confirmation reports by deviation and specification 2014-2015

Although the numbers in most categories of report are broadly similar to the 2014 data there is a noticeable increase (+23 or 4.8%) in the number of SAEs that fall into the 'other' category and also a noticeable decrease in the number of 'storage' SAEs (-13 or 6.2%).

Storage errors n=198

Storage remains the second largest individual error category. Specific storage error subtypes are shown below.

Table 5.1:
SAE storage error subclassifications 2013–2015

Storage subclassification	2013	2014	2015	Change
30 minute rule	9	13	9	-4
Component expiry	56	77	58	-19
Failure to action alarm*	18	14	21	+7
Incorrect storage of component	73	42	45	+3
Miscellaneous	0	4	3	-1
Return to stock error	13	15	17	+2
Sample expiry	18	18	19	+1
Security	7	7	13	+6
Storage temperature deviation	17	21	13	-8
Total	211	211	198	-13

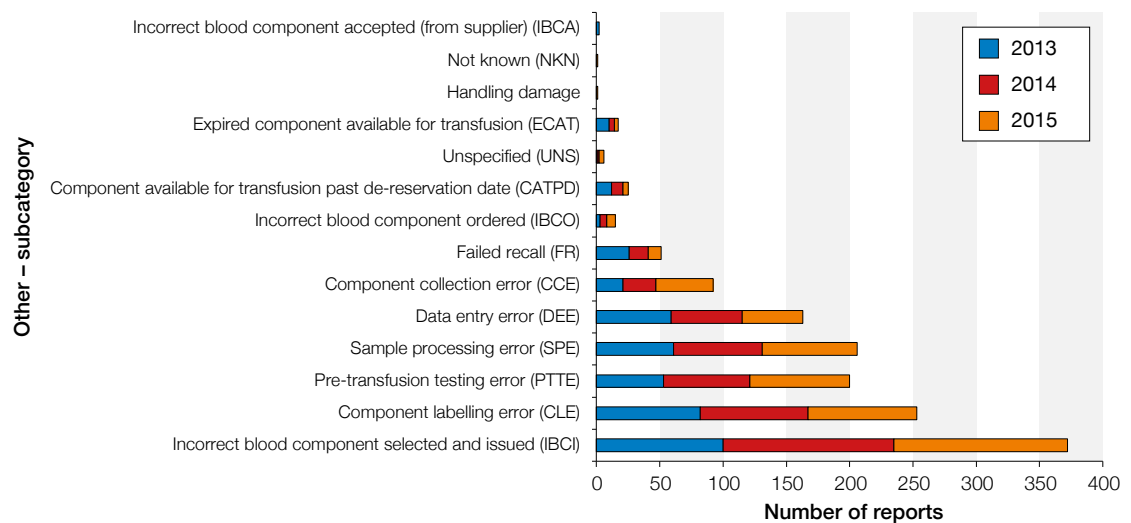
*An increase of 7 SAEs related to failure to action alarm generally refers to inadequate procedures for dealing with alarms or in some cases situations where staff were not able to effectively deal with an alarm as well as carrying out their normal laboratory duties

Laboratory staff should also ensure that procedures related to storage equipment, temperature monitoring and removing unsuitable units from storage locations are robust and clear and that staff are trained and able to activate those procedures effectively, even when lone working or during emergency situations.

Other n=500

As 'other' is the largest category of SAE reports, the MHRA haemovigilance team has created subcategories to further analyse this type of error.

Figure 5.7:
SABRE reports, subcategory 'other'/ human error, 2013–2015



Incorrect blood component issued (IBCI) errors remain the largest group and are mainly laboratory errors where specific requirements are not met. A common theme emerging from review of a selection of narratives in IBCI reports is that these errors occur when the BMS has been busy during a lone working period. Furthermore, many have occurred following HSCT or solid organ transplant where the appropriate ABO and D group for transfusion has changed from the patient's original group.

Component collection errors (CCE) may be either the wrong type of component for the right patient, or more worryingly, a component for a different patient. These errors should be detected at the bedside, but some are not, (see sections on wrong component transfused and inappropriate transfusions) fortunately without harm to a patient. Three key reasons are demonstrated for CCEs occurring:

- The correct selection and checking procedures are not performed
- Staffing or workload issues had resulted in the checks being rushed and performed incorrectly
- Although trained, the member of staff had forgotten the correct procedure

All staff must complete all steps in a procedure and at a pace that minimises risk of error. If staff have a workload that is not suitable for their ability, they are more likely to make mistakes. It is important that re-training is delivered at an appropriate frequency. Staff who perform a task less often may require more frequent training than someone that performs the same task regularly. These issues and discussion about **component labelling errors (CLE), pre-transfusion testing errors (PTTE) and sample processing errors (SPE)** are expanded in the full MHRA chapter in the 2015 Annual SHOT Report: Web Edition.

Human error n=740

Human errors can be divided into the following categories:

- Procedural steps not performed correctly – failure to carry out a step(s) correctly
- Procedural steps omitted – missing a key step or not following the procedure
- Inadequate process – inadequate design of a process or fundamental quality management system (QMS) failure
- Incorrect procedure – process not properly described in the SOP
- Ineffective training – training not understood by operator
- Inadequate training – training process not fit for purpose
- Lapsed or no training – carrying out a procedure without any formal training

Human error subcategory	Total
Inadequate process	263
Procedure steps not performed correctly	159
Procedural steps omitted/wrong procedure performed	141
Ineffective training	75
Inadequate training	43
Incorrect procedure	39
Lapsed/no training	20
Total	740

Table 5.2: SABRE reports by human error subcategory 2015

NOTE: These numbers should be used as guidance only. The quality of these data is limited by a number of factors:

- The root causes of incidents are usually the result of many contributory factors. The subcategory chosen reflects the most likely reason
- The subcategory chosen is based on the information in the report which may be limited

The most common reason for SAEs occurring is **inadequate process**. This category covers poorly designed tasks which have not been properly planned and allow errors and mistakes to go unnoticed. It also includes those SAEs where there is a fundamental flaw in the overall QMS such as a high workload and inappropriate levels of staffing at the time of the error.

Procedural step errors: These may be a result of being busy, multi-tasking, being distracted or interrupted during the task.

Procedural steps not performed correctly. These incidents are likely to result from slips and lapses by individual members of staff. The individual has carried out the correct procedure, but they have made a mistake in calculation, interpretation or accuracy. These errors may be rare or infrequent for the individual, but are unlikely to be related to a poorly designed process, competency, training and education. A common error that falls into this category is **component labelling error** (CLE), where compatibility labels are transposed.

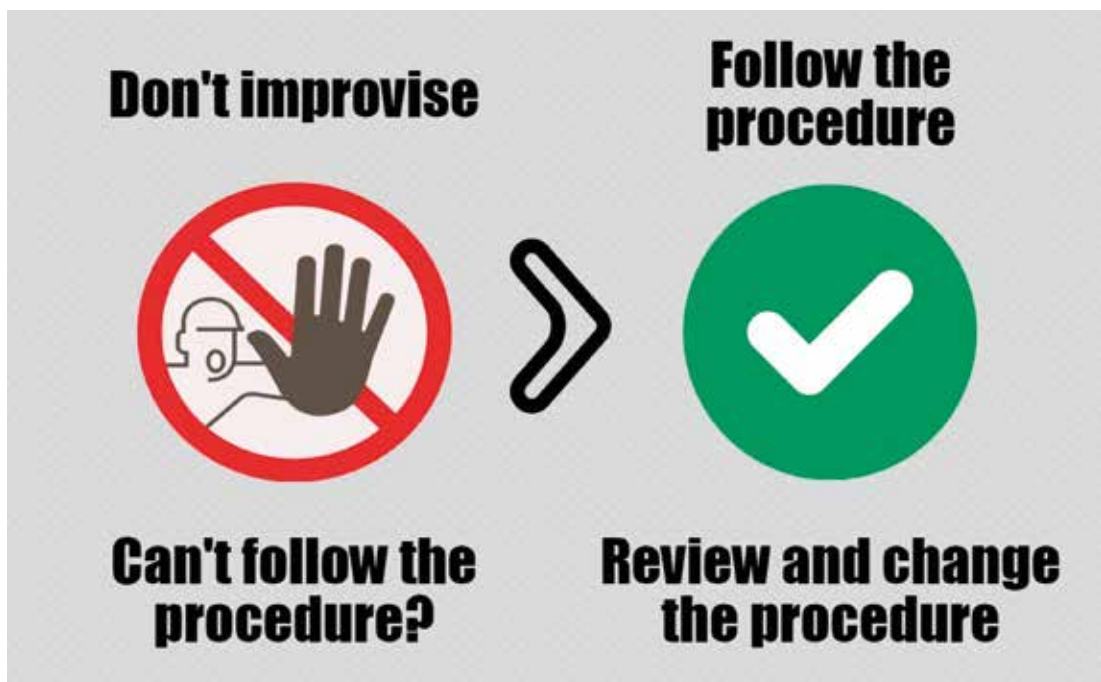
Procedural steps omitted or wrong procedure performed. These errors are characterised by omission of a vital step in a procedure, or the wrong procedure carried out. Common errors include **incorrect blood component issued** (IBCI), where a patient's transfusion history is not checked.

These errors are best addressed by:

- Reviewing and redesigning processes, focusing on the human factors involved, such as the causes of distractions
- Assessing laboratory ergonomics to ensure lean processes and effective laboratory lay-outs
- Completing or reviewing capacity plans which can be used as evidence for addressing long-term staffing issues
- Addressing workload and workflow issues to avoid peaks and troughs in activity
- Addressing short-term staffing levels with policies for annual leave, appropriate break times and cover for acute staffing shortages

It is important **always** to follow the correct procedure – never cut corners or take short cuts.
If you cannot follow the procedure as written, then review it, improve it and re-write it.

Figure 5.8:
Don't improvise,
follow the procedure



One-off or infrequent procedural errors can be dealt with as above. However, should there be a trend that develops indicating these same errors affect multiple members of staff, or at the same time of day, or day of the week, a more thorough investigation may be required to uncover CAPA that can address flaws or weaknesses in the overall QMS.

Top 5 SAEs with good laboratory practice points

SAE what happened	Why did it happen?
1. Incorrect blood component selected and issued (IBCI)	Inadequate process
2. Component labelling error (CLE)	Procedure performed incorrectly
3. Pre-transfusion testing error (PTTE)	Inadequate process
4. Sample processing error (SPE)	Procedure performed incorrectly
5. Storage (component expiry)	Inadequate process

Table 5.3:
Top 5 SAEs with the
type of human error

The following examples illustrate what might be considered as CAPA to address the root causes. These are representative of many of the reports received, and are designed to focus on improvements to systems, practice and transfusion laboratories. The examples show the categorisation for MHRA SAEs and the SHOT equivalent in brackets.

1. IBCI (incorrect blood component transfused IBCT): Inadequate process

Neonatal FFP was ordered, but neonatal cryoprecipitate was selected, issued and transfused.

- Two similar looking components were stored on the same shelf
- The BMS should have taken time to properly read the labels and select the correct component
- Laboratory staff also need to address additional knowledge and training and understanding of the blood components and be able to differentiate between them

A simple change to the process addressed the human factors involved. The root cause was addressed by separating the two types of component, placing them on different shelves and labelling the shelves with the expected contents.

2. CLE (right blood right patient RBRP): Procedure performed incorrectly

Two red cell components were being issued and had similar donation numbers.

- The labels were transposed
- The porter collecting the units did not notice the error, but it was discovered during the bedside check
- The BMS admitted to being fatigued
- The BMS was undertaking the activity in the designated 'quiet zone' and was listening to the conversation of two other members of staff
- This distraction led to a failure to properly check that the donation numbers on the label and the bag matched before attaching them
- The porter collecting the units did not carry out the proper checks before taking them to the clinical area

This example demonstrates how a relatively simple process can be affected by a number of contributory factors and it also demonstrates the 'Swiss cheese' effect when a number of barriers within the process fail. Distractions, such as conversation, in a busy laboratory are not always avoidable. This is why it is important that staff concentrate on the task at hand, following the procedures they have been trained in, to the letter. Although it is typical to see 'second checks' or scanners used to detect labelling errors, these do not address the human factors which have already led to the error.

3. PTTE (IBCT): Inadequate process

Incorrect electronic issue of blood

- A sample result showed a dual population in the anti-B test of the blood group performed on the analyser. This was due to recent transfusion of emergency group O blood

- One unit was requested urgently by the ward and issued by electronic issue (EI) but the sample was not suitable for EI because the blood group had to be interpreted manually
- The BMS did not notice the dual population result when checking during the process where the LIMS asks if the results are automated and to confirm that it has not been amended. The wrong entry was selected
- The error occurred at the weekend when the BMS was working alone. Due to the high volume of work, the BMS had not had any kind of break for over 5 hours

A long-term solution to the problem was stated to be a new LIMS system which does not ask the BMS to enter whether the sample is automated or manual. This is an improvement to the way the process itself runs, but does not address the actual root cause of this incident.

Human factors such as workload, staffing, break times and urgency of the task can affect the behaviour of the member of staff in terms of their concentration, accuracy, judgement and the pace at which they work. Laboratory managers should not expect staff to work in environments that do not allow staff to work safely.

4. SPE (IBCT or RBRP): Procedure performed incorrectly

Minor discrepancy in patient demographic

- A sample was received into the laboratory and booked in
- Two units of red cells were issued and one unit had already been transfused before it was noticed that there was a slight discrepancy in the spelling of the patient's name
- The sample was checked and it was discovered that the name on the sample was incorrect by a single letter. Note that in another similar instance with a single wrong letter, a patient died as a result of delayed transfusion (Case 7.1 in Chapter 7, Avoidable, Delayed or Undertransfusion (ADU))

The SHOT category depends on whether the sample with the incorrect spelling of the patient name resulted in a transfusion to the patient it was intended for (RBRP) or to another patient (IBCT) or as above ADU if delayed.

This case study demonstrates how very small errors or discrepancies are extremely hard to spot in the laboratory. CAPA in this case may simply be to make the member of staff aware of the error and provide a reminder of the procedure. However, when processes and workflow are being designed, managers should pay attention to the human factors related to tasks that involve a high level of concentration and may be repetitive and monotonous.

5. Component expiry (not SHOT-reportable): Inadequate process

Expired red cells in blood refrigerator

- Seven units of blood expired at midnight on Friday 4th. They were discovered, still in the stock refrigerator, on Monday 7th

If the expired component had been transfused then it would become SHOT-reportable as a handling and storage error (HSE).

The reporter identified a number of factors which failed or were not robust demonstrating an overall weakness in the QMS:

- There was a procedure to clear the refrigerator at midnight, but it can only work if people know about it. The BMS was not aware of the correct procedure which indicates problems with training and communication
- The training processes need to be reviewed to ensure that changes to procedures are communicated and adequately trained in a timely fashion. A daily task sheet is not fit for purpose if it does not include all the key tasks that are expected to be completed

Effective CAPA

From these top five categories of SAEs (Table 5.3), a number of different approaches and actions can be applied when identifying suitable, targeted CAPA. Effective CAPA that addresses weaknesses and flaws in the QMS can prevent errors occurring in other areas of the laboratory, and not just with the actual task that failed. The focus should not necessarily be on retraining, re-competency assessment or adding extra steps in a process, unless it is absolutely necessary. There are certain key principles to consider when improving QMS and when investigating incidents. This list is not exhaustive and is meant for guidance only.

- QMS
 - Is staffing appropriate?
 - Is workload manageable?
 - Is the environment (premises and plant) fit for purpose?
 - Are tasks and processes designed to be robust?
- Procedures
 - Are there SOPs to describe the tasks and processes?
 - Are they document-controlled?
 - Do they contain unambiguous instructions as opposed to a set of requirements or expectations that need to be achieved?
- Training
 - Is there a training plan?
 - Is the training material adequate and fit for purpose?
 - Has training been delivered?
 - Has training been understood and understanding assessed?
 - Does good manufacturing practice (GMP) education cover the relevant aspects of GMP?
- Personnel
 - Is there effective supervision and leadership?
 - Do supervisors watch out for and challenge bad practice?
 - Are staff aware of their responsibilities?
 - Do staff carry out their duties in accordance to GMP?
 - Are staff actively engaged in improving the QMS?

Training

Adequate and effective training is essential. No member of staff should perform a task unless adequately trained. This also applies to any locum or bank staff. Simply because a member of staff has the required level of education and experience on paper, it cannot be assumed that they are familiar with local processes and procedures. A recurring theme in SAE reports relates to locum staff who may be unfamiliar with the laboratory.

Frequency of training is also a factor when errors are made when members of staff appear to forget what the correct procedure is. Although the National Blood Transfusion Committee (England) recommendation for training is 3 yearly, the BSQR does not stipulate any time-frames for training. The MHRA recommendation for activity within the BSQR is at least yearly. If a risk-based approach is taken to training, then that period can be extended to 2 yearly training. What this means is that senior laboratory managers need to assess the effectiveness of training over a period of time. A member of staff who performs a task, for example re-stocking a satellite refrigerator, on a daily basis may have their training period extended to 2 yearly if they continue to perform the task accurately. A member of staff who only performs the same task once or twice a week will require training more frequently to ensure they perform the task correctly.

Figure 5.9:
What to consider
when investigating
an event



Joint MHRA and SHOT conclusions

It is important to note that, even with approximately 2.7 million components issued in the United Kingdom (UK) last year, only 765 SAE confirmation reports were submitted to Europe which equates to 283 SAEs per million components issued or 0.03%. SHOT laboratory incidents were 455 and there were also 287 near miss laboratory errors so the total is 742, a comparable number to the MHRA SAEs. The number of components issued in 2015 was 2,577,276 (Chapter 2, Table 2.2), so the error rate for SHOT-reportable laboratory incidents was 0.029%. (The number of issues recorded by MHRA and SHOT are sourced differently, the MHRA from hospitals and SHOT from the Blood Services and Octapharma). These are very low error rates that likely reflect the high standards of blood transfusion throughout the UK. The UK remains one of the safest countries in the world to receive a blood transfusion, but further efforts can be made to continue to improve the quality and safety of blood and blood components and the safety of the transfusion process.

Pathology services within the National Health Service (NHS) are undergoing fundamental changes. The pressures of such changes are a recurring theme in many cases. These incidents raise concerns in relation to laboratory staff shortages and pressures associated with heavy workload and distractions (Chaffe et al. 2014).

The majority of reports highlight that the LIMS or the clinical area supply all relevant information to the laboratory, but the BMS fail to heed this due to:

- Lack of knowledge and understanding
- Communication
- Staffing and work pressures
- Inadequate processes

Several other reports have highlighted the inadequacy of some information technology (IT) systems to meet the required standards to support safe transfusion practice (BCSH Jones et al. 2014).

UKTLC survey results

In 2015 the UK Transfusion Laboratory Collaborative undertook a further national survey which was distributed to 327 transfusion laboratories to be answered on Wednesday 25th March 2015 in order to give a snapshot of one day in a hospital transfusion laboratory. The survey consisted of 90 questions. The questions were designed to enable comparison with data collected by UKTLC surveys in 2011 and 2013, but included additional questions identified by the National Blood Transfusion Committee (NBTC) (England), emerging through the Regional Transfusion Committees and of interest particularly to the laboratory managers' group. The total number of responses was 204/327 (62.4%) in 2015.

Reorganisation of pathology services was reflected by 100/178 (56.2%) laboratories who had been, were currently or were to be reorganised in future. Managing staff through change is challenging. Staff shortages were reported with dependence on locum and agency staff. Vacancies were present in some laboratories for significant periods of time, for example 14 laboratories reported Band 7 BMS vacancies for over a year. It has become more difficult to train and mentor staff (69.1%, 123/178, who answered this question), and financial resources for training have reduced. Attendance at educational events, other than those which are mandatory, was not facilitated by meeting the agreed staffing level in 50/146 (34.2%) respondents. Fifty-six laboratories had one or more members of staff over the age of 60 years and 144 have staff aged 50-59 years. As these members of staff retire much specialist knowledge will be lost. Blood Service specialist laboratory staff have noted an increase in requests for tests or advice which in the past they expected hospital transfusion laboratory staff to know. Comments about changes in training with the advent of Modernising Scientific Careers (MSC) suggest that knowledge and competency at the time of qualification are reducing. It is not surprising that morale is low (UKTLC Bark et al. 2016).

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Incorrect Blood Components Transfused (IBCT) n=280

Laboratory errors n=132
Clinical errors n=148

6

Authors: Peter Baker, Joanne Bark, Julie Ball and Paula Bolton-Maggs

Definitions:

Wrong component transfused (WCT)

Where a patient was transfused with a blood component of an incorrect blood group, or which was intended for another patient and was incompatible with the recipient, which was intended for another recipient but happened to be compatible with the recipient, or which was other than that prescribed e.g. platelets instead of red cells.

Specific requirements not met (SRNM)

Where a patient was transfused with a blood component that did not meet their specific transfusion requirements, for example irradiated components, human leucocyte antigen (HLA)-matched platelets when indicated, antigen-negative red cell units for a patient with known antibodies, red cells of extended phenotype for a patient with a specific clinical condition (e.g. haemoglobinopathy), or a component with neonatal specification where indicated. (This does not include cases where a clinical decision was taken to knowingly transfuse components not meeting the specification in view of clinical urgency).

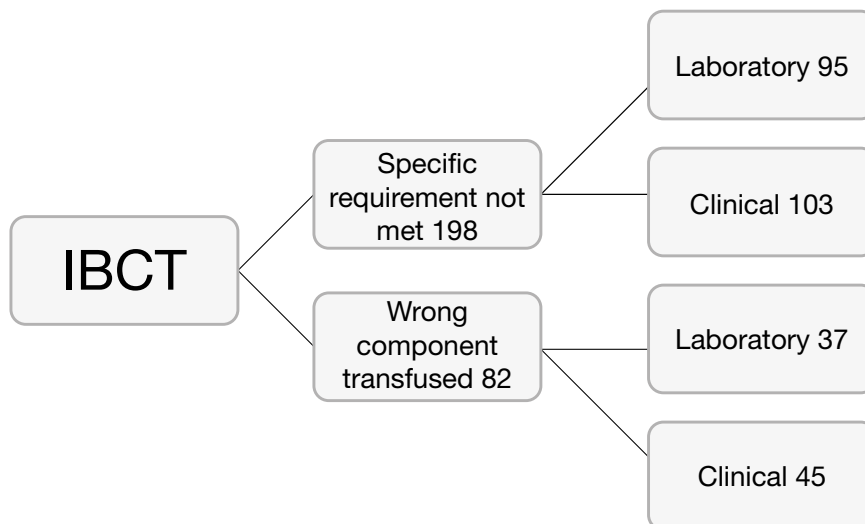


Figure 6.1:
Overview of IBCT
reports

ABO-incompatible red cell transfusions n=7 (1 death, 1 renal failure)

Never events n=7 (6 clinical and 1 laboratory case)

Unintentional transfusion of ABO-incompatible blood components is an National Health Service (NHS) 'Never Event' (NHS England 2015)

These cases do not include a further 6 cases where patients received red cell transfusions that were incompatible with their allograft haemopoietic stem cell transplants (HSCT) (see Chapter 23, Summary of Incidents Related to Transplant Cases).

Figure 6.2:
Never events
(red cells) ABO-
incompatible red
cell transfusions
n=7



The **laboratory error** occurred during core hours and resulted from an error made by a biomedical scientist (BMS) who routinely works in transfusion. The non-compliant laboratory information management system (LIMS) permitted release of incompatible red cells.

Case 6.1: ABO-incompatible transfusion permitted by an electronic issue (EI) system which was not fit for purpose as it had not been validated

A 29 year old male in sickle crisis required transfusion of 3 units of red cells. The patient was known to be group O D-positive with no alloantibodies. The BMS selected 3 group B D-negative red cell units in error and proceeded to issue these electronically via the LIMS. Warnings stating the ABO discrepancy were displayed, but were overridden by the BMS by pressing a function key, because there was no requirement to enter text such as 'yes proceed'. During transfusion of the first unit, the patient felt unwell and transfusion was stopped. The unit was returned to the laboratory but rather than initiating an investigation, the unit was placed in quarantine until the day staff came on duty when the ABO discrepancy was noticed. Overnight, 2 further ABO-incompatible units were transfused to the patient.

The investigation identified one root cause for this incident. Following a LIMS software upgrade, validation of the system had not included a test of ABO incompatibility, meaning that the EI system was not fit for purpose. This should have been a fundamental part of the validation procedure to ensure the upgrade had not compromised the electronic issue computer logic rules. There were also inadequacies in clinical management. Standard transfusion observations had not been recorded and when the patient developed symptoms during the transfusion and called for staff, no qualified staff came to assist. The patient was later transferred to another hospital for a full exchange transfusion. He is not reported to have any long term damage as a result of this ABO-incompatible transfusion.

Good practice points: Several lessons were learned following the investigation:

- The LIMS had allowed EI of ABO-incompatible units because validation had not been performed in line with national and legislative guidance
- All other units that had been issued for the patient should have been recalled/quarantined at the same time as the unit implicated in the reaction; this would have prevented further transfusion of ABO-incompatible units

- Staff were able to override and ignore computer-generated warnings

The risk of human error must be minimised by using information technology (IT) systems which are fit for purpose. The blood group of the recipient should be printed on the grouping report and should be checked against the group on the component label.

- Although not the root cause, there was a delay in detection of the incident. The returned unit was not investigated immediately and the patient's underlying condition was thought to have masked evidence of the transfusion reaction

Once the clinical reaction was recognised however, there was prompt response with transfer of the patient for exchange transfusion at another hospital. The blood transfusion laboratory staff worked hard to recheck other red cell units which had been issued to ensure no other errors had been made. All critical processes within the laboratory were reviewed and revalidated.

Clinical errors resulting in ABO-incompatible transfusions n=6

Deaths n=1

Case 6.2: ABO-incompatible transfusion and death of the patient

This case occurred in 2014 and the Trust investigation is complete but the inquest has not yet taken place. An elderly man had urgent coronary artery bypass surgery and required postoperative transfusion. The wrong unit was collected from a remote issue refrigerator, and an error was made when checking the patient identification against the blood. The error was not realised until after the full unit had been transfused. The patient developed suspected cardiac tamponade and died after some hours of active intervention.

In many reported cases of ABO-incompatible transfusion **Positive Patient Identification (PPId)** was not conducted at the bedside. **PPId** at two of the critical steps in the transfusion process, **sampling and administration**, can help prevent **ALL** clinical wrong component transfusions but may not detect some laboratory errors e.g. selection and issue of a component of the wrong group.

Failure to conduct **PPId** puts patients at risk of ABO-incompatible component transfusion. This may result in serious complications including renal failure or death.

Recommendation:

Use a 5-point practice improvement tool (checklist) at the patient's side immediately prior to connection of the transfusion. Never do this away from the patient.

Action: Trust/Health Board Chief Executive Officers and Medical Directors responsible for all clinical staff

For further details see Chapter 4, Key Messages and Recommendations.

Case 6.3: Incorrect method of patient identification followed by failure to conduct bedside check

A patient had been 'identified' by two registered nurses against the transfusion chart at the nurses' station. The registered nurse on the night shift offered to start the transfusion because the ward was very busy and other patients were requiring attention. She was interrupted and distracted on her way to the patient.

The final bedside check was not done so the wrong patient was transfused with part of an ABO-incompatible red cell unit (1.5mL). A nurse practitioner quickly realised blood was being given to the wrong patient and stopped the transfusion. The patient recovered but had slight haematuria.

Comment: Despite the fact that the patient was thought to have only received a small amount of wrong blood, this was a serious failure in the final checks. If carried out correctly, these checks could

have stopped the wrong transfusion. The transfusion process was complicated by a shift change and interruptions and distractions due to the demands of the ward and the telephone (this case is discussed in more detail in the Error Reports: Human Factors section, Case 2).

There were also two cases of D mismatch; both were caused by a combination of collection and administration errors.

Learning points

For patients receiving a blood transfusion

- **ALL** must wear an identification band*
- **ALL** patients must be asked to state (unless unable) their full name and date of birth which must match details on the identification band*
- **ALL** core identifiers on the identification band* must match the details on the blood component label

**or risk-assessed equivalent (BCSH Harris et al. 2009, RCN 2013)*

These principles do not only apply to blood transfusion but to any patient intervention undertaken by all grades of staff. This is the most fail-safe way of ensuring the correct patient receives the correct care. Observations in Wales of a number of serious incidents related to failure of identification have resulted in the issue of a Patient Safety Notice (PSN026) on PPId in April 2016 (www.patientsafety.wales.nhs.uk).

Wrong blood in tube (WBIT) leading to wrong component transfused n=2

Definition of WBIT incidents:

- **Blood is taken from the wrong patient and is labelled with the intended patient's details**
- **Blood is taken from the intended patient, but labelled with another patient's details**

Case 6.4: Wrong group transfused

A 44 year old male was admitted for femoral vascular surgery and a sample was sent for group and crossmatch. The sample grouped as A D-positive and 2 units of A D-positive blood were crossmatched and issued. The patient was transfused the first unit without incident. The following day the second unit was commenced and the patient had a reaction within the first 10 minutes. The blood was stopped and a repeat sample sent for further crossmatch. At this point it was discovered that the patient was group B D-positive. This was confirmed by a third sample. Local investigations revealed that the junior doctor (foundation year 1) had not completed positive patient identification correctly at the bedside before taking the blood sample and as a consequence the wrong patient had been bled.

The second WBIT incident resulted in group A D-negative red cell transfusion to a very sick patient who was group A D-positive, so fortunately compatible, and was detected in laboratory testing post transfusion (mixed field D result).

Near miss WBIT potentially leading to IBCT n=778 (+ 2 avoidable, delayed or undertransfusion (ADU) n=780 WBITs in total)

Although only two instances of WBIT resulted in wrong components transfused there were 778 near miss events, with an increase year on year.

Detection of WBIT incidents:

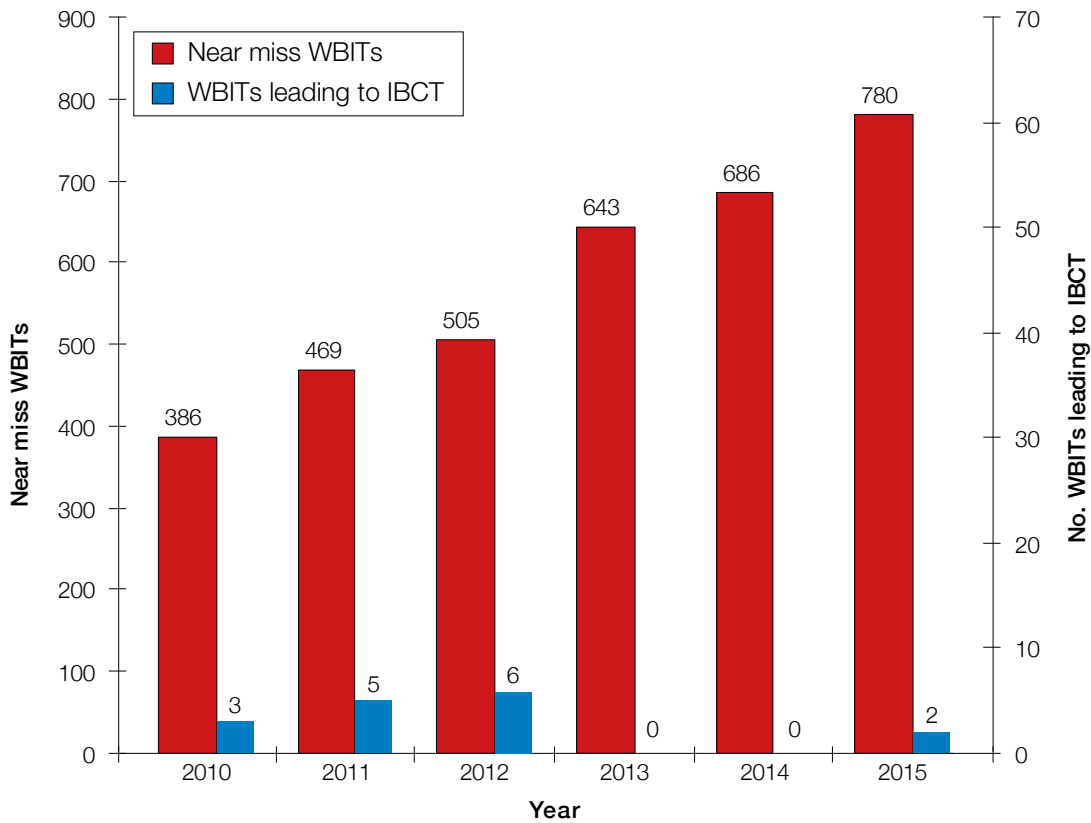


Figure 6.3:
Cumulative comparison of near miss WBIT and those leading to IBCT

Laboratory processes, including the group-check policy, are critical in detecting WBIT, but laboratory testing and vigilance cannot always detect WBIT incidents. Patient safety relies on quality processes and checks undertaken by all staff involved in transfusion, especially clinical staff at the time of sampling.

How are wrong blood in tube samples detected?

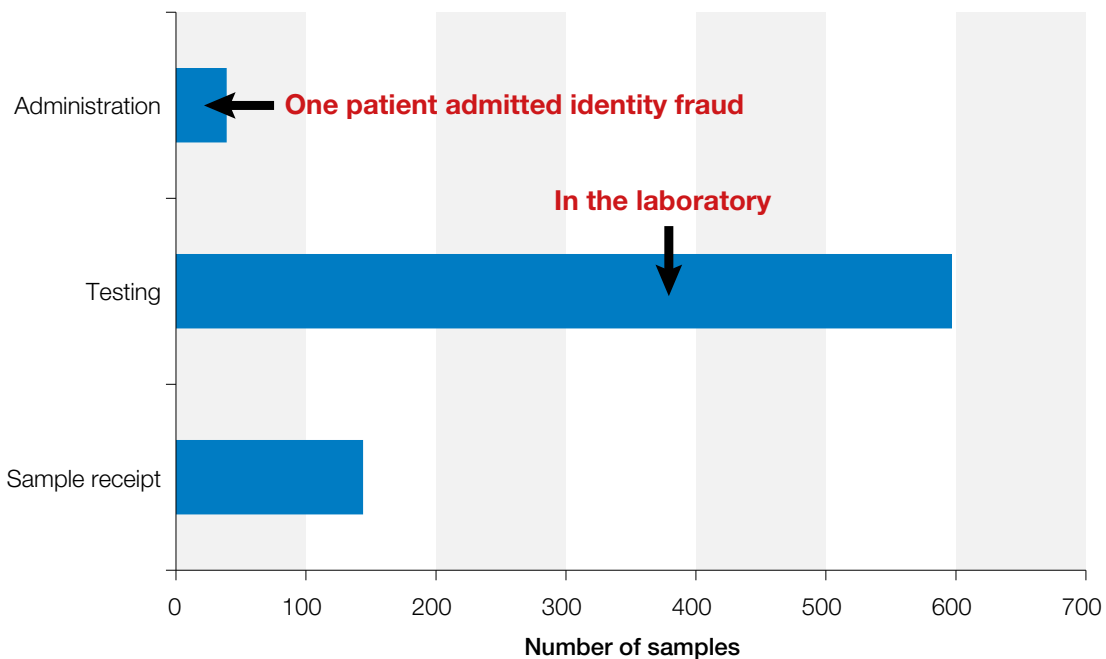


Figure 6.4: Point in the process where a wrong blood in tube incident was detected*

*Includes 2 WBIT incidents that could have led to avoidable transfusions which are discussed in Chapter 7, Avoidable, Delayed or Undertransfusion (ADU).

ABO-mismatched fresh frozen plasma (FFP) transfusions (2 laboratory cases): these are also ‘never events’

In 2 cases ABO-incompatible FFP was given. A seriously ill baby required FFP out-of-hours. Because of the urgency, the FFP was requested before the patient’s group had been confirmed. The BMS issued O D-negative red cells and subsequently mistakenly selected O D-negative FFP instead of group AB. This highlights basic requirements of training and resilience to be able to cope in stressful situations. This situation could have been prevented if laboratory staff understood that where a patient group is unknown, the correct group of FFP to select is AB (or A due to stock availability) and not group O. Unlike red cells group O plasma is not the universal group since it contains both anti-A and anti-B antibodies. A qualified BMS should know this.

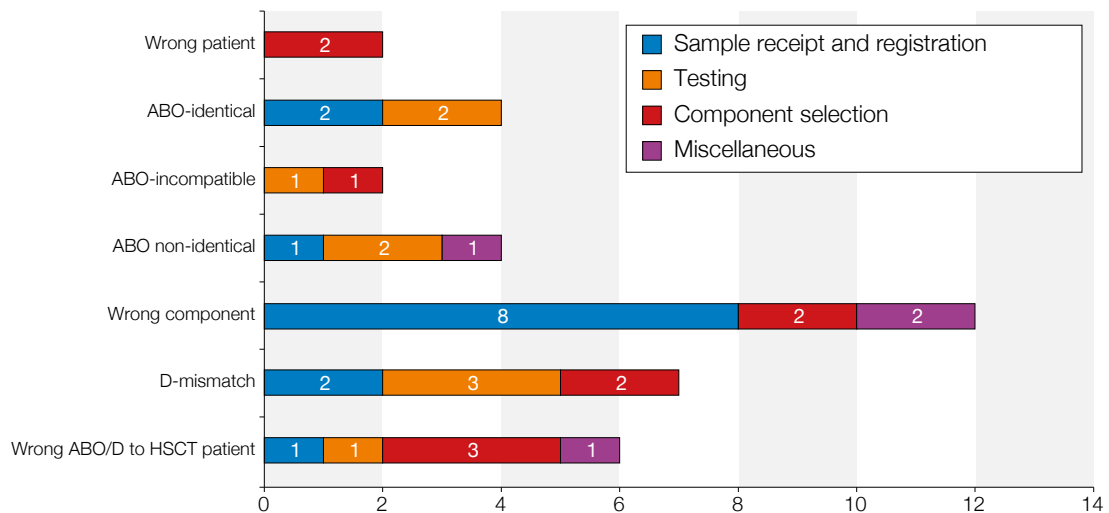
In the second instance a telephone request was received for 2 units of FFP for a 79 year old male patient of unknown weight. The BMS checked the patient’s group on the LIMS but misread the group and selected 2 units of incorrect group for thawing. A second BMS issued the FFP without checking the group of the patient or FFP relying on the previous BMS. Due care and attention is required when reading patient’s historical records. Similar cases are discussed in Chapter 5, Laboratory Errors. Additionally this was likely to be an inappropriately low dose, as the British Committee for Standards in Haematology (BCSH) guidelines on the use of FFP recommend a dose of FFP of 10-15mL/kg (BCSH O’Shaughnessy et al. 2004).

Other laboratory errors: Many incidents demonstrate failure to acknowledge or act on IT instructions such as not heeding or overriding warning flags. Most errors are due to human factors and are therefore potentially preventable with the correct infrastructure e.g. training, staffing (Chaffe et al. 2014).

Incorrect blood component transfused: wrong component transfused (WCT) n=82

Laboratory errors n=37

Figure 6.5:
Wrong component transfusions - category of laboratory error



Major morbidity n=4

Four instances of major morbidity were reported. In one case red cells suspended in saline adenine glucose mannitol (SAGM) instead of citrate phosphate dextrose (CPD) were provided for an infant exchange transfusion. This case is noted in Chapter 14, Haemolytic Transfusion Reactions (HTR) and described in detail in Chapter 16, Paediatric Summary (Case 16.1). The other 3 cases were reports of D-positive red cell transfusions to D-negative female patients which all resulted in anti-D antibody formation. These could have been prevented by correct testing and selection of the correct component.

Case 6.5: Error in manual grouping discovered after investigation by another hospital years later

A transcription error after manual testing resulted in a 15 year old female, who was group O D-negative, being transfused 2 units of O D-positive red cells in relation to a spinal operation. The error was detected 14 years later when she presented at a maternity unit at another hospital where her booking bloods showed she was O D-negative with anti-C+D.

Good practice points

- The retention of documents, as required by the Blood Safety and Quality Regulations, meant that data could be retrieved from storage and the error was identified
- Monitor the expectant mother throughout her pregnancy as the fetus is at risk of haemolytic disease of the fetus and newborn (HDFN) (the consequences of failing to monitor such cases can be seen in Case 1 in the Error Reports: Human Factors section)
- Blood grouping should ideally be performed on an analyser with the results transmitted electronically to the laboratory information management system (LIMS)

Potential for major morbidity n=2

Two cases were reported where the incorrect component was selected for women of childbearing potential, however anti-D Ig was prescribed and given following the incorrect transfusion of D-positive red cells to D-negative women.

Miscellaneous laboratory cases n=4

There were 4 cases (3 below and one with major morbidity is described above)

- **Failure to review patient records correctly:** A haemopoietic stem cell transplant (HSCT) patient's system flags had been entered incorrectly. The patient's group was B D-positive and the donor A D-positive. The flag incorrectly stated that group B high-titre negative (HT-) red cells should be given when it should be group O HT- red cells. As a result of this the incorrect blood group was issued over a 6 month period
- **Lack of understanding of LIMS:** The confirmed group of the patient was changed from B D-negative to O D-negative in error following a large transfusion of O D-negative red cells, resulting in O D-negative components being issued and labelled with the patient group shown as O D-negative. The root cause was failure to take note of warning messages showing that the cardinal group would be changed
- **Communication error and failure to heed prescription:** A consultant haematologist requested platelets and FFP for a patient. A request form for platelets was sent to the laboratory. On review a second haematology consultant decided not to proceed with the platelet transfusion but failed to communicate this to the laboratory. A porter came to the laboratory with a collection slip for FFP but was also collecting platelets for another patient and inadvertently asked for platelets for both patients. The platelets were delivered to the ward where the nurse mistook them for FFP and they were transfused to the patient

Clinical errors n=45

Additional examples of WBIT and sample labelling errors are reported in the avoidable, delayed and undertransfusion (ADU) category and the near miss category, including both group and screen and full blood count samples (Chapter 7, Avoidable, Delayed or Undertransfusion (ADU)).

Incorrect component type collected and administered n=18

In **12/18** cases emergency O D-negative adult units were given to neonates.

In **6/18** further cases adult patients were also transfused with an incorrect component. This included a paediatric emergency O D-negative unit being collected and transfused to an adult obstetric patient when adult emergency units were readily available.

- 4/6 the wrong component type was collected from the storage site
- 2/6 related to communication failure at handover and during a telephone request

Case 6.6: Adult red cells transfused to a neonate

A preterm neonate required emergency transfusion following massive pulmonary haemorrhage. An adult unit of emergency O D-negative red cells was collected from storage instead of the paediatric emergency O D-negative red cells that were also available for collection. This was complicated by the usual emergency blood refrigerator being out of action. The nurse who was collecting the unit did not realise that paediatric units were also available from the alternative location. The attending clinicians decided to continue with the transfusion of the adult red cells rather than delay the transfusion further.

Corrective action: Following a review of this incident, major haemorrhage drills for neonatal intensive care were planned. A protocol was introduced to inform staff what to do when the satellite refrigerator was out of action.

Learning point

Know your components

- It is important that hospital staff, who must be trained and competency assessed to collect blood components, are also aware of specific requirements, the different component types, their appearance, storage conditions, and locations

Figure 6.6:
What's special
about red cell
units prepared for
neonates?



What's special about red cell units prepared for neonates?

They are selected to be:

- Free from clinically significant red cell antibodies and high titre negative
- CMV negative
- HbS screen negative
- Prepared from blood donated by donors who have given at least one previous donation within the past 2 years



Transplant cases n=8 (clinical)

There were 8 cases where transplant patients received incorrect components (including one ABO-mismatch and two cases of D-mismatch). These resulted from communication failures between clinicians and the laboratory staff and are discussed in Chapter 23, Summary of Incidents Related to Transplant Cases.

Near miss IBCT cases

Point in the process	Type of error made	Number of cases	Percentage of cases
Request error	Request for incorrect patient	5	0.7%
	H SCT group error when requesting	3	
Sample taking	Wrong blood in tube (WBIT)*	778	87.7%
Sample receipt	Entered to incorrect patient record	3	0.5%
	Incorrect patient administration system (PAS)/LIMS merge	1	
Testing	Misinterpretation	1	0.9%
	Incomplete testing prior to issue	1	
	Manual group error	3	
	Equipment failure	3	
Component selection	D+ issued to D- patient	14	2.7%
	Incorrect component type	2	
	Wrong ABO group selected	8	
Component labelling	Transposition of labels between patients	4	0.5%
Collection	Collection of incorrect unit	34	4.8%
	Wrong details on collection slip	1	
	Wrong units sent to ward	8	
Prescription	Not prescribed	1	0.1%
Administration	Attempted administration to the wrong patient	19	2.1%
Total		889	100%

Table 6.1:
Near misses that could have led to IBCT n=889

* 2 other near miss WBIT incidents could have led to avoidable transfusions and are shown in Table 7.4 in Chapter 7, Avoidable, Delayed or Undertransfusion (ADU).

Incorrect blood component transfused: specific requirements not met (SRNM) n=198

Lack of knowledge of specific requirements is a recurring theme every year.

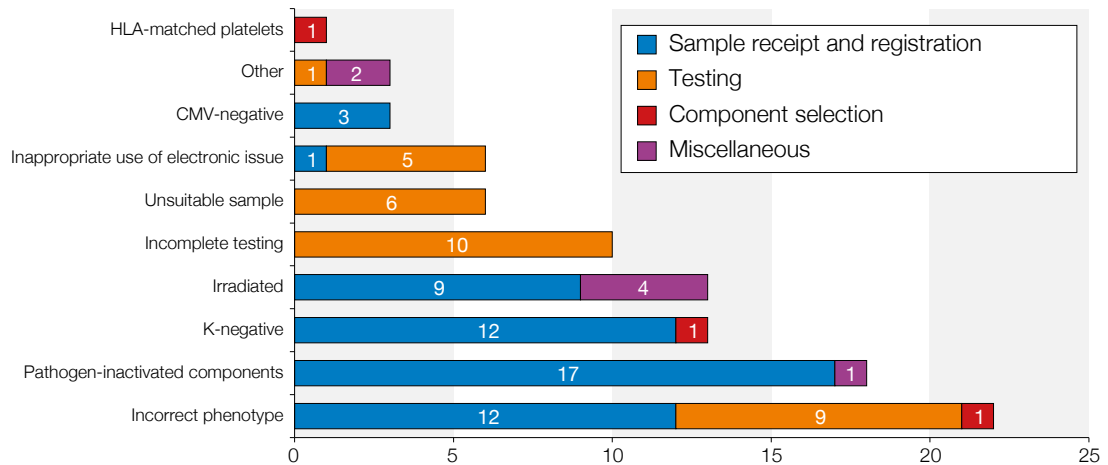
Type of specific requirement	Number of clinical cases	Number of laboratory cases
Irradiated	88	13
Phenotyped units	9	35
CMV-negative	3	3
Blood warmer	2	-
HLA-matched	1	1
Pathogen-inactivated components	0	18
Other	0	25*
Total	103	95

Table 6.2:
Specific requirements not met in 2015 n=198

CMV: cytomegalovirus HLA: human leucocyte antigen *see Figure 6.7 for further analysis of laboratory cases

Laboratory cases n=95

Figure 6.7:
Specific requirements not met due to laboratory errors divided by category of error



Major morbidity n=5

In 5 cases women of childbearing potential were given K-positive (K+) red cells, and all developed anti-K. These could have been prevented if the BMS had checked the patient's age and gender when reviewing the patient's historical records and selecting the component.

There were 7 additional potentially sensitising events due to transfusion of K+ red cells to women of childbearing potential however alloimmunisation did not occur in 3 cases, and the outcome was unknown in the other 4.

Case 6.7: Unclear nomenclature for K and k leads to a woman of childbearing potential being transfused a K-positive unit of red cells

An emergency unit which was not K-negative was selected from the laboratory stock. This was transfused to a 39 year old female. The investigation identified that the BMS knew of the requirement but had mistaken the labelling on the blood pack of k-negative for K-negative. The unit has 2 different nomenclatures on the same pack (Figure 6.8). Although the labelling was ambiguous and contributed to the error, the electronic despatch note (EDN) showing the donor phenotypes could be sent electronically to the hospital LIMS and that could have alerted the BMS of the incorrect selection.

Good practice points:

- Laboratories must ensure sufficient O D-negative red cell units of the correct phenotype (C-negative, E-negative, K-negative) are available for use in emergency situations
- If the extended phenotype is confusing or not understood by the BMS then the red cells should not be used (although there were two different nomenclatures the attached label does show 'K+ k-')
- Hospital blood transfusion laboratories should consider using the NHSBT electronic despatch note (see above). The Scottish and Welsh blood transfusion services do not add additional labels and do not overscore lower case antigen letters

Miscellaneous cases n=7

- Failure to provide irradiated components occurred in 4 cases because patient records were not maintained or updated on LIMS appropriately
- Failure to provide methylene blue-treated cryoprecipitate (MB-cryo) (1 case). In this case the BMS did not know that patients born after 1st January 1996 require imported pathogen-inactivated plasma components (BCSH O'Shaughnessy et al. 2004)

- Washed platelets were ordered on the online blood ordering system (OBOS) with the incorrect date required for transfusion therefore platelets were not available for the time of transfusion. Random platelets were transfused under clinical supervision
- Laboratory staff failed to add instructions for clinical staff to use a blood warmer on every one of 4 units that were being transfused to a patient with cold agglutinins. Instructions were only placed on the 1st unit however the clinical staff collected the 4th unit first which did not display these instructions. Generally units are to be used in expiry date order, and so the instructions were attached to the unit the laboratory assumed would be transfused first

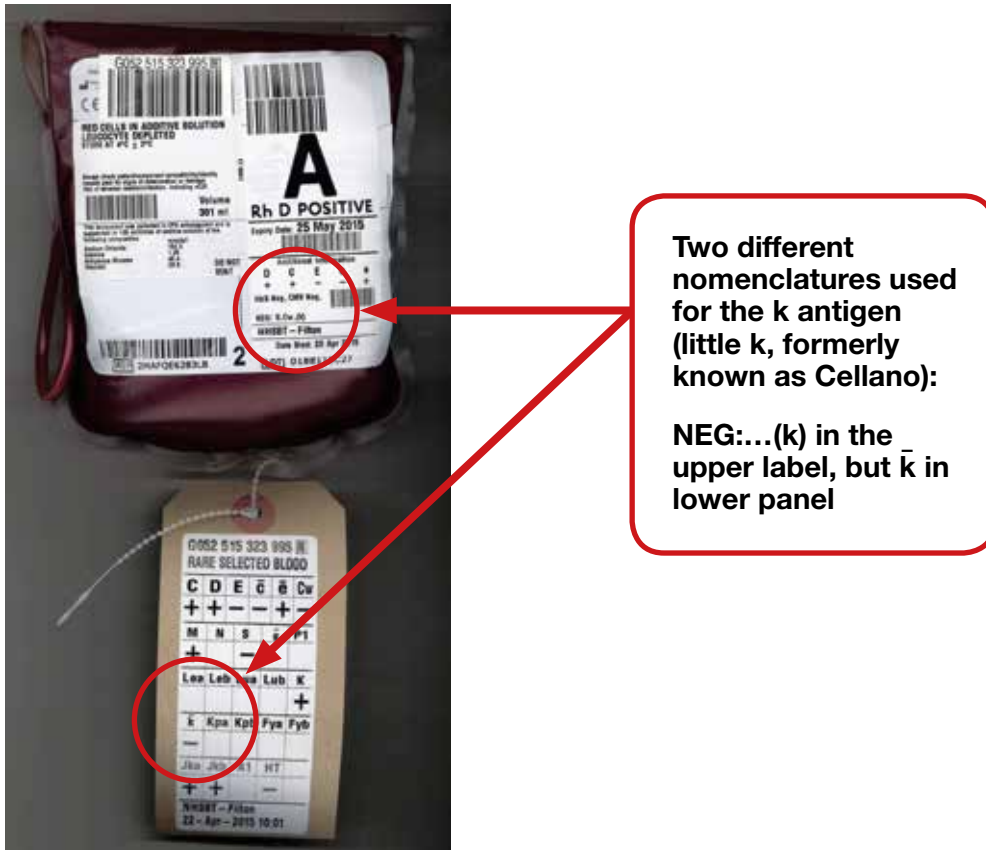


Figure 6.8: Double and confusing nomenclature for K and k

Case 6.8: A combination of laboratory and clinical errors result in failure to provide irradiated red cells

A 5 year old child with DiGeorge syndrome was admitted for cardiac surgery and irradiated red cells were requested by the clinical team and provided by the laboratory. The surgery was cancelled and the units returned to stock. When the surgery proceeded 2 days later, irradiated red cells were not requested as the nurse in theatre was unaware they were required. The laboratory had failed to update the LIMS with this patient's requirement. The patient was transfused non-irradiated units. This case shows that communication between laboratory and clinical areas is vital.

Good practice points:

- When laboratory staff accept telephone requests then in addition they should ask the requestor if there are any specific requirements. If the requestor is unsure then the order should be delayed until a clear component specification is provided
- Electronic requesting with fields forcing information from the requestor (mandatory field) should be developed within Trusts/Health Boards

Clinical errors n=103

In 88 clinical cases of failures to transfuse irradiated components, 14 patients had a current or previous diagnosis of Hodgkin lymphoma. In all 3 cases where CMV-negative components were missed, the clinical area had failed to inform the laboratory of the specific requirement for their pregnant patients.

Case 6.9: Failure to communicate or acknowledge specific requirements

A telephone request for red cells was received in the transfusion laboratory for a 39 year old lymphoma patient who was being worked up for haemopoietic stem cell transplant (HSCT) but specific requirements were not discussed. The BMS was distracted by a number of complex telephone queries at the time and did not complete the appropriate checks with the requestor. The specific requirements were documented on the 2nd comments page on the LIMS but were missed and non-irradiated red cells were issued. The patient asked not to be disturbed while he was on a work-related conference call but agreed the nurse could start the transfusion. The bedside check was compromised to minimise interruptions and the nurse failed to notice the specific requirements on the prescription. The patient notified the nurse that the blood was not irradiated when he saw there was no irradiation sticker on the unit. The blood transfusion was stopped.

Case 6.10: Failure to request irradiated units

An 11 year old patient with thalassaemia major required hypertransfusion in preparation for HSCT. A verbal request for red cells was made 2 days prior to the planned transfusion; there was no mention of any specific requirements. The decision to transfuse irradiated components was made on the morning of transfusion but non-irradiated red cells had already been prescribed, crossmatched and issued. The transfusion laboratory was informed of the error 13 days post transfusion.

Local investigation: The clinical area did not inform the laboratory of the decision to administer irradiated components. Specific requirements were not noted on the prescription chart. The transfusion laboratory staff were aware that the patient was scheduled to have HSCT and the critical notes had been updated but the standard operating procedure (SOP) did not confirm the need for irradiated components.

Learning point

- A robust procedure should be in place for the receipt of verbal telephone requests (BCSH Milkins et al. 2013). This can be used as an additional opportunity to check any specific requirements the patient may have

Case 6.11: O D-negative units are incompatible

An 81 year old patient developed acute blood loss during colorectal surgery (03:50). The patient had known anti-E and anti-c. A unit of emergency O D-negative red cells was removed from a ward-based remote issue refrigerator and transfused to the patient. This would, by definition, be incompatible with anti-c. The clinical staff did not discuss the use of the emergency blood with the transfusion laboratory and did not wait for crossmatched blood to be supplied. There was no known adverse outcome for the patient.

Comment: Effective communication between departments is fundamental to ensure excellent patient care, clearly demonstrated by this case. Discussion with the transfusion laboratory staff enables clinicians to make an informed decision on which components to use. If the clinical situation does not allow time to obtain crossmatched blood, the BMS can select uncrossmatched but appropriate antigen-negative units from stock (E-negative, c-negative in this case).

Case 6.12: Missed specific phenotype for patient with sickle cell disease

A 30 year old patient had a group and screen sample taken in a preoperative assessment clinic. The doctor completing the request failed to tell the laboratory that the patient had received a transfusion in the previous week and also that the patient had sickle cell disease and so required phenotype-matched units. Blood was requested and issued for theatre, again with no indication of the specific requirements and 1 unit was transfused. A consultant then informed the laboratory that the patient had sickle cell disease.

In 8 cases the patients themselves identified that their specific requirements were not met and in one further case the patient’s relative alerted staff to the error. Regularly transfused patients are usually well informed about their underlying diagnosis and specific transfusion requirements, but these should become apparent if the correct questions are asked when taking the patient’s medical history on admission to hospital.

Learning point

- The use of patient information leaflets or a similar alert system to inform patients of their specific requirements can help avoid these types of errors

New specific requirement: Hepatitis E

Hepatitis E (HEV) can be transmitted by blood components although it is more commonly acquired from the diet. The Advisory Committee on the Safety of Blood, Tissues and Organs (SaBTO) has issued guidance that HEV-screened components should be provided to patients undergoing solid organ transplants and allogeneic HSCT (SaBTO 2016). These recommendations will be reviewed by SaBTO in September 2016. Failure to meet this recommendation became a new missed specific requirement from Spring 2016 (dates of provision of HEV-screened components varied between the four Blood Services; Wales 25th January, England and Scotland 14th March and Northern Ireland on 16th May 2016).

Near miss SRNM cases n=97

Near miss incidents related to patients’ specific requirements show similar learning points to the full incidents which led to a transfusion of components where specific requirements were not met.

Point in the process	Type of error made	Number of cases	Percentage of cases
Request	Failure to request irradiated	29	34.0%
	Failure to request CMV-negative	2	
	Insufficient information for phenotyping	1	
	Failure to request pathogen-inactivated components	1	
Sample labelling	Sample tube out of date	1	1.0%
Sample receipt	Failure to notice request for irradiated/CMV-negative	7	7.2%
Testing	Incomplete testing prior to issue	12	16.5%
	Sample validity	4	
Component selection	Failure to issue irradiated	17	40.2%
	Failure to issue appropriate red cell phenotype	11	
	Failure to issue CMV-negative	6	
	Failure to issue pathogen-inactivated FFP	4	
	Failure to issue washed cells	1	
Component labelling	Component mislabelled	1	1.0%
Total		97	100%

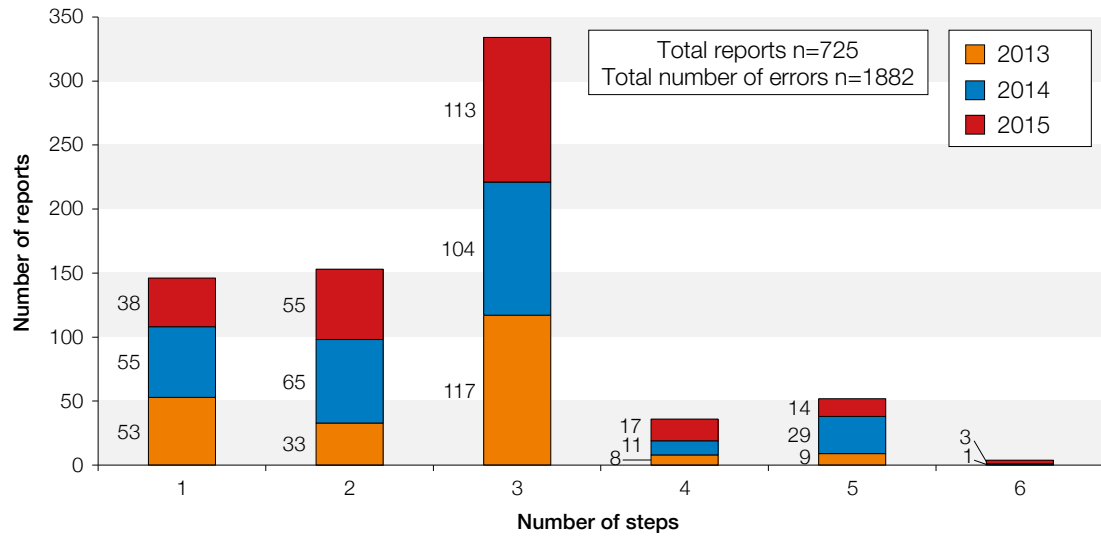
Table 6.3:
Near misses that could have led to IBCT-SRNM n=97

Incorrect blood components transfused: multiple errors n=240 (combined laboratory and clinical)

All reports analysed in this category have preventable errors. The critical steps of the transfusion process (Bolton-Maggs, Poles et al. 2014) provide ‘check points’ in both laboratory and clinical areas which help prevent wrong transfusions. However, SHOT continues to receive a number of reports related to transfusion of wrong components including ABO-incompatible red cell transfusions. It is everyone’s responsibility to ensure they complete their part of the process fully and with care, and use it as an opportunity to detect earlier errors and thus prevent a wrong transfusion.

The pattern and median number of clinical errors (median 3, range 1-6) is comparable to previous years with the majority resulting in failure to transfuse irradiated components.

Figure 6.9:
Multiple errors
2013–2015 n=725
reports (240 in
2015)



Miscellaneous n=40

These reports are not due to failure at a particular point in the process. As in previous years, the clinical cases (29/40) were mainly due to communication failures particularly in shared care.

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Avoidable, Delayed or Undertransfusion (ADU) n=241

7

Authors: Julie Ball and Paula Bolton-Maggs

Delayed transfusion n=94

Definition:

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

Key SHOT message

- Delays in transfusion contribute to death and morbidity, and are often caused by poor communication between the clinicians and laboratory staff

The number of delays reported has increased each year (2010–2015) Figure 7.1. In 63 cases the reporter identified delay as the primary error, 5 reports identified delay associated with another error. A further 21 reports were selected as delay by description of the event and 5 were transferred in from other categories.

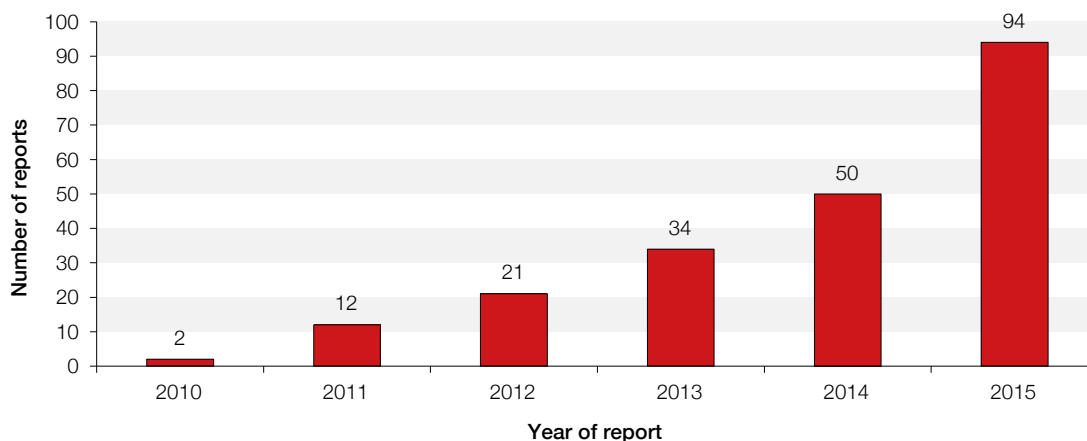


Figure 7.1: Delayed transfusion reports by year 2010–2015

Deaths in which the delay contributed n=6

Case 7.1: Failure in correct patient identification contributes to fatal delay in transfusion

An elderly woman was admitted for elective aortic aneurysm repair. The aneurysm had been identified when she attended the emergency department (ED) with gastroenteritis. She was transferred to another hospital where she was an inpatient for several days. On admission for surgery a week later, blood samples were taken and 6 units of red cells crossmatched. When the blood was required in theatre a discrepancy in the spelling of the patient's name was discovered (one letter was incorrect). The case notes and consent form had the wrong spelling but the blood was labelled correctly. The units were returned to the transfusion laboratory according to the hospital protocol. There was subsequently a delay in transfusion which contributed to her deterioration with development of coagulopathy and death later that night.

How did this happen? The name was correct on the original transfer letter but was entered incorrectly into the patient information system. This was discovered prior to her admission when checking against her general practitioner records, the electronic patient record was then updated, but not the hard copy case records. On admission the wristband was correct. However this was not accessible at surgery (under drapes) so the blood bags were checked against the hardcopy notes which still had the wrong spelling. Two new blood samples were sent to the laboratory who advised a delay of 45-50 minutes to provide crossmatched units. However, surgical complications followed requiring urgent transfusion but emergency group O D-negative units were not stored in the theatre refrigerator as it had inadequate temperature control so that there was a delay in arrival in theatre.

The root cause analysis (RCA) identified several issues:

- Failure to initiate a major haemorrhage call
- Poor communication between surgeon and anaesthetist
- Incorrect patient identification labels in the patient records
- No contingency plan for storage of emergency O D-negative blood
- Blood gas machines not functioning
- Several documentation issues

Case 7.2: Slow responses and communication failure in a critical situation

A 65 year old man fell at home and sustained a head injury complicated by a subdural haematoma detected on a scan 3 hours after admission. Delayed provision of platelets contributed to death.

His platelet count on admission was $9 \times 10^9/L$ (result at 09:48) and platelets were prescribed at 10:36 following confirmation of the low count on a second sample. The transfusion laboratory, unaware that this was an urgent sample, requested a blood group-check sample at 10:55. At 13:00 the patient fell a second time. Platelets arrived at 13:26 by standard courier and were issued at 15:30 following the receipt of the group-check sample. They were transfused at 16:00, approximately 9 hours after admission. Intravenous immunoglobulin was prescribed at 15:00 but not given until 04:50 the following morning. The patient deteriorated and died as a result of the head injuries about 44 hours after admission.

Comment: Good communication is essential. The laboratory were not made aware of the urgency for platelets resulting in a request for a group-check sample, failure to request urgent blue light transport and delay in administration of platelets.

Case 7.3: Delay in collection after crossmatching at the Blood Centre

This 77 year old was admitted for an urgent blood transfusion from the medical day unit. She had irregular antibodies and required crossmatching by the local Blood Centre laboratory. The units arrived on site at 01:30 for her. However, they were not collected until 09:55 by which time she arrested and died.

Comment: The incident review noted that there were multiple communication problems during shift handovers where the urgency was not passed on to either the laboratory or clinical areas, and the laboratory staff were also not informed of the ward to which the patient had been admitted. In the morning the doctor reviewed the patient and realised the transfusion had not taken place.

Case 7.4: Lack of leadership

An 83 year old man with a leaking aortic aneurysm was transferred from another hospital. The major haemorrhage protocol (MHP) was activated but there was delay and confusion in providing red cells with multiple different people contacting the laboratory, issues with a printer and reluctance of the surgeon to use emergency O D-negative units.

Case 7.5: Cumulative delays followed by death

An 85 year old man with pneumonia and a gastrointestinal bleed had Hb 54g/L, the result being telephoned through to the ward at 10:41. This anaemia was confirmed on a repeat sample, Hb 53g/L. No request for blood was made at this stage. A sample was taken at 11:15 for group and screen but was not received by the laboratory until 14:00. A 2-unit request was telephoned to the laboratory at ~15:15, blood issued and placed into the blood refrigerator by 16:30. However, the blood was not taken to the patient until 23:00, more than 12 hours after the severe anaemia was identified, when he was found dead.

Case 7.6: Massive obstetric haemorrhage with slow response

A 37 year old lady pregnant with twins was admitted at 32/40 weeks with a history of antepartum haemorrhage. The patient was delivered by caesarean section complicated by major haemorrhage, suffered a cardiac arrest and later died. The cause of death was acute blood loss. A delay in activation of the major haemorrhage protocol and a need for earlier involvement of obstetric consultants were noted in the review.

Major morbidity related to delay n=5

Two of these were obstetric emergencies. Delay resulted in one case because ‘all available personnel were tied up with clinical emergencies’. The other two patients had irregular antibodies which resulted in the need for identification/crossmatch to be performed off site at red cell specialist laboratories with consequent inevitable delay. Both cases demonstrated poor understanding (by medical staff) and poor communication between the clinical and laboratory areas.

Case 7.7: Cardiac ischaemia exacerbated by delay

A 77 year old man with myelodysplastic syndrome was admitted for routine immunoglobulin treatment but reported that he had chest pain in the night. The Hb was reported as 49g/L at 11:00. There was difficulty crossmatching resulting in the sample being sent to the red cell specialist laboratory, but the urgency of the transfusion was not communicated to the local nor specialist laboratory so that it was processed as routine and not urgent. Chest pain recurred in the afternoon and further ischaemic cardiac damage was detected on the electrocardiogram (ECG) with elevated troponin. The transfusion started at 22:30. The delay in transfusion was considered to contribute to the myocardial damage.

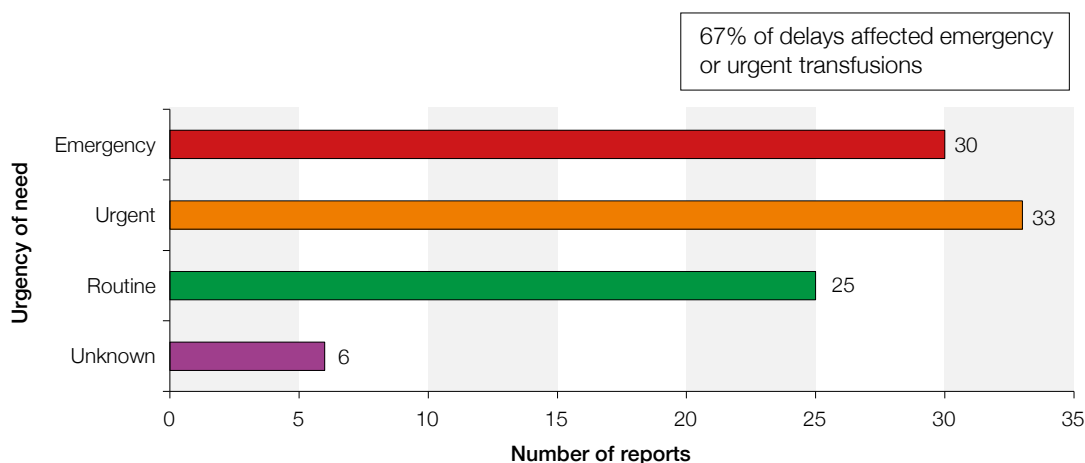


Figure 7.2: Summary of delayed transfusions 2015

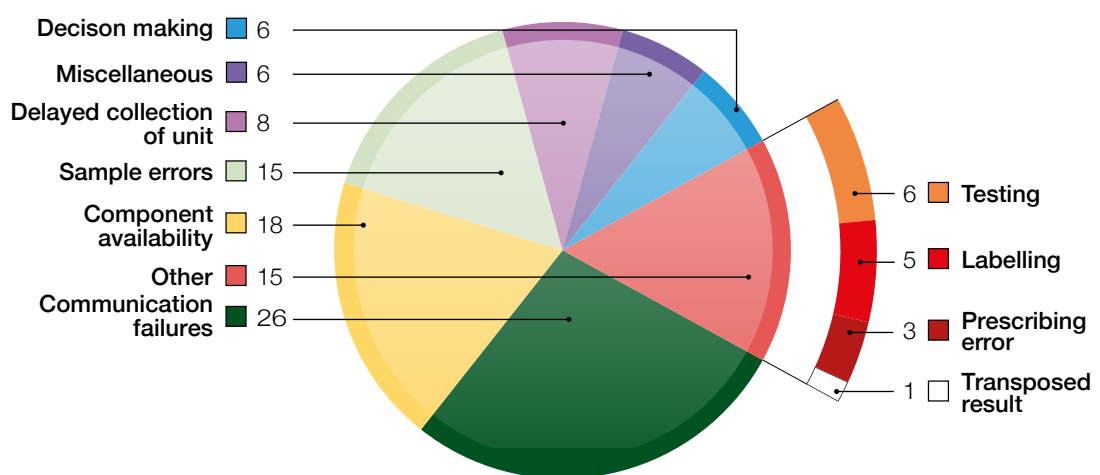
Comment: Most delays occurred in acute situations: urgent (33/94) or emergency (30/94), together 63/94 (67.0%). Delays were also reported in routine transfusions highlighting system failures that resulted in delayed treatment for patients. Examples included delayed component availability due to ordering, packing or delivery errors, sample labelling errors and instances of wrong blood in tube (WBIT).

An observational study of major haemorrhage management in trauma from 22 UK hospitals noted delays in administration of platelets and cryoprecipitate in particular, but also of fresh frozen plasma (FFP). The authors note that only 2.0% of all patients with massive haemorrhage received FFP:red cells at a ratio of at least 1:2 and conclude that there is more work to be done to understand and remove barriers to timely component transfusion (Stanworth et al. 2016).

The most important cause of delay was **communication failure**.

Some communication failures were inter-disciplinary and others involved external service providers e.g. specialist laboratory services.

Figure 7.3:
Causes of delayed
transfusion n=94



Case 7.8: Failures of telephones at two Blood Centres

An 81 year old man admitted in the middle of the night with haematuria required urgent transfusion of platelets (count $4 \times 10^9/L$) and red cells. The biomedical scientist (BMS) ordered 2 units of platelets electronically at 03:13. Approximately 30 minutes later, the emergency department consultant asked for the platelets urgently. The BMS tried to phone two Blood Centres on two different numbers but all, including the emergency number, were unobtainable. He was also crossmatching blood, and was unable to find compatible blood. He then tried to contact the red cell specialist laboratory but again was unable to get through on several attempts. Eventually, after leaving this number ringing out for approximately 5-10 minutes, it was answered. He then requested an emergency crossmatch. This message was not understood, as became evident some hours later, when another BMS working the day shift contacted the red cell laboratory on the same number for an update. The BMS was advised that she should not be using this telephone number unless we required an emergency crossmatch, to which she replied that she did. These miscommunications resulted in a delay to the transfusion of both platelets and red cells.

The root cause was identified as a telephone service outage. During planned changes on the network an unexpected problem resulted in 32 sites experiencing a loss of telephone service. A major incident was declared by the service provider and a full root cause analysis was initiated following the event resulting in several learning points and preventive and corrective actions for the service provider and the Blood Service. No other patients were impacted by this loss of business continuity.

Case 7.9: Failure of correct patient identification in an emergency

Two patients with the same first name were having identical procedures in theatre. The first patient bled excessively, but the MHP was activated for the wrong patient. Red cells were sent to the clinical area for the patient who was not subject to a MHP. The blood was returned to the transfusion laboratory issue refrigerator. Blood was then sent to theatres for the correct patient. The incident occurred out-of-hours at the end of a week. The notes of the wrong patient were used for identification.

Case 7.10: Delay due to power failure at refrigerator

Red cell units could not be released in an emergency from a remote issue refrigerator due to power failure. The patient had irregular antibodies and the units had been prepared in advance of his elective surgery but were required urgently when he bled during the procedure (Hb 57g/L). After a 20-minute delay group-specific units were supplied from the main laboratory and further units crossmatched.

Case 7.11: Delay due to computer confusion

Three units of FFP issued for Patient 1 were returned to stock. The units were re-issued to Patient 2 on the following day. On removal from the secure remote refrigerator the 'XM' to 'ISSUE' status message related to Patient 1 not Patient 2 as expected. The units were now at 'ISSUE' status in the blood inventory on the laboratory information management system (LIMS) for Patient 1, 'ISSUE' in blood product history (audit trail) on LIMS for Patient 2 and 'XM' in patient file in LIMS for Patient 2. Furthermore the 'ISSUE' status was transmitted to the hospital information system for Patient 1 not Patient 2 so the units could not be electronically given to the correct patient. This caused significant delay to the patient's transfusion and required a manual process to be applied by the transfusion practitioner. This is an information technology (IT) issue to be resolved by the provider.

In 16/26 (61.5%) cases reported as communication failure, the components were required for an urgent or emergency situation.

Sample errors n=15

Type of sample error	Number of cases
Sample labelling error	2
Sample delayed in reaching laboratory or no sample available	4
Wrong blood in tube (group and screen)	7
Wrong blood in tube (full blood count)	1
No second sample available. Preoperative assessment at another hospital	1
Total	15

Table 7.1: Sample error categories

Case 7.12: Delayed transfusion due to poor practice

A patient required a 2-unit transfusion following rectal bleeding at 13:25. A sample with a crossmatch form was sent by the locum doctor but the form was not signed. The sample was discarded and no further sample received until the patient had a cardiac arrest. There was a 7-hour delay from the blood being requested to patient receiving a transfusion.

There were 15 sample errors leading to delayed transfusion. In 4/7 WBIT cases, patient details had been incorrectly entered on to the hospital patient information system. In all four cases the error was detected at the final check prior to transfusion; however the reports documented that there were delays in treatment until the problems were resolved.

Paediatric cases of delayed transfusion

Twenty cases were reported in children (4 described below) illustrating difficulties in obtaining appropriate components urgently, or communication failures resulting in delay.

Case 7.13: Delayed urgent transfusion

There was a delay of 2 hours to obtain red cells suitable for neonatal use for a neonate with Hb 47g/L, but there was no discussion with a haematologist to consider concessionary release of adult units.

Case 7.14: Irradiated unit without adequate labels

A 3 day old baby required urgent red cell exchange for hyperbilirubinaemia. A suitable irradiated unit was sent from the Blood Centre but without confirmation-of-irradiation labels attached. The delay to obtain another unit would be 3-4 hours, so this unit was given concessionary release and transfused with a 3-hour delay.

Case 7.15: Exchange transfusion but poor communication

A 31 weeks gestation baby at 24 hours of age required exchange transfusion with the decision made at around 01:00. Neither the verbal or written request indicated that this was an exchange. The baby's bilirubin levels had been above the exchange transfusion threshold 12-13 hours earlier. When blood arrived at 03:30 it did not meet the requirements for neonatal exchange transfusion (i.e. blood was not less than 5 days old and was not irradiated).

Case 7.16: Communication confusion with misunderstanding of antibody information

A sample was received for a group, direct antiglobulin test and crossmatch late at night. The information on the request form stated 'maternal anti-E and -C antibodies' and that the patient had received intrauterine transfusions (IUT) although the question 'Has the patient previously been transfused?' was answered 'No'. The BMS crossmatched blood appropriate for the antibody information (the IUT and delivery had been performed in a different hospital so there was no way of confirming the maternal details out-of-hours), but the blood was found to be incompatible. The BMS spoke to the registrar at 05:21 who confirmed the blood transfusion was not urgent yet. On investigation it was discovered that the information about the maternal antibodies was incorrect. These were actually anti-c and anti-Jk^a. This explained the incompatible crossmatch. It then took the Blood Centre a further 5 hours to provide suitable blood. The baby had a considerable delay to transfusion of more than 12 hours due to inaccurate information being provided initially.

Comment: The combination of anti-E with anti-C is very unusual and might have prompted the BMS to query the accuracy. This case demonstrates how important it is to have an accessible database with historic sensitisation information.

Avoidable transfusions n=143

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.

This section includes avoidable use of emergency O D-negative blood where group-specific or crossmatched blood was readily available for the patient.

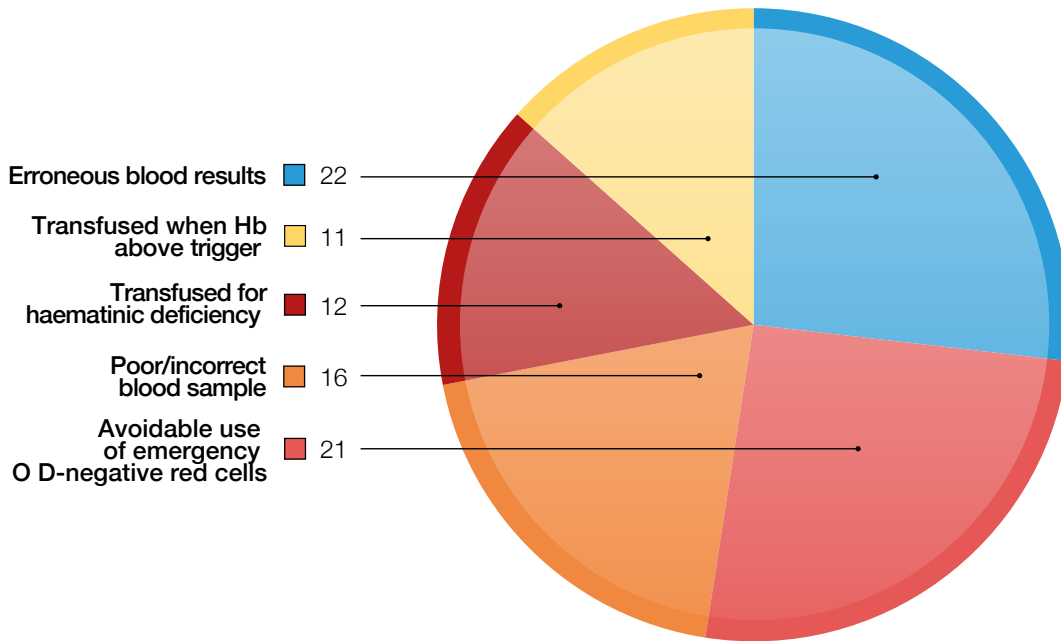


Figure 7.4: Causes of avoidable transfusions: Top 5 causes n=82 cases

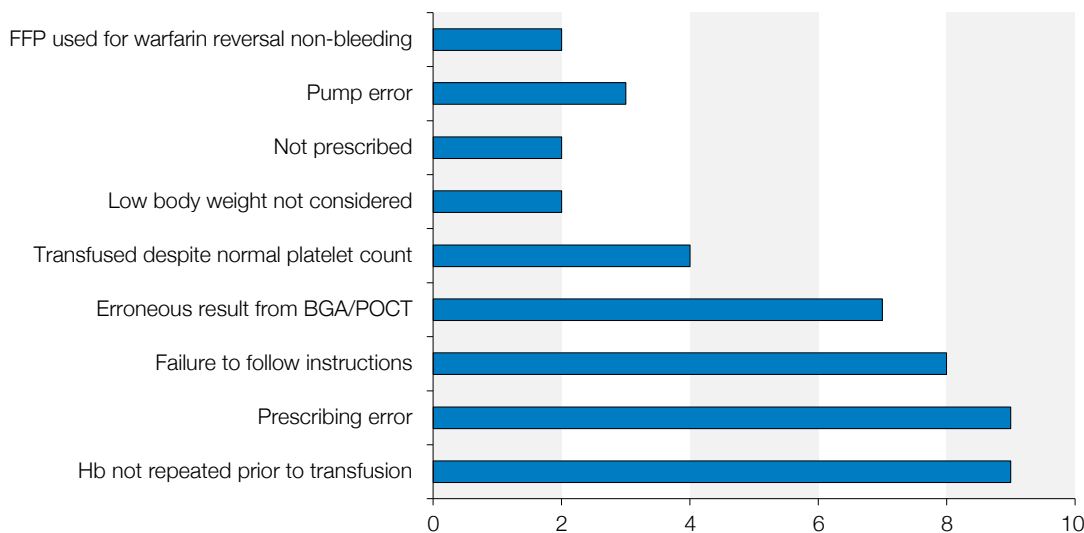


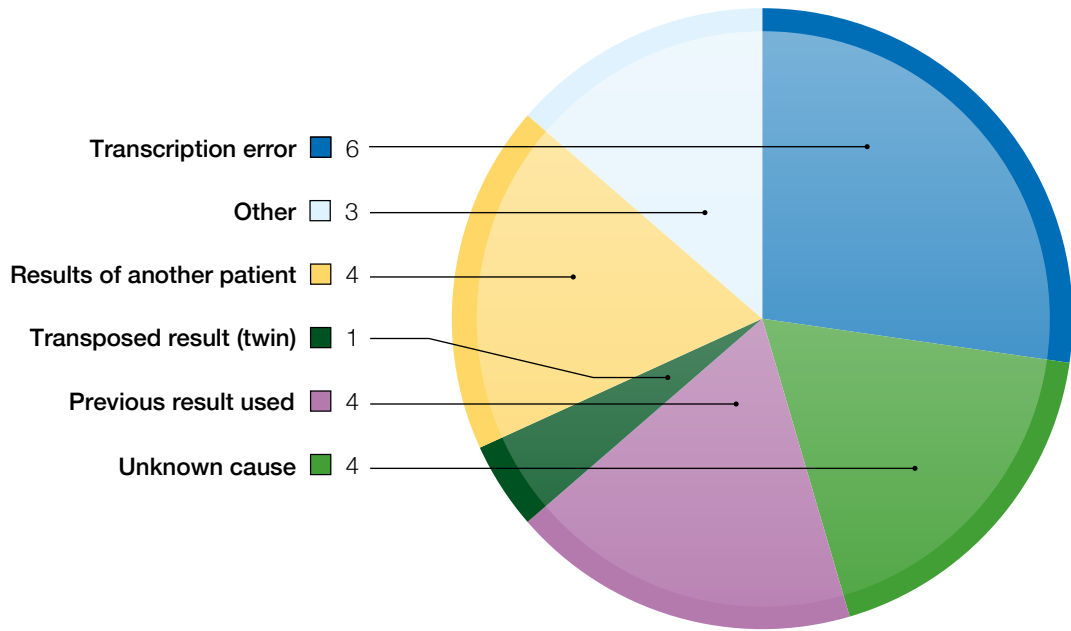
Figure 7.5: Other causes of avoidable transfusions n=46

BGA: blood gas analyser POCT: point of care test (Note: 15 miscellaneous cases not included)

Pre-transfusion assessment is a fundamental part of the transfusion process and can prevent avoidable transfusions. The principles of patient blood management and better blood transfusion are comprehensive means of pre-transfusion assessment prior to taking the decision to transfuse (NBTC 2014).

Transfusion based on the erroneous blood results n=22

Figure 7.6:
Causes of
erroneous blood
results n=22



Case 7.17: Transposition of results for twins results in one delayed and one unnecessary transfusion

Twins in the neonatal unit had their Hb checked. Twin 1 had previously been transfused and the Hb was 134g/L. Twin 2 had Hb 76g/L. At some point during the night shift the results for Twin 1 and 2 were transposed. Twin 1 received an unnecessary transfusion resulting in Hb 171g/L. The staff realised the error when this result was reviewed together with Twin 2’s repeat Hb which was 74g/L. Twin 1 was kept under observation, and Twin 2 given a top up transfusion (post-transfusion Hb 114g/L). Fortunately there were no adverse sequelae.

Good practice point: The incident review determined that the usual practice for recording telephoned results was to write them on a piece of paper without any formal identification step. There was then no confirmation of results or identity before prescribing the transfusion. Telephoned results are now to be transcribed directly into the patient record using all patient identifiers and the results are to be repeated back (BCSH Milkins et al. 2013).

Avoidable use of emergency O D-negative red cells n=21

Table 7.2:
Avoidable use
of emergency O
D-negative units
n=21

Reason	Number of cases
Crossmatched units available	8
Group-specific units available/could have been made available	4
Sample labelling error	3
Failure to ensure 2 samples prior to theatre	2
No blood requested for AAA surgery	1
No valid group and screen sample for surgery	1
Hb results did not indicate transfusion required	1
Incorrect sample used for crossmatching	1
Total	21

AAA: abdominal aortic aneurysm

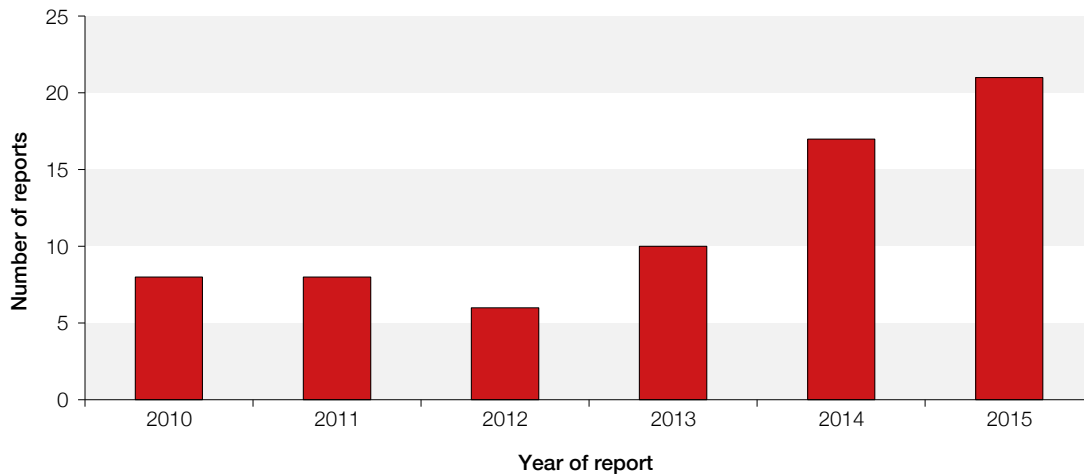


Figure 7.7:
Cumulative
avoidable use
of emergency O
D-negative red
cells n=70 reports

There has been a steady increase of reports of avoidable use of emergency O D-negative blood. In the majority of cases it has been used instead of available crossmatched or group-specific red cells. Only two reports related to the lack of a group-check sample.

Emergency O D-negative red cells are an essential resource in the emergency situation when no other options are available. These are not suitable for everyone, for example D-negative red cells (cde/cde) are, by definition, incompatible for individuals who have developed anti-c (BCSH Milkins et al. 2013). Clinical staff are encouraged to communicate with the laboratory to ensure a safer option is offered to the patient (O D-positive R1R1 (CDe/CDe) units do not have the c antigen).

Haematinic deficiency n=12

The majority (11/12) of these were patients with iron deficiency anaemia. The diagnosis and management of patients with iron deficiency is well documented (Goddard et al. 2011, NICE 2015, RCN 2015, CMFT 2013) to guide clinicians.

Blood gas analyser and point-of-care (POC) testing errors n=7

SHOT consistently receives a small number of these cases each year. The causes may be that the machine is not quality-assured for this purpose or that the test was poorly carried out by inadequately trained staff.

Two cases resulted in the unnecessary transfusion of emergency O D-negative red cells. This also included one instance where a blood glucometer was used to measure the patient Hb in error.

Case 7.18: Incorrect Hb result obtained from use of wrong point-of-care testing device

A 64 year old patient was bleeding heavily during arterial surgery (1200mL). The anaesthetist asked the operating department assistant (ODA) to order 4 units of red cells and the transfusion laboratory advised that this would take around 40 minutes. The Hb result of 5.7g/dL from point-of-care testing was lower than anticipated but was feasible in the circumstances. The anaesthetist decided he could not wait for the crossmatched units and requested emergency O D-negative units instead.

The nurse who came to help in theatre identified that the Hb had been measured using a glucometer and there was no haemoglobin testing device in the department.

There were a number of issues identified in the RCA:

- ODA working in an unfamiliar environment
- The incorrect piece of equipment was identified to test the Hb
- No label on the device to clearly identify what it was
- Lack of knowledge of operator

- Busy, stressful environment and a difficult case
- Miscommunication about what equipment was available
- Inadequate pharmacy stocks
- Missing and/or broken equipment

Review of POC machines demonstrated that haemoglobin and glucose monitors can look surprisingly similar.

Commercial branding may result in an increased risk of errors

There is a dichotomy between the commercial benefits of branding and a potentially higher risk of errors resulting from brand-led confusion. Branding can be defined as ‘a set of associations that a person (or group of people) makes with a company, product, service, individual or organisation’ (Design Council, 2013). The aim of branding is to create a presence in a commercial market in order to attract and retain loyal customers. A strong brand can enhance a company’s financial worth (Keller 1993) and brand awareness has been shown to be a dominant factor in consumer choice (Hoyer et al. 1990).

Elements of branding include common themes between products, such as logos, colours, style and mode of use in order to reinforce the company’s image. However, while such branding might encourage purchases, it can both enhance safety and conversely increase the risk of error. Branding similarities enhance marketing purposes, by making products easily recognisable. This may have positive safety implications, especially from familiarity with the operation of a product, so if for example one point of care testing apparatus works in a similar way to another, then an operator familiar with one will be able to operate the other. Conversely, there is a risk of error if two POC testing products look almost identical and can be confused at the time of use.

Research from over a decade ago showed that there was little evidence within the NHS of an understanding of the value and significance of design to improve patient safety (Clarkson et al. 2004). The continuing opportunity for confusion between POC testing analysers indicates there remains a split between commercial branding values and patient safety error reduction requirements.

Prescribing errors n=9

In one instance the IT set up was not fit for purpose: the electronic prescribing system defaulted to the volume of an adult unit for neonatal intensive care unit (NICU) patients – discussed in Chapter 10, Information Technology (IT) Incidents.

Sample errors n=16

Table 7.3:
Full blood count
sample errors n=16

Reason	Number of cases
Dilute sample	8
Wrong blood in tube	3
Clumped/clotted	3
Insufficient/short sample	2
Total	16

Near miss cases n=7

Similar lessons can be learnt from near miss cases that were detected before the patient received an avoidable or inappropriate transfusion.

Point in the process	Type of error made	Number of cases
Request	Requested on the basis of erroneous results	2
	Requested for incorrect patient	2
Sample taking	Wrong blood in tube FBC* sample	2
Prescription	Laboratory issued blood that had not been requested or prescribed	1
Total		7

*FBC: full blood count

Table 7.4:
Near misses that
could have led
to unnecessary
transfusions n=7

Inappropriate transfusion of FFP n=3

In 3 cases FFP was transfused inappropriately. These do not include Case 11.4 in Chapter 11, Acute Transfusion Reactions (ATR) and another patient who experienced transfusion-associated circulatory overload (TACO) following inappropriate transfusion of FFP (NICE 2015).

Transfusion of inappropriate volumes:

Undertransfusion n=4 (not included in the total 143 avoidable transfusions)

Most of these were failures to transfuse sufficient components in the face of bleeding. One adult patient was unnecessarily transfused a single unit of FFP.

Overtransfusion n=27

There were 27 avoidable transfusions that resulted in overtransfusion. Poor decisions were made in 16 of these cases.

Inappropriate or delayed administration of prothrombin complex concentrate n=4 (not included in the total 143 avoidable transfusions)

In 2015 SHOT asked reporters to submit summaries of incidents involving the inappropriate or delayed administration of prothrombin complex concentrate (PCC). Four cases were submitted to SHOT by email (not included in the overall number of SHOT reports).

Case 7.19: Wrong, wrong and wrong

An 80 year old man on warfarin was admitted to the emergency department (ED) with possible gastrointestinal haemorrhage. He was inappropriately supplied with 6 vials of PCC as a 'take home' prescription; this dose was supposed to have been administered while an inpatient when he was first admitted (international normalised ratio (INR) 5.1), but as a result of delay and transfer between wards, the INR fell without treatment to 1.6. He did not need the PCC at all.

Case 7.20: PCC administered to wrong patient

An 82 year old man was admitted to the ED with a 1-week history of reduced mobility and left sided weakness. A computerised tomography (CT) scan showed a large cerebral haematoma. The junior doctor tried to contact the neurosurgical team by telephone (at another hospital) to discuss the results of the CT scan. While she was waiting on the telephone, she was also trying to arrange a CT scan for another patient. When asked about the patient's INR result she read results from the wrong case notes in error. Treatment with PCC and vitamin K was advised by the haematology consultant. PCC was issued and checked with the staff nurse before administration. Another staff nurse on the ward advised that the patient actually receiving PCC had not had an INR sample taken. The administration was stopped after 1.5mL. The patient came to no harm.

Case 7.21: Inappropriate PCC prescription

A patient with liver disease and acute renal failure needed a central line. Coagulation tests showed minimal derangement (normal fibrinogen, borderline activated partial thromboplastin time, and prothrombin time of 22.8 seconds). PCC was given inappropriately as it was not indicated for this clinical scenario. No repeat coagulation tests were performed.

Case 7.22: Confusion over batch numbers for a blood product

A dose of 2500IU PCC was requested. The BMS selected 1 vial from one batch and 2 vials from another batch. The BMS did not realise the mistake and the wrong batch labels were attached to the vials. This was not detected at the final check prior to administration.

Comment: SHOT is taking reports of delayed, and inappropriate or unnecessary PCC administration. Please contact the SHOT office if you have a case to report.

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Near Miss Reporting (NM) n=1243

8

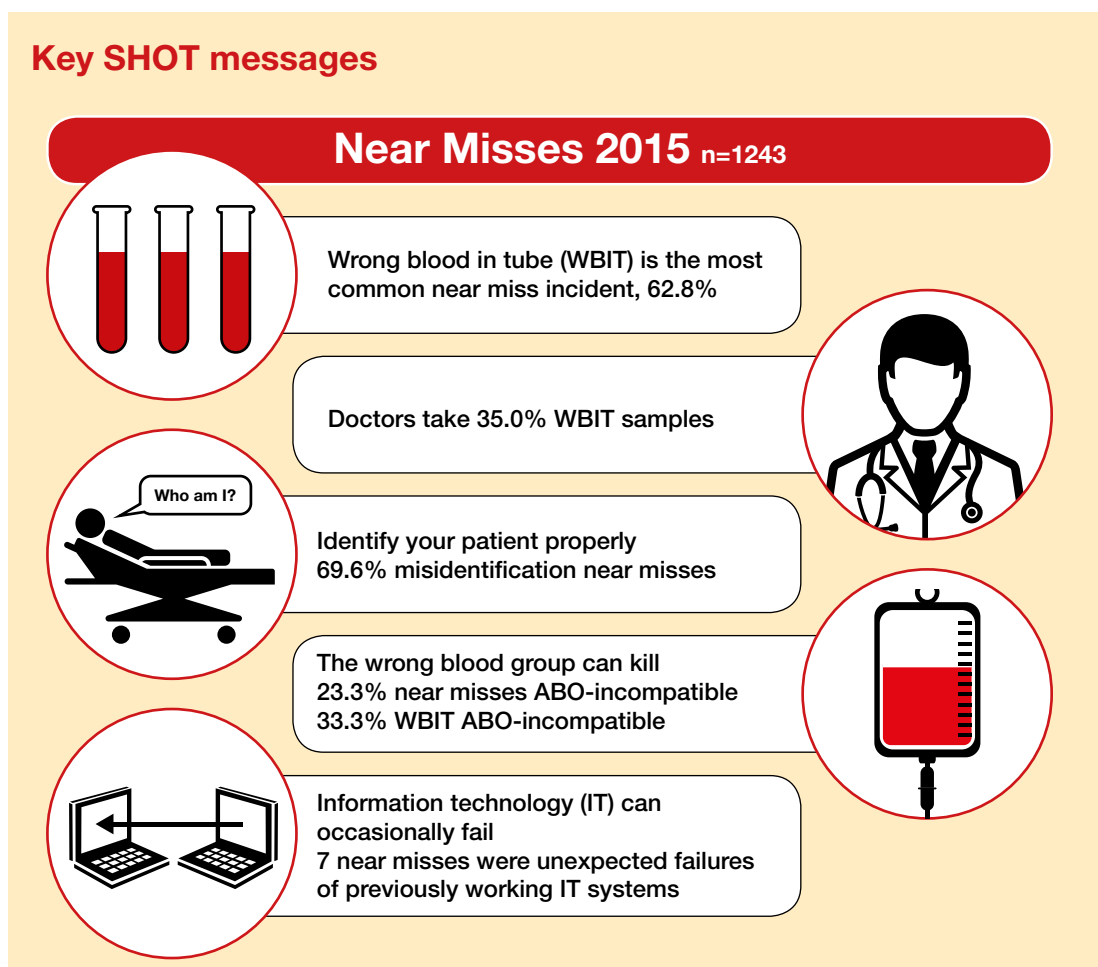
Authors: Alison Watt and Katy Cowan

Definition:

A 'near miss' event refers to any error which, if undetected, could result in the determination of a wrong blood group or transfusion of an incorrect component, but was recognised before the transfusion took place.

Near miss reports continue to increase, n=1243 in 2015 from n=1167 in 2014.

Key SHOT messages



Discussion of near miss errors in other chapters

In order to highlight the importance of continuing to report and learn from near miss incidents, full discussions of these cases are incorporated into each relevant chapter according to the likely outcome if the near misses had progressed to full incidents and components had actually been transfused. Table 8.1 details the subcategorisation of near miss events according to SHOT definitions.

Table 8.1:
Categorisation of
all near misses
according to SHOT
definitions

Categorisation of all near misses according to SHOT definitions		Related chapter	Number of cases	Percentage of cases
Incorrect blood component transfused (IBCT)	Wrong component transfused (WCT)	Chapter 6	889	71.5%
	Specific requirements not met (SRNM)		97	7.8%
Right blood right patient (RBRP)		Chapter 19	130	10.5%
Handling and storage errors (HSE)		Chapter 20	97	7.8%
Adverse events related to anti-D immunoglobulin (Anti-D Ig)		Chapter 9 & 21	23	1.8%
Avoidable, delayed or undertransfusion (ADU)		Chapter 7	7	0.6%
Total			1243	100%

Reporting of near miss errors

Wrong blood in tube incidents (WBIT) are the most frequently reported errors, 62.8% (780/1243) of all near misses in 2015, but important lessons can be learnt from all near miss errors, so continued reporting is strongly encouraged.

ABO incompatibility prevented by detection of near miss incidents n=288

ABO-incompatible red cell transfusions could have resulted from 288/1243 (23.2%) near miss events. More than half of these would have been the most high risk error of group A red cells being transfused to a group O patient (145/288, 50.4%). Previous SHOT analysis (Bolton-Maggs et al. 2014) indicates approximately one third of ABO-incompatible transfusions result in death or major morbidity.

Table 8.2:
Potential ABO-
incompatible
transfusions

Potential incorrect ABO transfusions	Number of cases	Percentage of cases
A to O	145	50.4%
B to O	46	16.0%
A to B	28	9.7%
B to A	26	9.0%
AB to O	11	3.8%
AB to A	10	3.5%
AB to B	5	1.7%
Groups not stated	17	5.9%
Total	288	100%

ABO mismatches that would not result in incompatible red cell transfusions could still be unsuitable for transfusion of plasma components. There might also be circumstances where the patient has red cell antibodies that have not been detected, because the WBIT sample tested was not their blood, Case 8.1.

Case 8.1: WBIT could have resulted in a transfusion incompatible for both ABO and K

A sample was received from the emergency department (ED). The sample acceptance criteria were met. The patient's historical record was group A D-positive, with anti-K. The sample received tested as AB D-positive, as a result of a wrong blood in tube error.

Alongside potential ABO incompatibilities, there were also 83/1243 (6.7%) cases where patients were at risk of D mismatches, of whom 30/83 (36.1%) were females of childbearing potential.

Potential D-mismatches		Number of cases	Percentage of cases
D-positive to female of childbearing potential n=30	ABO-incompatible and D-mismatch	16	19.3%
	D-mismatch alone	14	16.9%
D-positive to others n=53	ABO-incompatible and D-mismatch	14	16.9%
	D-mismatch alone	39	47.0%
Total		83	100%

Table 8.3:
Potential D-mismatched red cell transfusions

It is important to understand that the severity of an error is not related to the outcome. Near miss errors, such as the 288 that might have led to ABO-incompatible transfusions, could in more unfortunate circumstances have led to death or major morbidity. SHOT is aware of individual staff members who have been disciplined or dismissed because an error in transfusion has led to patient harm. When compared with the potential outcome of these near miss events, it may be inappropriate to assign blame to staff only when the outcome is more severe, because the potential outcomes of all these events could be equally catastrophic. Within the field of human factors it is recommended that institutions adopt a ‘just culture’ policy (Dekker, 2012) where staff members are not punished unless there has been wilful violation or gross negligence (see also further comments in the Error Reports: Human Factors section).

Importance of group-check policy

A small sample of wrong blood in tube cases (43/780) were analysed where the reporter mentioned the policy of requiring a group-check sample, as recommended in the British Committee for Standards in Haematology (BCSH) guidelines for pre-transfusion compatibility (BCSH Milkins et al. 2013) (Figure 8.1). Reports of a further 4/780 WBIT cases indicated that a group-check policy had not yet been introduced.

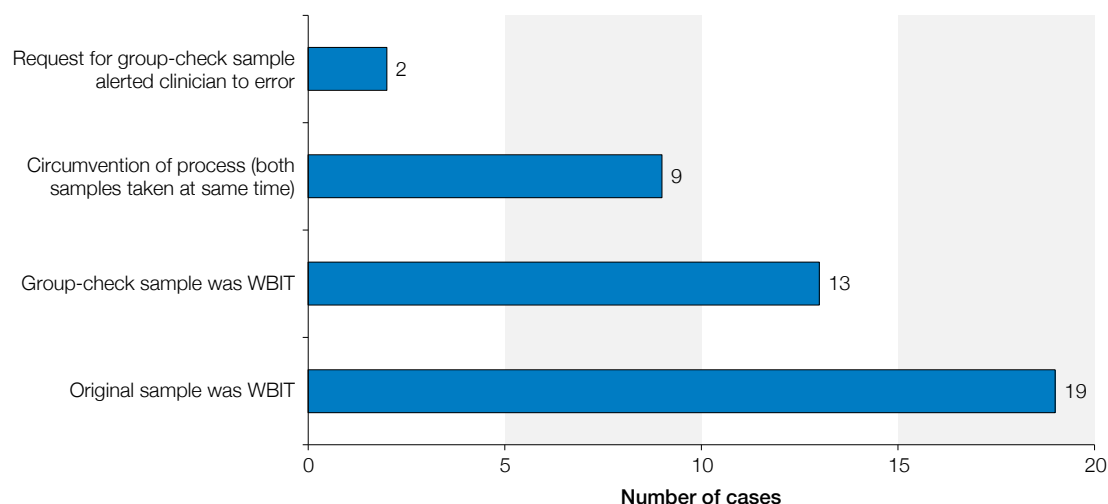


Figure 8.1:
Outcomes of testing a group-check sample on a previously unknown patient n=43

These numbers may not be very representative of the process as a whole. Use of the group-check policy is becoming part of routine practice, so reporters may not mention the policy when a repeat sample detects an earlier WBIT (19/43, 44.2%), but may be more likely to refer to the policy when either the group-check sample was a WBIT (13/43, 30.2%) or there has been a circumvention of the process (9/43, 20.9%). In the circumvention of process incidents, 6/9 cases revealed that two samples were taken at the same time from the wrong patient. A specific question about the group-check policy has been added to the SHOT WBIT questionnaire from January 2016.

Case 8.2: The transfusion group-check policy highlights an error in non-transfusion samples

A group and screen sample was taken on a previously unknown patient. The group-check sample taken the next day showed a discrepancy with the blood group and the investigation revealed that the first sample was a wrong blood in tube. Non-transfusion blood samples taken at the same time

as the initial error were also from the wrong patient and this impacted on the patient's care, because abnormal liver function test results were not recognised for a further 24 hours.

Case 8.3: Incorrect second sample reveals other underlying poor practice

A group and save sample grouped as O D-positive. A few days later a group-check sample was taken, because the patient was having a surgical procedure, but this grouped as AB D-positive. The patient was re-bled to check the group and this confirmed the patient was O D-positive. Although not relevant to this case, which was separated by a few days, the investigation revealed that when the individual involved was aware that two samples for grouping were needed, she would ask a colleague to check the patient details with her and take both samples together, instead of following the correct procedure where two separate people identify and bleed the patient at different times.

A further danger was highlighted unexpectedly and is not included in the data in Figure 8.1, because a group-check sample is not required when secure electronic sample labelling is used. Case 8.4 revealed that a supposedly secure electronic labelling system was being used incorrectly.

Case 8.4: WBIT shows a secure electronic labelling system was being used incorrectly

Two samples were sent for the same patient from the ED. Sample bottles were electronically labelled and forms and bottles matched. As the bottles had been electronically labelled, a group-check sample was not required and a single sample would have been deemed safe for transfusion purposes. The laboratory was alerted by a telephone request for another patient in the ED, from whom no sample had been received. When the two samples labelled for the same patient were tested, one sample grouped as B D-positive and the other as O D-negative. The sample taker confirmed when taking the WBIT sample the patient wristband was scanned with the electronic labelling system handheld device without it being on the patient's wrist. In addition, no verbal confirmation was done of the patient identity and all of the labelling was done away from the patient.

Learning point

- Continued education is needed to ensure all staff understand the reasons for a group-check policy and the possible consequences of trying to circumvent the system

Since the BCSH guidelines for pre-transfusion compatibility (BCSH Milkins et al. 2013) recommended the introduction of a group-check policy, there has been some debate about what constitutes a historical sample. This was summarised in a presentation at the 2015 UK National External Quality Assessment (NEQAS) *Blood Transfusion Laboratory Practice* (BTLP) and British Blood Transfusion Society (BBTS) Blood Bank Technology Special Interest Group (Rowley 2015). SHOT data from WBIT reports in 2015 show that 66/780 were historical WBIT samples. Many of these historically incorrect samples were taken close to the repeat sample that demonstrated the error, 32/66 in the same year 2015, many of these within the same patient episode and 11/66 in the previous year, 2014. However, the dates of historical WBIT errors stretch back as far as 1990 and 7/66 were tested before 2000. It is doubtful if records that old could be treated as valid historical groups.

Learning point

- Local group-check policies should include a cut-off point, before which a historical record in that institution should not be considered valid and a further group-check sample should be requested

Quality management systems

Quality processes and checking procedures can prevent errors leading to incorrect transfusions, but there were elements of good fortune in the detection of 261/1243 (21.0%) of near miss cases. A further 581/1243 (46.7%) were found as a result of testing anomalies, usually a different ABO/D group, which is only possible if the incorrect sample is of a different group. Hence there was an element of good fortune in the detection of 842/1243 (67.7%).

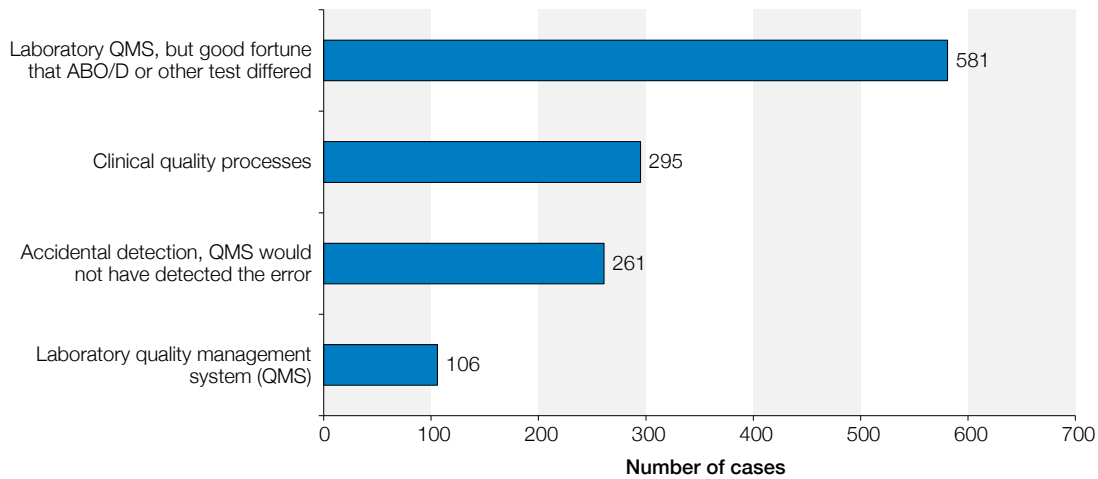


Figure 8.2: Near miss detected by quality management system or good fortune

Staff groups responsible for taking WBIT samples

As in previous years doctors are the largest group that take WBIT samples (Figure 8.3), but in general it is not known what proportion of transfusion samples are taken by different staff groups. Data provided from the Oxford hospitals, which use a fully electronic system, provide some denominator evidence. Comparison of the percentages of each group who take transfusion samples shows that doctors and midwives are overrepresented in the WBIT group.

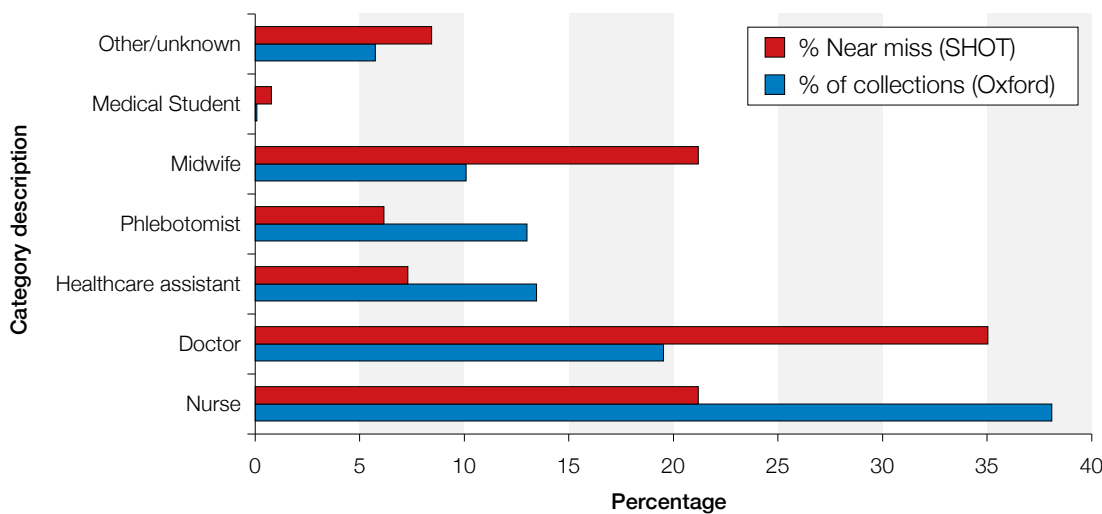


Figure 8.3 Staff groups responsible for WBIT samples reported to SHOT (n=780) compared with staff groups who take all transfusion samples in Oxford Hospitals. Total Oxford samples n=14802 (3 months January to March 2016)

With thanks to Professor Mike Murphy and colleagues for making these data available

Case 8.5: Sample labelling error on a cord sample reveals WBIT caused by dangerous practice

A cord blood sample was received to check whether anti-D immunoglobulin (Ig) prophylaxis was required for the mother. This grouped as O D-negative. However, the sample was missing the baby's hospital number, so a repeat sample from the baby was requested, which grouped as A D-positive. A further sample confirmed the correct group as A D-positive. On investigation it was discovered that at delivery the placenta and cord had been disposed of in a clinical waste bin. After realising a cord blood sample should have been taken, the midwife sampled the placenta in the bin. However there was more than one placenta in the clinical waste and the incorrect one was selected, so that cord blood from another baby was sent. As a consequence, it had initially been queried whether there could have been a switch of babies, until the discovery of the sampling error. If the error had not been discovered, then no prophylactic anti-D Ig would have been issued as the baby would have been reported as D-negative.

IT and analyser-related near miss reports n=7

As reported in 2014 there were again a small number of reports of unanticipated IT equipment failures leading to laboratory problems, n=7. These incidents were all in separate Trusts/Health Boards and all involved the IT not working as expected, including 3/7 where the patient demographics were populated with an incorrect group. Of those, 2/3 involved the same manufacturer and this was discussed with the Medicines and Healthcare Products Regulatory Agency (MHRA), when these incidents were reported under the Blood Safety and Quality Regulations (BSQR) (BSQR 2005), so the MHRA are aware of two similar issues related to the same analyser supplier.

The other 4/7 incidents involved IT equipment not working as it had previously (3/4), or as expected following additional programming requested of the manufacturer (1/4). Errors such as these are often the result of validation or testing failures when new or updated systems are implemented. Ongoing vigilance and validation is vitally important where reliance on IT is critical to the process, such as for electronic issue of blood as demonstrated by the ABO-incompatible transfusion (Case 6.1) reported in Chapter 6, Incorrect Blood Component Transfused (IBCT).

Further analysis of total near miss errors n=1243

Table 8.4:
Numbers of near misses originating in clinical or laboratory areas

Category of incidents	Number of cases	Percentage of cases
Clinical errors	956	76.9%
Laboratory errors	287	23.1%
Total	1243	100%

Additional tables showing the subcategorisation of near miss errors consistent with those in previous Annual SHOT Reports (2010–2014) can be found in the supplementary information on the SHOT website www.shotuk.org.

COMMENTARY

Failure of patient identification is a common root cause of transfusion errors. In near miss cases misidentification can lead to WBIT or to collection or attempted administration of components intended for another patient. Patient identification failures contributed to 865/1243 (69.6%) of all near misses.

Wrong blood in tube incidents (WBIT) remain the most commonly reported near miss error, 780/1243 (62.8%) of all near misses. Reporters are encouraged to report all types of near miss, because valuable lessons can be learnt.

Near miss incidents show that errors can put patients at considerable risk of ABO-incompatible transfusions 288/1243 (23.2%) and at particular risk when the incident is a WBIT sample 260/780 (33.3%). A group-check policy is an effective quality improvement to detect wrong blood in tube events and all Trusts/Health Boards should implement the policy as detailed in the BCSH guidelines for pre-transfusion compatibility (BCSH Milkins et al. 2013) and recommended by SHOT in previous Annual SHOT Reports.

Laboratories are heavily dependent on IT systems and a small number of near misses (n=7) demonstrated that IT is not always 100% reliable. Robust validation and testing of IT can mitigate many of these problems and laboratory staff need to remain vigilant for unexpected failures.

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9 Adverse Events Related to Anti-D Immunoglobulin (Ig) n=350

Author: Tony Davies

Key SHOT messages

- SHOT's key message about anti-D Ig is to encourage consistency of practice within hospitals, with robust policy formulated as a partnership between obstetricians, midwives and the laboratory, regardless of which professional guideline may influence the finer detail

Themes in this year's reports show:

- Misunderstanding of national guidance, specifically that anti-D Ig should be offered for sensitising events, regardless of whether the woman has received routine antenatal anti-D Ig prophylaxis (RAADP) (and vice versa), and that diagnosis and delivery of intrauterine deaths (IUD) should be treated as separate sensitising events as they may be some days apart
- There persists a culture of transcribing blood grouping results onto maternity notes and care plans, often incorrectly, resulting in omission or inappropriate administration of anti-D Ig
- Failure to consult computer records before issuing anti-D Ig from the laboratory
- Putting the onus on the woman to return for anti-D Ig when she is variously frightened, traumatised, too ill, or has her hands full with a new baby, instead of issuing it at presentation is inappropriate. Putting the blame for failure onto the woman for not complying does not improve an inadequate system
- Comments such as 'nobody would take responsibility for dealing with this issue' denote a poor system
- Community midwives often do not have access to the electronic patient record, and therefore do not see the most recent or updated reports related to D status or antibody titres, relying instead on what may be outdated versions in the hand-held notes
- Poor (and largely unsubstantiated) advice that there is no point in administering anti-D Ig once 10 days have passed since a sensitising event has become common practice. Evidence from 1975 indicates that administration up to 2 weeks may be beneficial (see Chapter 21 in Web Edition)

A total of 350 case reports were reviewed this year, of which 271 (77.4%) related to the omission or late administration of anti-D Ig. This is a continuing worrying situation, putting a significant number of women at risk of potential sensitisation to the D antigen with associated mortality and morbidity in affected neonates.

There was one case where immune anti-D was wrongly assumed to be present due to prophylaxis and so the pregnancy continued unmonitored, resulting in a severe case of haemolytic disease of the fetus and newborn (HDFN) requiring exchange transfusion, during which the baby died.

Case 9.1: Assumption coupled with poor handover leads to unmonitored pregnancy

A biomedical scientist (BMS) tested a woman's sample and found anti-D to be present. A message was left for the next shift to ask maternity whether anti-D Ig had been administered. The message was misinterpreted as meaning that the detectable anti-D was prophylactic, and the pregnancy continued unmonitored, along with further prophylaxis. The baby was born extremely jaundiced, requiring immediate exchange transfusion, but developed complications leading to death (see Case 1 in the Error Reports: Human Factors section).

There were 3 cases where a woman developed an immune anti-D following delay or omission of prophylaxis during the current pregnancy.

It is disappointing to read a comment from one case, that 'The onus on checking reports from the reference laboratory should be on clinical staff', when the hospital laboratory has such an important role to play in interpreting and conveying often complicated messaging to clinical colleagues whose concerns are 'Should I be worried by this?', or 'Do I need to do anything because of this report?'

There is however one excellent example of implementation of good practice following reported errors, and this is to be applauded:

Case 9.2: Laboratory report misinterpreted

Anti-D Ig was issued for routine prophylaxis at 28 weeks from clinical stock, after midwives misinterpreted 'Antibody Screen Negative' as 'D negative'. The laboratory has changed the wording on their grouping reports to; 'No antibodies detected' in an attempt to stop this happening again.

Full details of Anti-D Ig Errors are available in the full chapter, Chapter 21, in the 2015 Annual SHOT Report: Web Edition.

10

Information Technology (IT) Incidents

Authors: Megan Rowley and Paula Bolton-Maggs

Since 2007, the Annual SHOT Report has included a detailed analysis of transfusion adverse events related to laboratory information management systems (LIMS) as well as other information technology (IT) systems used in hospital transfusion service delivery. This year we have not undertaken an in-depth analysis but have taken the opportunity to reflect on the recurrent IT-related themes identified year-on-year and to review key messages and recommendations made in previous annual reports. The aim was to see if SHOT messages about IT remain valid, to summarise whether any progress has been made to prevent IT-related errors and to apply 'human factors' thinking and methodology to the 'human-computer' interface!

Each year an increasing number of cases have been identified where IT systems may have **caused** (or contributed) to the errors reported, have been **used incorrectly** resulting in an error or where IT systems **could have prevented** errors but were not used. A recent patient safety report also noted that with increasingly complex care 'the increasing reliance on IT in healthcare can threaten patient safety' (Yu et al. 2016). The SHOT IT system messages fall into 4 broad categories:

1. **Promoting** the benefits of existing IT systems, and **developing** new IT systems, to aid transfusion safety recognising that national standardised specifications are essential to ensure systems support compliance with regulations, guidelines and emerging clinical requirements.

The benefits of IT systems to support safe transfusion practice are many including: LIMS configuration to prevent issue of ABO-incompatible blood; algorithms for electronic issue of blood; alerts, warnings and logic rules to ensure specific requirements are met; widely accessible databases of patients with complex transfusion requirements; vein-to-vein electronic blood management systems to support giving the 'right blood' to the 'right patient'.

There are now national and international specifications for IT systems to support safe blood transfusion practice and to structure the important dialogue between manufacturers and hospital transfusion services. The recent National Institute for Health and Care Excellence (NICE) transfusion guidelines recommend electronic patient blood management systems (NICE 2015) and a business case with evidence has been published based on data from Oxford (OUH 2016).

2. **Validating** IT systems to ensure they are configured correctly by using a broad range of scenarios covering the whole spectrum of transfusion practice. This applies to new systems but is equally important when existing systems are upgraded.

Validation is costly and time consuming but essential to ensure that IT systems are working as intended. SHOT has repeatedly shown that incompletely validated systems can put patients at risk.

We rely on IT systems in transfusion as a fail-safe mechanism to protect patients from receiving the wrong blood. It is important to still have an understanding of correct practice so that, when IT systems fail, the people operating the systems are in a position to detect and correct the errors.

3. **Training** all clinical and laboratory staff to use IT systems correctly and as intended. This includes communicating the very real risk to patient safety that exists where flags, alerts and warnings are bypassed in an IT system designed to protect patients from wrong blood incidents. Training should cover both routine and emergency situations so that IT systems support both safe and timely blood supply.

The importance of training and assessment of competence to use IT systems in the laboratory and clinical setting cannot be overemphasised. SHOT errors, and audits of transfusion practice, show how people are able to circumvent the barriers and prompts put in place.

Examples where training has not been adequate include: overriding or ignoring error messages for ABO-incompatible blood or specific requirements; using other people's identification (ID) badges (or logon details) to gain unauthorised access to remote issue refrigerators; being unable to issue blood resulting in delay because of unfamiliarity with standard operating procedures (SOP) for the LIMS.

4. **Ensuring accuracy** and security of data transfer across electronic interfaces to minimise error-prone manual transcription of data to and from IT systems.

Despite the national guidance to healthcare providers to use transferrable unique patient numbers (National Health Service (NHS) number, community health index (CHI) number) the uptake of this has been incomplete. Transfusion errors arise when patients move from hospital to hospital, or where hospitals and/or transfusion departments merge, and computer records are not accessible, visible or robustly linked or merged.

Inevitably there are some manual steps in the transfusion process but these can be minimised. The Medicines and Healthcare Products Regulatory Agency (MHRA) have issued guidance that electronic issue of blood components should not be possible if there is a manual step in the process but not all laboratories can comply with this because of their LIMS systems.

In some situations, and SHOT has shown maternity records as an example, there is no computer interface between laboratory and clinical systems so data has to be transcribed manually. This has led to both incorrect administration of anti-D immunoglobulin (Ig) to women with immune anti-D and omission of anti-D Ig in D-negative women because the wrong blood group or antibody screen result has been copied over.

COMMENTARY

IT systems are increasingly used to make blood transfusion safer but, in 2015, SHOT reports show the same pattern of IT system errors. This means that the full benefit of the protection for patients afforded by IT systems has not been realised and there is room for improvement. It is both an individual and organisational responsibility to ensure that IT systems that have been shown to improve transfusion safety are specified correctly and validated thoroughly. Training to use IT systems needs careful planning and to be adequately resourced because healthcare staff who use them need to understand their limitations and understand the consequences of using them incorrectly.

Case examples:

Case 10.1 (Case 6.1 in Chapter 6, Incorrect Blood Components Transfused): ABO-incompatible transfusion permitted by electronic issue (EI)

Case 10.2: Failure of correct bedside check

In 2014 one hospital noted after audit that 273 units were transfused by 105 different staff bypassing the final bedside check because the BloodTrack system had been set up to suit local preferences rather than as the manufacturer intended (staff using the emergency mode intended only for emergency O D-negative units on the personal digital assistant (PDA) to administer blood components that had been grouped and issued for a named patient). This was reported in the Annual SHOT Report 2014, Chapter 12, Summary of Errors Related to Information Technology.

Surprisingly, in 2015 SHOT received a further report from the same hospital concerning 162 units transfused by 58 further members of staff in the same way over 11 months, indicating that their corrective action had not been effective. Each of these had the potential for ABO-incompatibility if a wrong unit was selected. A poster was issued to all clinical areas and was on all the crash trolleys; the staff involved received further training but clearly this was not sufficient. The company introduced new software in

November 2015, but this has taken time to implement because the company has to build 125 secure digital (SD) cards, one for each PDA. This shows how very difficult it can be to catch the horse after it has bolted, to change wrong practice in a very large hospital, leaving patients at risk for a further 12 months.

Case 10.3: Electronic prescribing system in paediatric intensive care defaults to adult units

A 2 month-old child was prescribed 65mL of red cells over 2 hours in a paediatric intensive care unit, but the electronic prescribing system (for intensive care) automatically defaulted to one adult unit over 2 hours so the child received 141mL before the error was recognised but suffered no ill effects.

Case 10.4: (Case 8.4 in Chapter 8, Near Miss Reporting) WBIT shows a secure electronic labelling system was being used incorrectly

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REACTIONS IN PATIENTS

Serious Adverse Reactions (SAR)

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Reactions in Patients: Serious Adverse Reactions (SAR) (for EU Reporting)

Definition:

An unintended response in a donor or in a patient that is associated with the collection, or transfusion of blood or blood components that is fatal, life-threatening, disabling or incapacitating, or which results in or prolongs hospitalisation or morbidity...blood establishments and the person responsible for the management of a hospital blood bank shall notify the Secretary of State (Competent Authority) of any serious adverse reactions observed during or after transfusion which may be attributable to the quality or safety of blood or blood components:

- (i) Collected, tested, processed, stored or distributed by the blood establishment, or
- (ii) Issued for transfusion by the hospital blood bank

Key SHOT message

This definition (BSQR 2005) is pertinent to both SHOT and SABRE reports, therefore if the SAR conforms to this definition it must be reported to both SHOT and SABRE.

BSQR. **Blood Safety and Quality Regulations** (SI 2005/50, as amended)
<http://www.legislation.gov.uk/uksi/2005/50/contents/made>

SAR confirmed to the MHRA in 2015 n=262

Reactions in patients reported to SHOT (n=497) include the following and definitions are included at the heading of each chapter:

- Acute transfusion reactions n=296
- Transfusion-transmitted infections n=4
- Pulmonary complications n=102
- Haemolytic transfusion reactions n=59 (excludes ABO-incompatible transfusions with haemolysis which are included in Chapter 6 Incorrect Blood Components Transfused (IBCT))
- New or unclassifiable complications of transfusion n=14

Other categories located in the 2015 Annual SHOT Report Web Edition:

- Post-transfusion purpura n=2
- Cell salvage incidents n=20

Acute Transfusion Reactions (Allergic, Hypotensive and Severe Febrile) (ATR) n=296

11

Authors: Janet Birchall, Hazel Tinegate and Fiona Regan

Definition:

Acute transfusion reactions are defined in this report as those occurring at any time up to 24 hours following a transfusion of blood or components excluding cases of acute reactions due to an incorrect component being transfused, haemolytic reactions, transfusion-related acute lung injury (TRALI), transfusion-associated circulatory overload (TACO), transfusion-associated dyspnoea (TAD) or those due to bacterial contamination of the component.

In contrast to previous years unclassifiable reactions have also been removed. This largely leaves febrile type, allergic and hypotensive reactions for which no other obvious cause is evident. These are classified according to the International Haemovigilance Network/International Society for Blood Transfusion (IHN/ISBT) definitions which can be found in the supplementary information on the SHOT website www.shotuk.org, (ISBT/IHN 2011) and these have been adopted by the British Committee for Standards in Haematology (BCSH Tinegate et al. 2012).

Key SHOT message

- SHOT data and published studies indicate that the use of platelets suspended in platelet additive solution (PAS) is associated with a reduction in allergic response. Hospitals should consider preferential use of platelets suspended in PAS in patients with a history of this type of reaction. If reactions continue then platelets resuspended in 100% PAS can be supplied

Number and types of reactions

Total number of reactions n=296

Deaths n=0

Major morbidity n=86

	Moderate	Severe	Total
Febrile	122	20	142
Allergic	64	58	122
Mixed allergic/febrile	18	7	25
Hypotensive	6	1	7
Total	210	86	296

NB: in 25 of the 86 reactions classified as severe this was primarily because the patient was admitted

Table 11.1:
Classification of
reactions

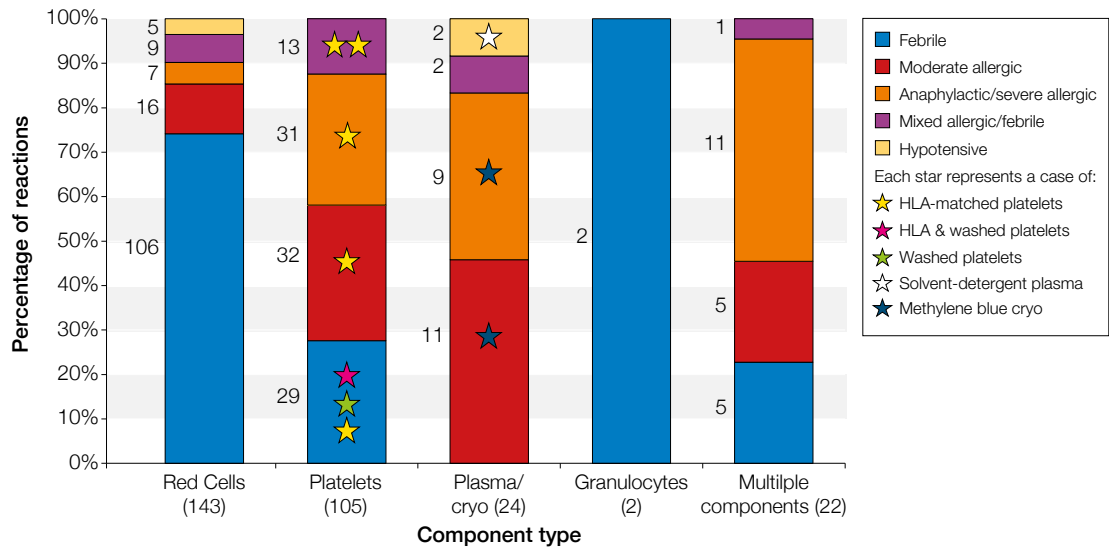
Comparison with previous Annual SHOT Reports

Similarities to 2014

Reactions by component type

These remain similar to previous Annual SHOT Reports: Figure 11.1. Red cells are usually associated with febrile-type reactions (~75%) whereas plasma and platelets more commonly cause allergic reactions (~80% and ~60% respectively). The percentage of severe reactions remains similar to 2014 at 30% and in around 30% of these this was primarily because the patient required admission. As in previous years, many reactions were difficult to classify as a result of insufficient information, the IHN/ISBT grade of reaction severity not being used and because of the difficulty distinguishing true transfusion reactions from symptoms and signs caused by the patient’s underlying condition.

Figure 11.1:
Reaction by component type



HLA: human leucocyte antigen, SD-FFP: solvent detergent-treated fresh frozen plasma

Table 11.2:
Analysis of reactions (similar to last year)

Characteristic	Occurrence
Age distribution	90% 18 years or over and 1% under 1 year
Gender	Similar numbers of male and female cases
Urgency of transfusion	70% were given routinely
Timing of transfusion	50-60% occurred within standard hours
Location	20% in outpatients/day units, 50-60% on wards

Treatment of reactions

Similar to last year, where medication was given to treat a febrile-only type of reaction more than 50% were given an antihistamine +/- steroid for which there is no evidence of benefit.

Only around 10% were given paracetamol as treatment for allergic-only symptoms and signs; Table 11.3.

	Number of reports	Medication stated	Antihistamine +/- steroid
Febrile			
2015	142	101/142 (71.1%)	57/101 (56.4%)
2014	144	97/144 (67.4%)	42/97 (43.3%)
	Number of reports	Medication stated	Paracetamol
Allergic			
2015	122	106/122 (86.9%)	10/106 (9.4%)
2014	139	112/139 (80.6%)	14/112 (12.5%)

Table 11.3: Treatment of reactions

Management to prevent subsequent febrile reactions

Although numbers were small the most common medication stated as prophylaxis to prevent future pure febrile-type reactions was an antihistamine +/- steroid; Table 11.4.

Prophylaxis	Febrile	Medication stated	Antihistamine +/- steroid
2015	44	9	7/9 (77.8%)
2014	52	24	9/24 (37.5%)

Table 11.4: Management to prevent subsequent febrile reactions

Differences from 2014

Use of platelet additive solution

In 2015 in England PAS was introduced to replace plasma in concentrates made from platelet pools with full implementation by July 2015. Apheresis platelets remained suspended in plasma. Using adult data for England only and corrected for the total number of pooled and apheresis platelets issued, a reduction in allergic reactions to pooled platelets is evident. This has not been observed for allergic reactions linked to apheresis platelets or for febrile-type reactions associated with either component. This is in keeping with published studies (Tobian et al. 2014, Cohn et al. 2014, Cazenave et al. 2011, Yanagisawa et al. 2013). The lack of a demonstrable effect of PAS on febrile-type reactions is likely to be because these are caused by the accumulation of cytokines post storage and not directly related to plasma: see Figures 11.2 and 11.3.

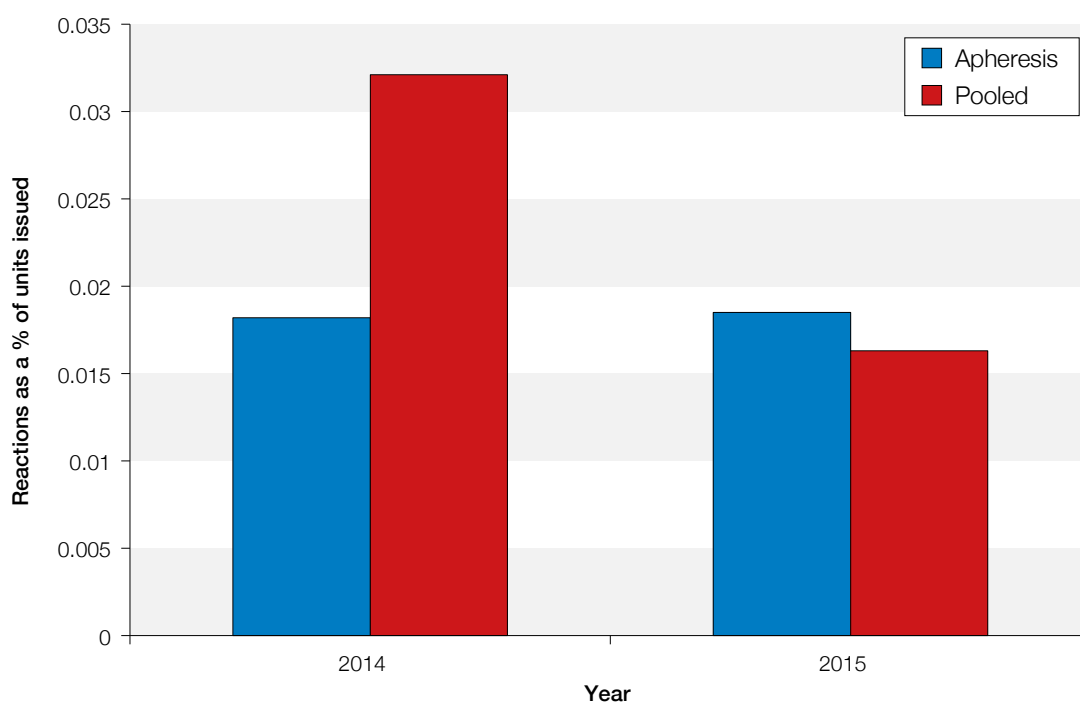
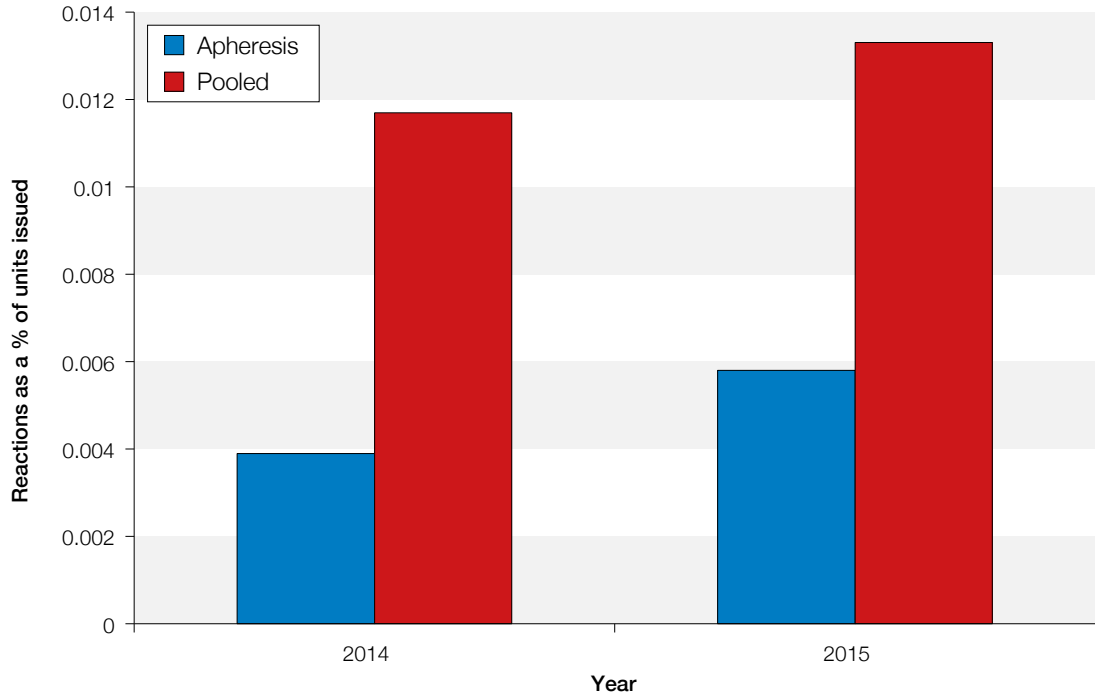


Figure 11.2: Percentage of moderate/severe allergic reactions 2014 compared with 2015

Figure 11.3:
Percentage of moderate/severe febrile-type reactions 2014 and 2015

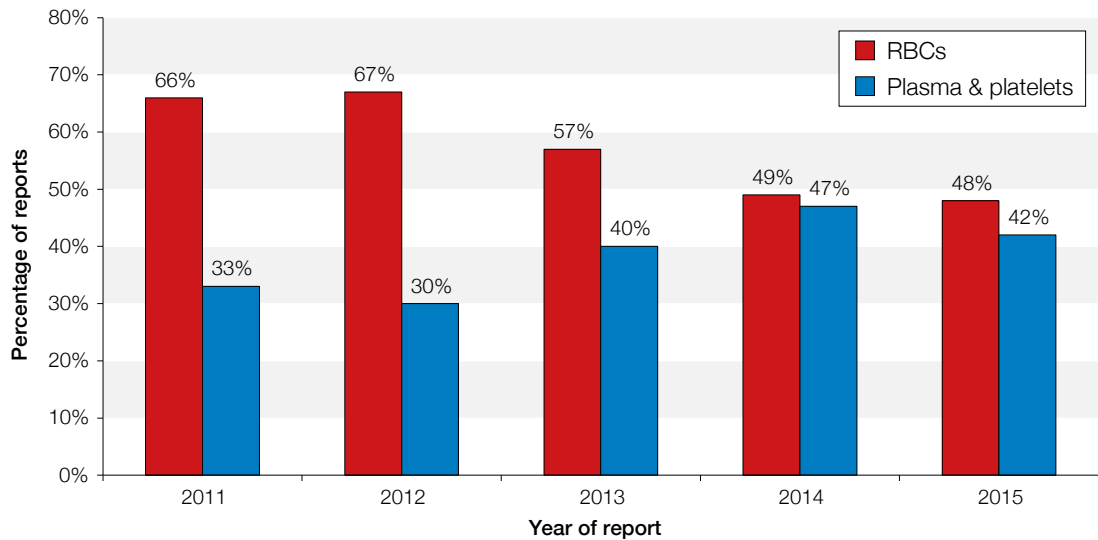


Percentage of reactions associated with each component

The percentage of reactions associated with plasma and platelets has reduced from 48% to 42%. This is entirely due to a reduction in reactions to FFP from 39 (13%) in 2014 to 20 (7%) this year. Out of the 20 reported 19 were linked to standard FFP and only one to pooled solvent detergent (SD)-treated plasma. Pooled plasma is known to cause fewer reactions and its increased use is likely to have contributed to the observed reduction: Figure 11.4.

In 2015 there were only 3 reactions associated with methylene blue (MB)- or SD-treated plasma components compared to 10 last year. The reaction to SD-FFP was a severe hypotensive reaction in a 9 day old cardiac surgery patient coming off extracorporeal membrane oxygenation. There were two reactions to MB-cryoprecipitate: a severe allergic reaction in a 16 year old and a moderate allergic reaction in an 18 year old.

Figure 11.4:
Percentage of cases reported by component



Illustrative cases

Case 11.1: A severe febrile reaction

An adult male with chronic bone marrow failure was transfused standard red cells and within 30 minutes he developed severe rigors with dyspnoea, hypertension and tachycardia. Symptoms and signs resolved on cessation of the transfusion. Culture of the implicated unit was negative. Screening for HLA antibodies was also requested and prophylaxis with hydrocortisone and chlorphenamine planned for future transfusions.

Comment: It is unclear how the presence of HLA antibodies would alter management or why hydrocortisone and chlorphenamine would prevent similar reactions.

Case 11.2: A moderate febrile reaction resulting in admission

A girl receiving treatment for a brain tumour attended hospital for a platelet transfusion. At the end of the infusion her temperature had increased from 37.6°C pre transfusion to 40.1°C. Other observations remained stable. Blood cultures were taken; she was given paracetamol, started on intravenous antibiotics and admitted. Within three hours post transfusion her temperature had returned to normal. Blood cultures were negative.

Comment: Febrile-type reactions can be indistinguishable from more severe reactions at presentation and thus requiring admission for investigation and treatment.

Case 11.3: An anaphylactic reaction with classic rise in mast cell tryptase

An adult male with chronic bone marrow failure who was refractory to standard platelets, with HLA antibodies, was transfused with HLA-matched platelets. He rapidly developed hypotension with collapse and hypoxia. Resuscitation with adrenaline, hydrocortisone, chlorphenamine, intravenous fluids and high flow oxygen was successful. Serial samples for mast cell tryptase identified a high level at 84 picograms (pg)/L in the first sample taken post reaction, 121pg/L 30 minutes later and a normal level of 9pg/L the following day.

Comment: SHOT reporting has previously shown similar rates of allergic reactions to both HLA-matched and standard platelets.

Case 11.4: An allergic reaction following plasma infusion to reverse warfarin

An adult male was given FFP prior to cystoscopy to reverse a raised international normalised ratio (INR) of 7 associated with warfarin. After the first bag had been infused he developed an itchy rash with shortness of breath and chest tightness. The transfusion was discontinued and adrenaline and hydrocortisone given. He made a complete recovery.

Comment: This was an inappropriate transfusion. The treatment of choice to reverse the effect of warfarin is prothrombin complex concentrate.

Case 11.5: A severe reaction in a patient with IgA deficiency

An adult female presented with acute myeloid leukaemia (AML). She had been found to be IgA-deficient, with IgA antibodies, during investigation for chronic fatigue several years previously but had never received blood. She was transfused a unit of standard red cells and experienced a severe reaction with nausea, rigors, wheeze and a feeling of impending doom. She subsequently received washed red cells and platelets without problems, achieved remission and underwent a successful allogeneic stem cell transplant. The stem cells were washed to remove donor plasma.

Comment: Reactions associated with IgA deficiency are rare despite a prevalence of IgA deficiency of around 1 in 200. In this case symptoms of allergy were present, which are considered standard, but in addition rigors occurred which are typical of a febrile-type reaction.

Recommendation

- SHOT data and published studies indicate that the use of platelets suspended in platelet additive solution (PAS) is associated with a reduction in allergic response. Hospitals should consider preferential use of platelets suspended in PAS in patients with a history of this type of reaction. If reactions continue then platelets resuspended in 100% PAS can be supplied

Action: UK Blood Services, Hospital Transfusion Teams (HTT)

Key recommendations from previous years can be found in the supplementary information on the SHOT website www.shotuk.org

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Transfusion-Transmitted Infections (TTI) n=3 events, 4 recipients

12

Authors: Rachael Morrison and Su Brailsford

Definition:

A report was classified as a transfusion-transmitted infection if, following investigation:

- The recipient had evidence of infection following transfusion with blood components and there was no evidence of infection prior to transfusion and no evidence of an alternative source of infection

and either:

- At least one component received by the infected recipient was donated by a donor who had evidence of the same transmissible infection

or:

- At least one component received by the infected recipient was shown to contain the agent of infection

Note that for the purposes of the European Union (EU) legislation, serious adverse reactions (SAR) are defined as any reactions in patients that are 'life-threatening, disabling or incapacitating, or which result in or prolong hospitalisation or morbidity.'

These must be reported to the Medicines and Healthcare Products Regulatory Agency (MHRA) (a legal requirement). This includes all confirmed transfusion-transmitted infections.

Key SHOT messages

- Bacterial screening of platelets has been shown to be useful in reducing the risk of contaminated platelets entering the blood supply, however, there is still a small residual risk that bacteria may not be detected
- The risk of transfusion-transmitted hepatitis B (HBV), hepatitis C (HCV) or human immunodeficiency virus (HIV) is very low in the United Kingdom (UK)
- Clinicians investigating suspected viral TTIs should explore all possible risk exposures in parallel with the Blood Service investigations, in order to determine the patient's most likely source of infection. For example, HEV is commonly transmitted by food. Investigation includes checking records and if available, testing samples taken prior to the implicated transfusion(s) to check that the recipient did not already have the infection

Introduction

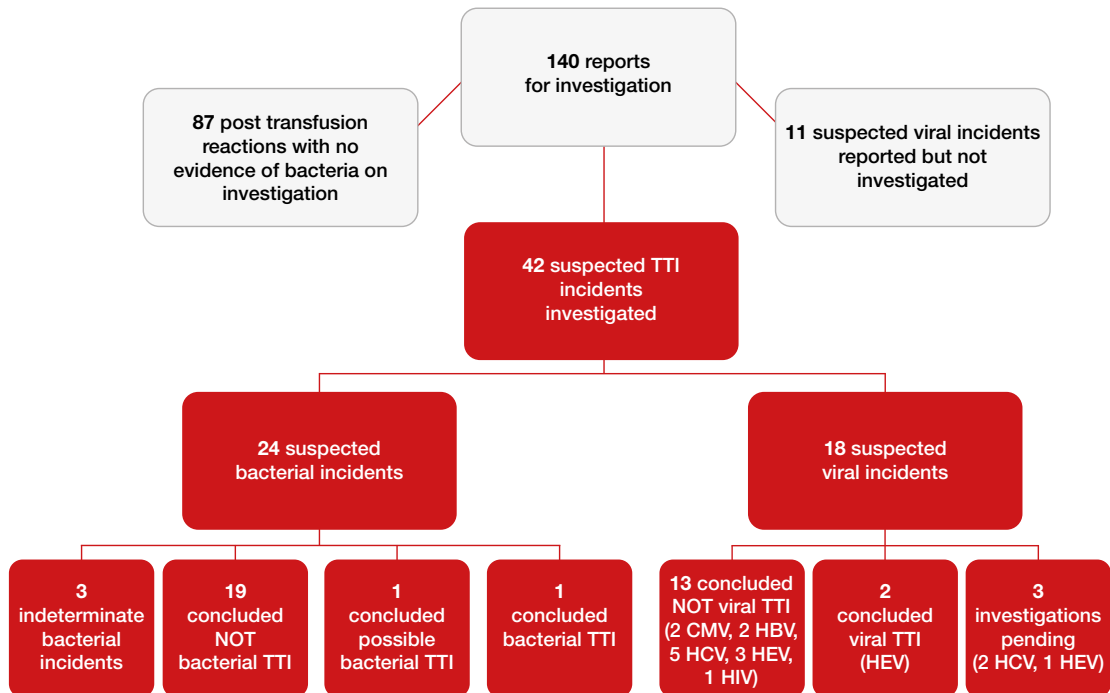
This chapter describes the possible transfusion-transmitted infection incidents investigated by the UK Blood Services and reported to the National Health Service Blood and Transplant (NHSBT)/Public Health England (PHE) Epidemiology Unit in 2015.

Summary of reports made to the NHSBT/PHE Epidemiology Unit in 2015

During 2015, UK Blood Services investigated 111 suspected bacterial cases and 18 suspected viral incidents total n=129 (Figure 12.1). An 11 additional suspected viral incidents were not investigated. From these suspected cases, there has been:

- One proven bacterial transfusion-transmitted *Staphylococcus aureus* infection
- One possible group B streptococcus transmission; although the investigation is complete, the source of infection in the patient could not be confirmed
- Two transfusion-transmitted hepatitis E virus (HEV) incidents, one following multiple transfusions between December 2014 and November 2015 and one following 2 doses of platelets and 2 doses of cryoprecipitate in July 2015

Figure 12.1:
Outcome of reports
of suspected
TTIs made to
the NHSBT/PHE
Epidemiology Unit
in 2015*



*HCV investigations where the transfusion was prior to screening are not included in this Figure
CMV=cytomegalovirus

Bacterial TTI reports 2015

In 2015, there was one proven bacterial transfusion-transmitted incident, one possible bacterial transmission (not included in Table 12.2) and no near miss incidents.

Case 12.1: Confirmed bacterial TTI

A six day old pooled platelet unit was transfused to a female neutropenic patient with acute myeloid leukaemia who was in her 70s. Fifteen minutes into the transfusion, the patient became agitated and experienced symptoms of rigors, tachycardia and pyrexia. The patient's temperature spiked at 38.7°C and continued to rise overnight reaching 40°C. The transfusion was stopped and the patient was given hydrocortisone, chlorphenamine and started on broad spectrum antibiotics, ciprofloxacin, piperacillin/tazobactam and gentamicin. The patient recovered and was well enough to be discharged from hospital.

Bacterial screening of the pooled platelet was negative at day 7; investigation revealed no obvious errors in either sampling or in the screening protocol. The same strain of Staphylococcus aureus was isolated from patient blood cultures, cultures from the almost empty pack of the transfused unit and skin swabs from one of the donors whose donation was included in the pool. The strains were compared using molecular typing and were found to be indistinguishable.

It was the good practice and quick thinking of the hospital staff which prevented further harm being caused to this patient.

Case 12.2: Possible bacterial TTI

A seven day old pooled platelet unit was transfused to a female patient in her 50s at a routine outpatient appointment as part of ongoing treatment for aplastic anaemia. The patient previously had allergic reactions to platelets and was routinely given prophylaxis with hydrocortisone and chlorphenamine. Half-way through the transfusion, the patient developed rigors and angioedema, but the blood pressure was normal. The patient was admitted overnight and treated with piperacillin/tazobactam and steroids and recovered. Bacterial screening was negative and no obvious errors were detected in sampling or screening protocol. The hospital reported that Streptococci were identified in both the pack and the patient blood culture 24 hours post transfusion.

Streptococcus agalactiae (also known as group B streptococcus) and E. coli were isolated from the returned platelet pack; although the same organism was isolated from the component and the patient it was not possible to confirm that the source of the infection was the pooled platelet.

Bacterial TTIs 1996–2015

Screening of platelet components cannot guarantee freedom from bacterial contamination. Packs are released for issue as 'negative-to-date' which may be before bacteria have multiplied sufficiently to trigger an initial screening reaction. On the other hand, an initial screen-reactive result may be a false positive result, or related to bacteria which are of low pathogenicity and unlikely to cause any noticeable reaction in the recipient. Prior to 2015 the previous documented confirmed bacterial TTI was in 2009, predating universal bacterial screening of platelets throughout the UK Blood Services (2011). There have been 4 near misses (3 in platelets) reported to the unit between 2011 and 2015. Overall, since reporting began in 1996, a total of 37/44 bacterial transfusion-transmissions to individual recipients (34 incidents) have been caused by the transfusion of platelets, and 7/44 by red cells (Table 12.2).

Viral TTI reports 2015

In 2015, there were two confirmed transfusion-transmitted hepatitis E virus (HEV) incidents.

Case 12.3: Confirmed viral TTI (1)

A male patient in the 50-60 age group (life-long vegetarian) with multifocal central nervous system lymphoma diagnosed in December 2014, underwent an autologous stem cell transplant for reversible bone marrow failure and received extensive transfusion support from June 2015. HEV testing was carried out because the patient developed persistent transaminitis. The patient eventually died with decompensated liver failure.

There were 33 donor exposures based on donations transfused in the 12 weeks prior to the first positive HEV result. Two donations from two different donors were implicated. One donation in a pooled platelet transfused with a low viral load in June 2015 (donor 1) and one apheresis platelet split with a high viral load transfused in May 2015 (donor 2) were found on retesting of the archive samples to have been HEV ribonucleic acid (RNA) positive at the time of donation. Red cells and fresh frozen plasma (FFP) had also been issued from the donation given by donor 1; neither recipient had evidence of current or past hepatitis E when tested at least 6 months after transfusion. The second platelet split from donor 2 was transfused to a paediatric liver transplant recipient, who was diagnosed with HEV, treated, and cleared the infection before the HEV-positive platelet component had been identified.

Sequencing studies showed that the recipient's virus changed over time and it cannot be said with certainty whether HEV from one or both HEV RNA positive donations was transmitted to this recipient.

The donors both cleared their HEV infection and remain on the active donor panel.

Case 12.4: Confirmed viral TTI (2)

A male patient in the 40-50 age group with non-Hodgkin lymphoma received 2 doses of platelets and 2 doses of cryoprecipitate (18 donor exposures) on 31st July 2015. On the 19th October 2015 (80 days post transfusion), he was admitted to hospital with jaundice, nausea and abdominal discomfort. He was hepatitis A virus (HAV)-, HBV- and HCV-negative, however he was HEV IgG (low) and IgM (high) positive.

Records of all donors were examined. None of the donors had reported any illness at the time of donation or subsequently. Archive samples from the 18 index donations were tested for HEV RNA. One donation which was included in one of the cryoprecipitate doses was found to be HEV RNA positive. Red cells from the same donation were transfused to a paediatric thalassaemia patient; this patient had no evidence of transfusion-transmitted HEV.

The donor cleared the infection and remains on the donor panel.

Update on viral TTI reports from 2014

There were three pending HEV and one HBV case in 2014. One HEV case was subsequently a confirmed TTI.

Case 12.5: Confirmed viral TTI

A male liver transplant recipient received blood components in the perioperative period. He was found to be significantly HEV viraemic 68 days post transplant (October 2012) whereas he was negative when assessed in June 2012. The liver donor tested negative for HEV.

On investigation, it was found that the index patient had received 5 doses of apheresis platelets, 14 units of FFP, 9 units of red blood cells, 1 platelet pool (4 donors) and 1 cryoprecipitate dose (5 donors) in August 2012. Two units of platelets transfused in 2011, prior to the patient being reported as HEV positive, were excluded from this investigation. Thirty-seven blood donor exposures were identified. Archive samples from all 37 donations were retrieved and tested for antibodies to HEV (IgG and IgM) and HEV RNA. One donor (FFP) showed evidence of active HEV infection (HEV IgM and HEV RNA positive; HEV IgG negative) at the time of donation. An additional three donors had evidence of past HEV infection (HEV IgG positive, HEV IgM and HEV RNA negative) at the time of donation. Sequence analysis showed that the sequence in the HEV RNA positive donor was a highly conserved match with the transplant patient sample.

Viral TTIs 1996–2015

The year of transfusion may be many years prior to the year in which the case is investigated and reported to SHOT because of the chronic nature, and therefore late recognition, of some viral infections. Since 1996, 29 confirmed incidents of transfusion-transmitted viral infections have been documented, involving a total of 36 recipients. HBV is the most commonly reported proven viral TTI in the UK. This is partly because the 'window period' where an infectious donation from a recently infected donor cannot be detected by the screening tests is longer than for HCV or HIV, despite nucleic acid testing (NAT).

Risks of HBV, HCV or HIV being transmitted by transfusion

The risk of a component potentially infectious for HBV, HCV or HIV being released for use in the UK is very low (Table 12.1) (PHE 2015).

	HBV	HCV	HIV
Number per million donations	0.63	0.038	0.16
95% confidence interval	0.17-1.19	0.015-0.100	0.10-0.23
At 2.3 million donations per year testing will miss a potentially infectious window period donation every:	year	16 to 17 years	2 to 3 years

*The window period is the time at the start of an infection before the tests can detect it

Far fewer TTIs are observed in practice than estimated in Table 12.1, partly because the estimates have wide uncertainty and the model is based on the risk in all packs released. The model does not incorporate pack non-use, recipient susceptibility to infection, or under ascertainment/under reporting, for example due to recipients dying from an underlying medical condition before a chronic asymptomatic viral condition is identified, or, in the case of HBV, an asymptomatic acute infection.

HEV testing 2016

In 2015, the Advisory Committee on the Safety of Blood, Tissues and Organs (SaBTO) recommended that HEV-screened components were required for specific patient groups:

- Allogeneic stem cell/bone marrow transplantation
- Solid organ transplantation

More details can be found here <http://hospital.blood.co.uk/products/hepatitis-e-screening>.

UK Blood Services began testing blood and apheresis donations for HEV RNA in order to supply HEV-screened components for selected patient groups from spring 2016.

Parasitic TTIs

There were no reported parasitic infections for investigation in 2015. There have been two proven malaria TTIs reported to SHOT, the last in 2003 (Table 12.2). Malaria antibody testing was not applicable at the time according to information supplied at donation, and the donor selection guidelines were updated after these incidents to minimise the risk of further malaria TTIs (Kitchen et al. 2005). The current selection guidelines on deferral and additional testing for malaria can be accessed at the UK transfusion guidelines web pages at <http://www.transfusionguidelines.org.uk/red-book>.

Variant Creutzfeld-Jakob Disease (vCJD) 2015

There were no vCJD investigations in 2015.

vCJD 1996–2015

Three vCJD incidents (Table 12.2) took place prior to the introduction of leucodepletion and other measures taken by the UK Blood Services to reduce the risk of vCJD transmission by blood, plasma and tissue products. All these measures have been reviewed and endorsed by SaBTO (SaBTO 2013).

Risk assessment and research into vCJD continues, however currently there is no suitable blood test available for screening blood donations for vCJD.

More information can be found here https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/407681/measures-vcjd.pdf

Table 12.1:
The estimated risk of a potentially infectious HBV, HCV or HIV window period* donation entering the UK blood supply: 2012–2014

Table 12.2:
Number of confirmed TTI incidents*, by year of transfusion** with total infected recipients and outcomes (death, major morbidity, minor morbidity) in the UK between October 1996 and December 2015 (Scotland included from October 1998)

Year of transfusion**	Number of incidents (recipients) by infection											Implicated component				
	Bacteria	HAV	HBV	HCV	HEV	HIV	HTLV I	Parvovirus (B19)	Malaria	vCJD/prion	Total	RBC	Pooled platelet	Apheresis platelet	FFP	Cryo
Pre 1996	-	-	1 (1)	-	-	-	2 (2)	-	-	-	3 (3)	3	-	-	-	-
1996	-	1(1)	1 (1)	1 (1)	-	1 (3)	-	-	-	1 (1)	5 (7)	5	1	-	1	-
1997	3 (3)	-	1 (1)	1 (1)	-	-	-	-	1 (1)	2 (2)	8 (8)	6	1	1	-	-
1998	4 (4)	-	1 (1)	-	-	-	-	-	-	-	5 (5)	2	1	2	-	-
1999	4 (4)	-	2 (3)	-	-	-	-	-	-	‡ (1)	6 (8)	5	3	-	-	-
2000	7 (7)	1 (1)	1 (1)	-	-	-	-	-	-	-	9 (9)	1	5	3	-	-
2001	5 (5)	-	-	-	-	-	-	-	-	-	5 (5)	-	4	1	-	-
2002	1 (1)	-	1 (1)	-	-	1 (1)†	-	-	-	-	3 (3)	2	1	-	-	-
2003	3 (3)	-	1 (1)	-	-	-	-	-	1 (1)	-	5 (5)	1	1	3	-	-
2004	††	-	-	-	1 (1)	-	-	-	-	-	1 (1)	1	-	-	-	-
2005	2 (2)	1 (1)	1 (1)	-	-	-	-	-	-	-	4 (4)	1	3	-	-	-
2006	2 (2)	-	-	-	-	-	-	-	-	-	2 (2)	-	1	1	-	-
2007	3 (3)	-	-	-	-	-	-	-	-	-	3 (3)	2	1	-	-	-
2008	4 (6)	-	-	-	-	-	-	-	-	-	4 (6)	-	2	4	-	-
2009	2 (3)	-	-	-	-	-	-	-	-	-	2 (3)	1	-	2	-	-
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	-	-	1 (2)	-	1 (2)	-	-	-	-	-	2 (4)	2	-	-	2	-
2012	-	-	1 (1)	-	1 (1)	-	-	1(1)	-	-	3 (3)	2	-	-	1	-
2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	-	-	-	-	2 (3)	-	-	-	-	-	2 (3)	1	-	-	2	-
2015	1(1)	-	-	-	2 (3)	-	-	-	-	-	3 (4)	-	2	1	-	1
Number of incidents	41	3	12	2	7	2	2	1	2	3	75					
Number of infected recipients	44	3	14	2	10	4	2	1	2	4	86	35	26	18	6	1
Death due to, or contributed to, by TTI	11	-	-	-	1	-	-	-	1	3	16					
Major morbidity	29	2	14	2	5	4	2	1	1	1§	61					
Minor morbidity	4	1	-	-	4	-	-	-	-	-	9					
Implicated component																
RBC	7	1	11	2	3	2	2	1	2	4	35					
Pooled platelet	21	2	1	-	1	1	-	-	-	-	26					
Apheresis platelet	16	-	1	-	1	-	-	-	-	-	18					
FFP	-	-	1	-	4	1	-	-	-	-	6					
Cryoprecipitate	-	-	-	-	1	-	-	-	-	-	1					

Numbers in brackets refer to recipients

*No screening was in place for vCJD, human T cell lymphotropic virus (HTLV), hepatitis A virus (HAV), HEV or parvovirus B19 at the time of the documented transmissions. In both malaria transmissions, malaria antibody testing was not applicable at the time according to information supplied at donation

** Year of transfusion may be prior to year of report to SHOT due to delay in recognition of chronic infection

† The two HIV incidents were associated with window period donations (anti-HIV negative/HIV RNA positive) before HIV NAT screening was in place. A third window period donation in 2002 was transfused to an elderly patient, who died soon after surgery. The recipient's HIV status was therefore not determined and not included

†† In 2004 there was an incident involving contamination of a pooled platelet pack with *Staphylococcus epidermidis*, which did not meet the TTI definition because transmission to the recipient was not confirmed, but it would seem likely. This case was classified as 'not transfusion-transmitted'

‡ Same blood donor as one of the 1997 transmissions so counted as the same incident; note: counted as two separate incidents in previous reports

§ A further prion case died but transfusion was not implicated as the cause of death. The outcome was assigned to major morbidity instead because although there was post-mortem evidence of abnormal prion proteins in the spleen the patient had died of a condition unrelated to vCJD and had shown no symptoms of vCJD prior to death

For further information or alternative breakdown of data please contact the National Coordinator for Transfusion-Transmitted Infections via the NHSBT/PHE Epidemiology Unit at epidemiology@nhsbt.nhs.uk.

Learning points and recommendations from previous years are still relevant and can be found in the supplementary information on the SHOT website www.shotuk.org.

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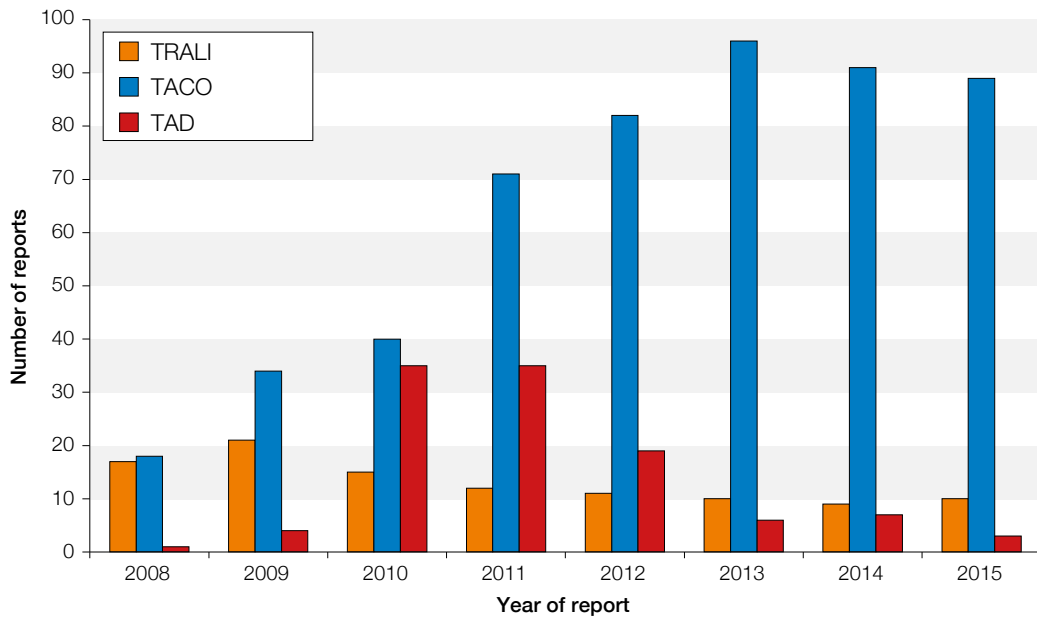
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13 Pulmonary Complications

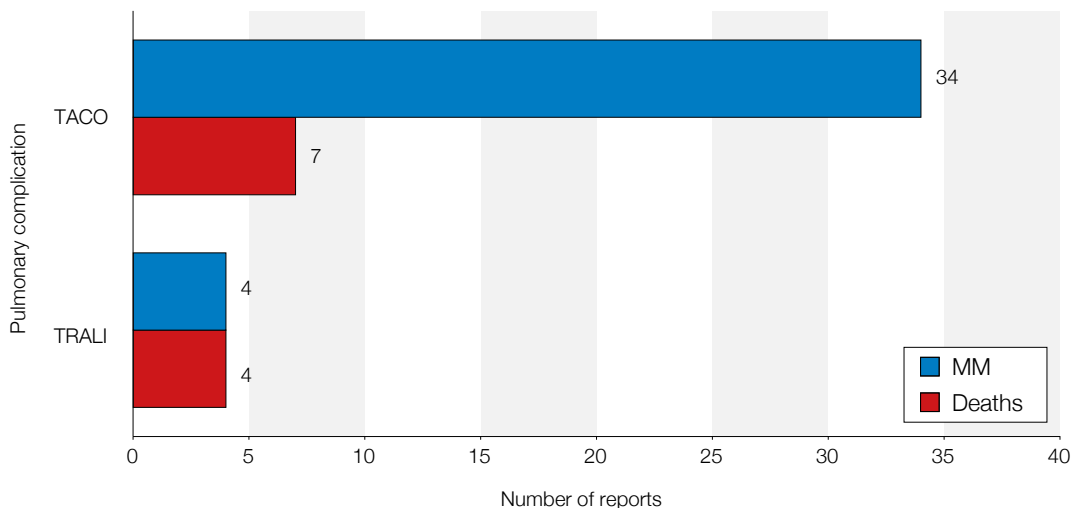
Pulmonary complications of transfusion are among the most dangerous and result in the greatest number of transfusion-related deaths. The transfused patients are often elderly with considerable comorbidity. The experts reviewing these cases find it difficult to classify them, often because essential data are not provided. Some patients may have both transfusion-related acute lung injury (TRALI) and transfusion-associated circulatory overload (TACO). The number of cases reported over time shows major changes (Figure 13.1). The low number of diagnoses of TRALI is consistent with changes in practice introduced earlier with a move away from female donors for fresh frozen plasma (FFP). There is a notable increase in cases of TACO, now the most frequent cause of death and major morbidity reported to SHOT (Figure 13.2), in contrast to data reported from the United States of America (USA). These changes may reflect increasing recognition of cases although it is likely that there is underreporting of TACO.

Figure 13.1:
Reports of pulmonary complications by year 2008–2015



TAD=transfusion-associated dyspnoea

Figure 13.2:
Death and major morbidity (MM) from pulmonary complications in 2015



Transfusion-Related Acute Lung Injury (TRALI) n=10

13a

Author: Tom Latham

Definition:

Transfusion-related acute lung injury (TRALI) is defined as acute dyspnoea with hypoxia and bilateral pulmonary infiltrates during or within 6 hours of transfusion, not due to circulatory overload or other likely causes.

10 cases of suspected TRALI have been included in 2015 (9 in 2014). Full details are available in the 2015 Annual SHOT Report: Web Edition.

COMMENTARY

Five patient deaths were reported. One was assessed as probably due to TRALI, three as possibly related and one was unlikely to have been caused by TRALI. This is the highest number of reported deaths since the introduction of TRALI-reduction measures but it is notable that all cases had alternative, and often multiple, reasons for respiratory deterioration which in most cases were more likely than TRALI. Two of the deaths classified as TRALI according to SHOT definitions because of the presence of antibodies would not have been classified as TRALI under the Canadian Consensus definition due to the presence of fluid overload.

Three cases this year were found to have received donations from female donors with concordant human leucocyte antigen (HLA)-specific antibodies. The implicated component/s were pooled cryoprecipitate and red blood cells in optimal additive solution (RBCOA) in one case and RBCOA only in two cases. Multiple female donors contributing to the cryoprecipitate pool were found to have leucocyte antibodies.

The recommendation from last year's Annual SHOT Report for all United Kingdom (UK) Blood Services to avoid the use of female donor plasma for the preparation of cryoprecipitate thus remains active.

No case of TRALI linked with transfusion of female FFP, apheresis platelets or plasma contribution to platelet pool containing concordant HLA or granulocyte-specific antibody has been reported to SHOT during the last five years.

Colleagues throughout the United Kingdom (UK) are encouraged to refer cases of suspected TRALI to the Independent TRALI Intensive Care experts for assessment before laboratory investigations are initiated (contact Tom Latham e-mail: tom.latham@nhsbt.nhs.uk).

13b Transfusion-Associated Circulatory Overload (TACO) n=89

Authors: Sharran Grey and Paula Bolton-Maggs

Transfusion-associated circulatory overload (TACO) remains without an agreed definition. The International Society of Blood Transfusion (ISBT) working party continues its work to refine and agree a definition that can be used to identify cases and assign a level of likelihood.

Key SHOT message

- TACO must be suspected where there is respiratory distress that improves with treatment for circulatory overload (diuretics, morphine and nitrates). It is important to report these cases to SHOT

Definition:

Current ISBT definition (revision in progress)

Any 4 of the following within 6 hours of transfusion

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

89 cases were analysed compared to 91 in 2014.

Demographic overview of cases

Table 13b.1:
Demographic
overview of cases

Demographic	Number of reports
Deaths	7
Major morbidity	34
Age	6 days to 97 years (median 73 years)
Top three clinical specialties	Acute medicine (15), general medicine (13), haematology (12)
Bleeding patients	21 (indication code R1 – acute blood loss)
Non-bleeding patients	60 (other indication codes)
Unknown bleeding status	8 (no indication code given)
Single unit of red cells transfused	14

Where death was recorded, TACO was reported to be contributory in 7 cases (likely/probable n=2; possible n=5; excluded/unlikely n=6; not assessable n=1). There were 34 cases reported with either long-term morbidity (2, likely/probable n=1; possible n=1), or where there were signs and symptoms with risk to life with full resolution (n=32, certain n=2; likely/probable n=20; possible n=10).

The age range was 6 days to 97 years. Two cases involved neonates, one a month-old baby, and one

baby aged 1 year. One patient was aged 16 years, and the remaining cases were over 18 years of age. TACO can occur at any age and more commonly occurs in older adults. The young and elderly are both highly transfused populations, yet the incidence of TACO is reported disproportionately. This may reflect the more common practice of body weight dosing in the young, and the presence of comorbidities that predispose to circulatory overload in the elderly. The majority of patients were in medical specialties and received transfusion for normovolaemic anaemia. There were 14 reports that involved only a single unit of red cells. It is probable that TACO is more likely with red cell transfusion as red cells represent mass as opposed to a fluid which may be more readily removed by diuresis.

Diagnosis of TACO

It is accepted that current definitions for TACO are unsatisfactory. Some symptoms and signs are non-specific and some diagnostic procedures may not be readily available, or are more suited to a high care environment. This may result in under or over-attribution of TACO and/or the level of diagnostic certainty. Given the lack of agreement on a suitable definition for TACO, cases were assessed (as last year) against two sets of diagnostic criteria: clinical prioritisation of key features (CPKF) and the draft revised ISBT (DISBT) criteria.

CPKF

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

TACO was considered to be 'highly likely' with three or more features, or acute respiratory distress with pulmonary oedema on imaging; 'probable' with acute respiratory distress and clinical improvement with diuretic therapy (volume intolerance); and 'possible' with acute respiratory distress with evidence of a positive fluid balance.

DISBT

Acute or worsening respiratory distress within 6 hours of transfusion (some cases may occur up to 12 hours)

Primary features

- Evidence of acute or worsening pulmonary oedema with bilateral infiltrates
- Enlarged cardiac silhouette on imaging – enlarged heart contour should always be present if looked for
- Evidence of fluid overload – could be a positive fluid balance or a response to diuretic therapy combined with clinical improvement

Supporting features

- Elevated brain-natriuretic peptide (BNP) or N-terminal (NT)-pro BNP to more than five times the pre-transfusion value (if available)
- Increased mean arterial pressure (MAP). $MAP = DBP + 1/3 (SBP - DBP)$ or, increased pulmonary wedge pressure. The MAP is typically raised, often with a widened pulse pressure. There may be hypotension in acute cardiac collapse. (DPB=diastolic blood pressure and SBP=systolic blood pressure)

'Definite' cases must have at least two primary features, or one primary and two supporting features. Cases with only one primary feature (e.g. without chest imaging) may be considered 'probable' or 'possible' depending on the presence of other supporting features.

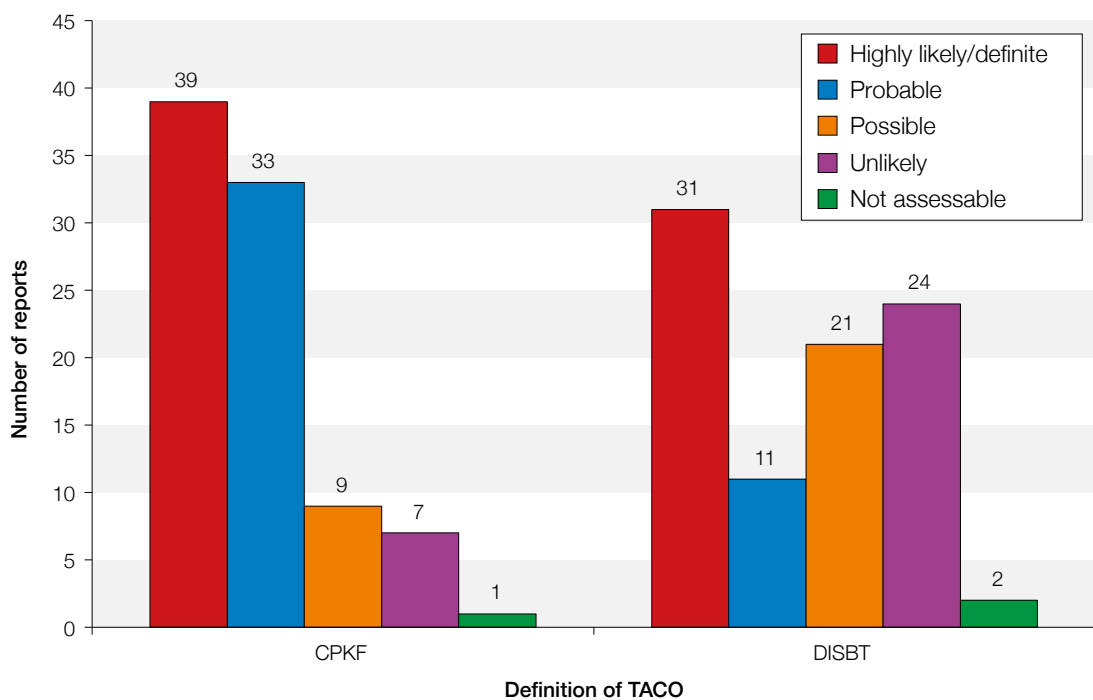
Comparison of assessments

This year 89 cases were analysed after withdrawals and transfer of some cases to other categories. Table 13b.2 and Figure 13b.1 below compare the likelihood of TACO by each definition.

Table 13b.2:
Diagnostic
likelihood by two
definitions

Likelihood	CPKF	DISBT
Highly likely/definite	39	31
Probable	33	11
Possible	9	21
Unlikely	7	24
Not assessable	1	2
Total	89	89

Figure 13b.1:
Likelihood by two
definitions



Two observations can be made. More cases are identified by CPKF criteria compared to DISBT criteria. This reflects both the lack of availability of BNP testing and routine reporting of the cardiac silhouette. The numbers of 'probable' and 'possible' cases are reversed when both definitions are compared. This probably reflects the lack of demarcation between 'probable' and 'possible' in the DISBT definition.

Inter-assessor variability: a case for standardisation of assessment

This year a sample of reports was assessed by two experienced individuals using both definitions (CPKF and DISBT) to understand inter-assessor variability and to identify issues with the current criteria. Table 13b.3 shows the results of the audit.

Assessment variability	Number of reports audited
Number of assessments with complete agreement	27 (34.6%)
Number of assessments with minor discrepant assessments (within one likelihood level)	40 (51.3%)
Number of significantly discrepant assessments (more than one likelihood level)	11 (14.1%)
Total number of reports audited	78

Table 13b.3:
Audit of inter-assessor variability

There was a high level of concordance for assessments that were in complete agreement or were discrepant to only a minor extent (within one level of likelihood). However the level of significantly discrepant assessments highlighted potential issues with interpretation and application of existing criteria, and these cases were further analysed by a panel case review. The rationale for all discrepant assessments were agreed to be justifiable and highlighted a number of issues.

- There was evidence of deviation from strict application of assessment criteria. Current criteria may not be sufficiently sensitive or flexible to account for the impact of incomplete history or investigations (or serial investigations for comparison), and for the presence of confounding medical factors in some presentation scenarios. This is especially evident with respect to the DISBT criteria concerning imaging of the cardiac silhouette and BNP/N-terminal (NT)-pro BNP which are often not performed. This limits the usable assessment criteria resulting in some cases having the likelihood of TACO reduced when there is an overall persuasive picture
- The diagnostic assessment could be finessed by weighting the strength of evidence from a particular clinical finding, and accounting for confounding factors such as the concomitant administration of diuretics and anti-allergy medications. A logic-based application may further support a standardised approach (discussed in the next section)

The findings and recommendations from this audit will be shared with the ISBT Haemovigilance Working Party to contribute to the ongoing refinement of the TACO definition and assessment criteria.

The following case was assessed as 'highly likely' by CPKF and 'unlikely' by DISBT definitions. It highlights the difficulty in diagnosing TACO when confounding clinical features are present.

Case 13b.1: Confounding clinical features leading to conflicting assessments

A patient with pre-existing congestive cardiac failure (CCF) and acute renal failure was admitted to an emergency department complaining of shortness of breath and swollen legs. The patient was prescribed a diuretic and two units of red cells (Hb 74g/L). Pre-transfusion vital sign observations were normal except for slightly low oxygen saturation. After three quarters of the unit had been transfused the patient experienced rigors, tachycardia, shortness of breath, tachypnoea, mild fever, mild periorbital oedema and bilateral wheeze. The transfusion was stopped and the patient was treated with a bronchodilator, antihistamine and steroid, and continued on oxygen. Six hours later the oxygen saturation dropped further and crackles could be heard in the chest. The chest X-ray revealed increased pulmonary oedema compared to the previous image. Treatment with an intravenous diuretic did not result in adequate diuresis and there was no change to the patient's respiratory function. The patient eventually recovered and survived.

Comment: This case was complicated by the presence of inflammatory symptoms, but TACO was considered 'highly likely' by panel review given pre-existing CCF and increasing pulmonary oedema. Lack of improvement following medication for allergy also suggests the respiratory distress was more likely to be related to TACO than to the allergic features. The lack of improvement following diuretics was due to inadequate diuresis because of renal failure. Consequently, the case had only one primary feature (increasing pulmonary oedema) by the DISBT criteria and no supporting features and therefore categorised as 'unlikely'. It also highlights that transfusion complications can co-exist.

TACO calculator: the effect of standardised assessment

A Microsoft Excel-based application was developed which calculated the likelihood of TACO based on the presence of weighted symptoms and signs across four diagnostic categories (Figure 13b.2) to produce an aggregated score. Every permutation of scenarios was evaluated as 'certain', 'probable', 'possible' or 'unlikely' depending on the score.

Figure 13b.2:
TACO calculator
weightings

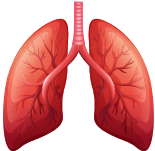


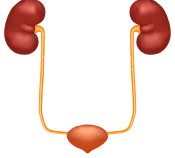
Diagnostic Category	Status	Score
 Respiratory	Acute or worsening respiratory distress with no apparent alternative cause	2
	Acute or worsening respiratory distress with possible alternative cause	1
 Imaging	Pulmonary oedema (+/- cardiomegaly) not on pre-transfusion image, OR worsening compared to pre-transfusion image	2
	Pulmonary oedema (+/- cardiomegaly) on imaging with no pre-transfusion image for comparison, OR no change from previous image	1
	Pulmonary oedema not present on image, OR no image available	0
 Fluid Balance	Clinically significantly positive fluid balance	1
	Unable to assess fluid balance	0
	Neutral or negative fluid balance	-1
 Diuretics	Improvement with diuretics and/or morphine and nitrates alone (not administered with steroid, anti-histamine or bronchodilator)	2
	Improvement with diuretics and/or morphine and nitrates (also administered with steroid, anti-histamine or bronchodilator)	1
	No improvement or worsening after diuretic	-1
	Unable to assess response to diuretic or diuretic not given	0

Table 13b.4 and Figure 13b.3 show a comparison of the results.

Table 13b.4:
Comparison of
CPKF and DISBT
assessments
against TACO
calculator
assessments

Assessment	CPKF	DISBT	TACO calculator
Highly likely/definite/certain	39	31	2
Probable/likely	33	11	43
Possible	9	21	36
Unlikely	7	24	7
Not assessable	1	2	1
Total	89	89	89

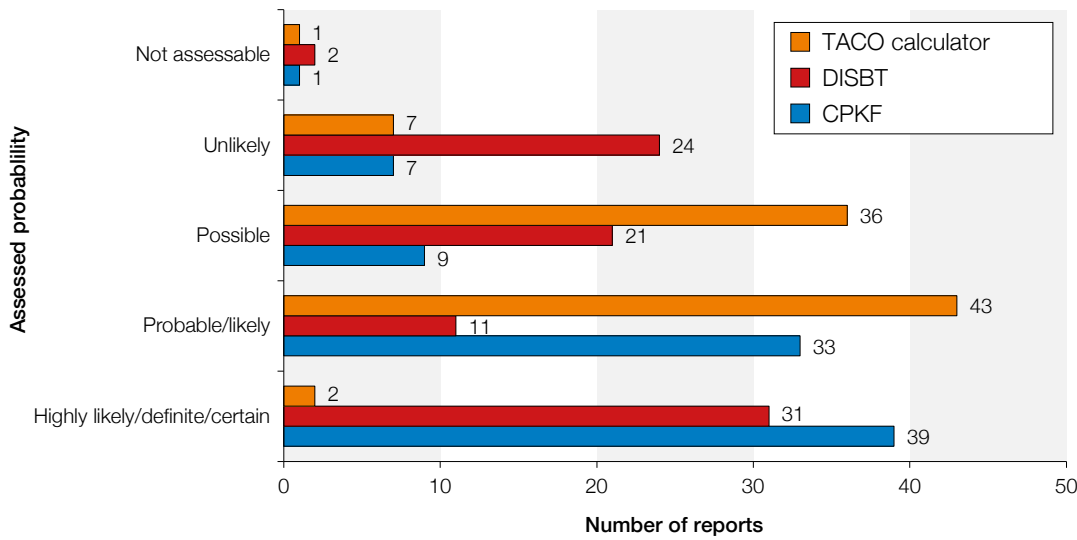


Figure 13b.3: Comparison of CPKF and DISBT assessments against TACO calculator assessments

The TACO calculator had strict high scoring criteria for ‘certain’ and produced fewer definite cases. The calculator is a prototype and requires further validation and possible re-calibration. It may be a useful tool in the future to facilitate reproducible and standardised diagnostic assessments, especially where there are confounding features and lack of an agreed definition for TACO.

Thematic analysis of ‘definite’ and ‘highly likely’ cases

There were 41 cases where the diagnostic likelihood was considered to be ‘highly likely’ by CPKF and/or ‘definite’ by DISBT definitions. The assessment for each case was summarised by the key factors that were judged to have contributed to TACO. These summaries were thematically analysed and results shown in Figure 13b.4.

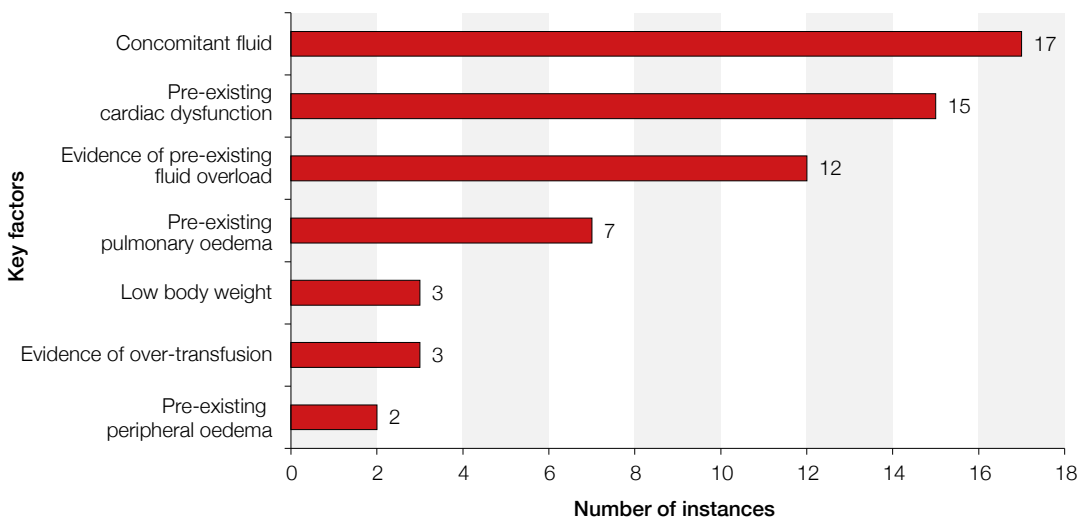
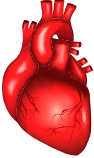




Figure 13b.4: Thematic analysis of ‘definite’ and ‘highly likely’ case summaries

Fifty nine instances of significant key factors were identified across the 41 cases. Fluid management was the most significant theme. The administration of concomitant fluid with the transfusion or in the 24 hours prior was the most frequent finding, followed by evidence of pre-existing fluid overload and pre-existing cardiac dysfunction. Other signs of potential fluid intolerance were pre-existing pulmonary oedema, low body weight and pre-existing peripheral oedema. Three patients developed TACO after being given an excessive volume of red cells to achieve their target Hb. These themes provide a useful basis for a pre-transfusion TACO risk assessment in the form of a checklist (Figure 13b.5).

An order set and checklist for TACO has been successfully piloted in Toronto demonstrating increased compliance following their introduction (Tseng et al. 2016).

Figure 13b.5:
TACO risk
assessment/
pre-transfusion
checklist

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

If 'yes' to any of the above



- Review the need for transfusion (do the benefits outweigh the risks)?
- Can the transfusion be safely deferred until the issue can be investigated, treated or resolved?
- Consider body weight dosing for red cells (especially if low body weight)
- Transfuse one unit (red cells) and review symptoms of anaemia
- Measure the fluid balance
- Consider giving a prophylactic diuretic
- Monitor the vital signs closely, including oxygen saturation

Case 13b.2: Inappropriate transfusion in a patient with CCF and poor fluid management

A patient with pre-existing CCF developed rectal bleeding following surgery. Four units of FFP were given to reverse warfarin over a total duration of one hour (two of which were given simultaneously), and a litre of crystalloid was also given. Three hours after the transfusion, the patient developed shortness of breath, reduced oxygen saturation, tachycardia, tachypnoea, hypertension and pulmonary oedema. No fluid balance had been recorded. The patient's respiratory function improved following treatment with diuretics, antihistamine and nitrates. The patient required admission to the intensive therapy unit and subsequently recovered.

Comment: Patients with cardiac dysfunction are at risk of fluid overload and require careful fluid management including the decision whether to transfuse. FFP had been given inappropriately (the patient should have received prothrombin complex concentrate which also represents a smaller infusion volume). The FFP had been given quickly with concomitant non-blood fluid, and with no fluid balance assessment in place.

Recommendation

- A formal pre-transfusion risk assessment for transfusion-associated circulatory overload (TACO) should be performed whenever possible as TACO is the most commonly reported cause of death and major morbidity. An example is shown in Figure 13b.5

Action: Trust/Health Board Chief Executive Officers and Medical Directors responsible for all clinical staff

Reference

Tseng E, Spradbrow J et al. (2016) **An order set and checklist improve physician transfusion ordering practices to mitigate the risk of transfusion-associated circulatory overload**. *Transfus Med*
<http://onlinelibrary.wiley.com/doi/10.1111/tme.12284/pdf> [accessed 15 May 2016]

13C

Transfusion-Associated Dyspnoea (TAD) n=3

Author: Paula Bolton-Maggs

Definition:

TAD is characterised by respiratory distress within 24 hours of transfusion that does not meet the criteria for transfusion-related acute lung injury (TRALI), transfusion-associated circulatory overload (TACO) or allergic reaction. Respiratory distress in such cases should not be explained by the patient's underlying condition (International Society of Blood Transfusion (ISBT) definition).

Key SHOT messages

- Patients with inflammatory conditions seem to be at increased risk of adverse transfusion reactions including pulmonary complications
- Careful clinical assessment should be made before any and every component transfusion to ensure it is clinically indicated, and that the benefit is likely to outweigh the risks

Three cases were finally accepted for this category in 2015. Twelve cases were withdrawn and an additional 7 were transferred to other categories: 4 were considered to have TACO, one had evidence of a haemolytic transfusion reaction and one suffered an acute transfusion reaction. A further case was transferred to avoidable, delayed and undertransfusion (ADU). This was an elderly man with several other morbidities who developed breathlessness after receiving fresh frozen plasma given inappropriately for reversal of warfarin. Please note that cases may be withdrawn if insufficient information is available to decide on the cause of the reaction. These cases may have circulatory overload but there was insufficient information to include them in that category.

Case 13c.1: An elderly man with renal failure

An 82 year old man with type-2 diabetes, sepsis and acute renal failure on dialysis was transfused a unit of red cells over one hour. He developed hypertension (blood pressure 198/111), tachycardia (130 beats per minute) and wheezing. He was treated with oxygen, steroids and antihistamines and recovered.

Case 13c.2: An elderly woman with malignant disease and sepsis

A 69 year old woman with cancer of the lung and neutropenic sepsis (C-reactive protein 279mg/L) was transfused with red cells for anaemia resulting from chemotherapy. With the second unit she developed rigors, dyspnoea with wheezing, hypertension and hypoxia. She was treated with antihistamines, hydrocortisone, diuretics and oxygen and recovered, and was transfused again uneventfully four days later.

Case 13c.3: An elderly woman with leukaemia and sepsis

A 79 year old woman with acute myeloid leukaemia and neutropenic sepsis developed breathlessness and decreased oxygen saturation after transfusion of a unit of apheresis platelets. Her respiratory rate increased from 20 to 36, her pulse rate from 56 to 101 and her blood pressure from 130/78 to 180/100. She was known to have pre-existing pulmonary fibrosis with angina and cardiac failure. Investigations gave no support for TRALI and she was not fluid overloaded.

COMMENTARY

A notable feature is that TAD seems to be triggered by transfusion in people who are already unwell with inflammation and perhaps suffer a cytokine storm (Garraud 2016). Clinicians need to bear this risk in mind when making decisions to transfuse very sick patients, and consider the risk-benefit balance. Differentiating the different pulmonary complications of transfusion is difficult. Several studies report an association between the presence of inflammatory markers and transfusion reactions. Chemokines and biological response modifiers may be present in the patient, related to the underlying illness (Garraud 2016), and in the blood components, particularly platelets (Roubinian et al. 2015, Hamzeh-Cognasse et al. 2014).

References

Garraud O (2016) **Introduction to post-transfusion inflammation and the potential role of biological response modifiers**. Blood Transfus 14 (Suppl 1), s14-s15

Hamzeh-Cognasse H, Damien P et al. (2014) **Immune-reactive soluble OX40 ligand, soluble CD40 ligand, and interleukin-27 are simultaneously oversecreted in platelet components associated with acute transfusion reactions**. Transfusion 54, 613-625

Roubinian NH, Looney MR et al. (2015) **Cytokines and clinical predictors in distinguishing pulmonary transfusion reactions**. Transfusion 55, 1838-1846

14 Haemolytic Transfusion Reactions (HTR) n=59

Author: Clare Milkins

Definition:

Acute haemolytic transfusion reactions (AHTR) are defined as fever and other symptoms/signs of haemolysis within 24 hours of transfusion; confirmed by one or more of the following: a fall of Hb, rise in lactate dehydrogenase (LDH), positive direct antiglobulin test (DAT), positive crossmatch.

Delayed haemolytic transfusion reactions (DHTR) are defined as fever and other symptoms/signs of haemolysis more than 24 hours after transfusion; confirmed by one or more of the following: a fall in Hb or failure of increment, rise in bilirubin, incompatible crossmatch not detectable pre transfusion.

NB: Simple serological reactions (development of antibody with or, without a positive DAT but without clinical or laboratory evidence of haemolysis) are summarised in Chapter 27, Alloimmunisation, available in the 2015 Annual SHOT Report: Web Edition. (From January 2016, SHOT is no longer collecting cases of alloimmunisation **apart from new anti-D antibodies found in pregnancy**).

Key SHOT messages

- Patients with sickle cell disease are particularly vulnerable to haemolytic transfusion reactions, often associated with hyperhaemolysis and major morbidity. The clinical picture is often complicated by sickle cell crisis, and clinicians and laboratory staff should be vigilant for any signs of haemolysis following a recent transfusion
- High-titre ABO antibodies from intravenous immunoglobulin (IVIg) and plasma-containing components can cause haemolytic transfusion reactions in non group O recipients. These reactions are usually mild, as they are self-limiting, but vulnerable patients such as neonates, and rarely adult patients receiving high dose IVIg or very large volumes of incompatible plasma can also suffer severe reactions. Where time permits, patients should receive ABO-compatible plasma, or high-titre negative if group O has to be given

Number of cases

59 cases have been included, 24 acute and 35 delayed (including hyperhaemolysis).

Age range and median

There were 6 paediatric cases this year (age range 3 to 13 years), although there were two reports from the same patient. The overall age range was 3 to 91, with a median age of 54.

Deaths n=3

There were 7 deaths in total. Four patients died due to their underlying disease, but in one case the haemolytic transfusion reaction definitely contributed to the patient's death (imputability 3), and in a further two cases, the reaction possibly contributed (imputability 1).

Case 14.1: Death due to anti-Wr^a following electronic issue

An elderly male patient with myelodysplastic syndrome (MDS), chronic obstructive pulmonary disease (COPD) and renal impairment, became hypertensive and complained of severe back and abdominal pain 160mL into the first of a two-unit transfusion, which was immediately stopped. The patient was admitted from outpatients, but continued to deteriorate and died about 12 hours later. Post-transfusion testing showed an elevated LDH (300U/L), increased creatinine (168 to 251micromol/L) and a raised bilirubin (5 to 101micromol/L). The antibody screen was still negative, but a retrospective indirect antiglobulin test (IAT) crossmatch showed the unit to be incompatible and anti-Wr^a was identified in the plasma and in an eluate made from the patient's red cells, and the unit was confirmed as Wr(a+). The post-mortem report supported the diagnosis that death was caused by the transfusion reaction.

Wr^a and risk/benefits of electronic issue

The Wr^a antigen has a frequency of approximately 1 in 1000 in the white population, but anti-Wr^a is a relatively common antibody, often found in patients with other red cell antibodies. Although incompatibility due to anti-Wr^a is a well-recognised cause of haemolytic transfusion reactions and haemolytic disease of the fetus or newborn (HDFN), it has rarely caused severe reactions and a literature search has not found any reports of associated death. In addition to 3 cases this year, there have been 7 cases of AHTR due to anti-Wr^a reported to SHOT in the last three reporting years (2012–2014), one of which resulted in the patient being admitted to the intensive therapy unit (ITU), whilst the other 6 caused minor morbidity only. There were none reported from 2008 to 2011. The increasing number of reports may well be related to the increasing use of electronic issue in the UK (from 42% in 2008 to 67% in 2015 - UK National External Quality Assessment Service (NEQAS) data).

Electronic issue has been widely used in some countries for over 20 years (Butch et al. 1994, Safwenberg et al. 1997), and the benefits are well documented and understood, including: more timely provision of red cells for transfusion, thereby reducing the potential for delays; a reduction in red cell wastage; significant reduction in hands-on work, freeing staff to undertake essential training, competency assessments and other quality improvements.

Learning point

- Haemolytic transfusion reactions due to antibodies directed against low frequency antigens are an acknowledged, but small, risk of omitting the indirect antiglobulin test (IAT) crossmatch, estimated at 1 in 500,000 to 1 in one million transfusions (Garratty 2002). The possibility of this event should always be considered when a patient has an acute haemolytic episode following transfusion, and a retrospective crossmatch should be undertaken to confirm the presence of a red cell antibody, so that the patient can be flagged as being unsuitable for electronic issue, thereby preventing future incompatible transfusions

Case 14.2: AHTR possibly contributed to death – cause of reaction unknown

A patient with MDS became acutely unwell 75mL into a red cell transfusion, immediately following a platelet transfusion. She became acutely short of breath, developed severe rigors and turned blue. She also passed dark urine, and Hb was confirmed in the urine by dipstick. Her Hb fell and bilirubin rose from 29 to 40micromol/L. She was given chlorphenamine, pethidine, hydrocortisone, oxygen and albuterol (Ventolin), and was admitted to critical care but died the next day following a cardiac arrest. Anti-E was identified post transfusion, but this unit and previously transfused units were confirmed as E-negative, as this was not a new antibody. The DAT was positive and anti-E was identified in an eluate made from the patient's post-transfusion red cells. It is possible this was an autoantibody. Anti-Wr^a was also identified post transfusion, but the unit was confirmed as Wr(a-). The cause of death was determined as multiorgan failure and drug-induced myocarditis, however the reporter feels that the transfusion may have contributed.

Case 14.3: DHTR due to anti-Jk^a possibly contributed to death of an already sick patient

An elderly patient was transfused 3 units of red cells in cardiac intensive care over 4 days post heart surgery. Twelve days post surgery this very sick patient developed anti-Jk^a with a positive DAT, increased bilirubin, a fall in Hb, and spherocytes, suggesting a DHTR. Her death was multifactorial, but the reporter believes that the reaction contributed to her critical illness.

Major morbidity n=17

There were 8 cases of major morbidity, with details shown in Table 14.1, plus an additional 9 cases of possible hyperhaemolysis in patients with sickle cell disease, described separately in a later section. Table 14.1 includes a 9th case, which was reported as an incorrect blood component transfused (IBCT), but which caused an acute haemolytic reaction.

Table 14.1
Details of cases of
major morbidity

Case type	Antibody/cause	Clinical symptoms	Criteria for major morbidity	Imputability
AHTR	Antibodies to flucloxacillin	Fever, chest pain, hypertension, vomiting, peripheral shutdown, black plasma	Intravascular haemolysis	Probable
AHTR	Not known Known multiple antibodies but Ab screen negative and antigen-negative blood given, DAT positive, no eluate	Rigors, pyrexia, back pain, tachycardia	ITU admission	Probable
AHTR	?E. coli infection with haemolysis exacerbated by transfusion	Pyrexia, fever, chills, hypotension, tachycardia, red plasma, impaired renal function	Required dialysis and ITU admission	Possible
AHTR	Anti-Bg ^a with unit Bg(a+)	Rigors, back pain, tachycardia, hypertension	Difficulty breathing requiring O ₂ support; required urgent transfer to specialist hospital	Probable
AHTR	Known anti-Fy ^a but Fy(a+) emergency O D-negative given	Shock, rigors, hypotension	Required resuscitation and transferred to ITU	Possible
AHTR	?anti-Jk ^b , RhCcEe-related antibody; ?exacerbation of AIHA in sickle cell patient	Back pain; dark urine	Required ITU admission	Certain
IBCT/AHTR*	Anti-A in neonate following exchange transfusion with group O SAGM red cells	Collapse, DIC	Intravascular haemolysis; required resuscitation	Possible
DHTR	Anti-U	Flu-like symptoms	Major drop in Hb 90 to 47g/L 6 days post transfusion	Certain
DHTR	Anti-Jk ^b	Chest pain, dyspnoea, jaundice	Required ITU admission (already on HDU)	Probable

AIHA=autoimmune haemolytic anaemia; HDU=high dependency unit; ITU=intensive therapy unit; DIC=disseminated intravascular haemolysis; SAGM=saline adenine glucose mannitol

*detailed discussion of this case in Chapter 16, Paediatric Summary

Clinical and laboratory signs and symptoms

Acute haemolytic transfusion reactions n=24 reactions in 23 patients

There appears to be no typical set of clinical symptoms associated with acute haemolytic reaction; the most commonly reported are shown in Figure 14.1.

All but one report provided laboratory evidence of haemolysis, with the majority of patients having a raised bilirubin and a fall in Hb. There were 9 reports of haemoglobinuria, and 2 severe reactions included haemoglobinaemia, suggesting intravascular haemolysis.

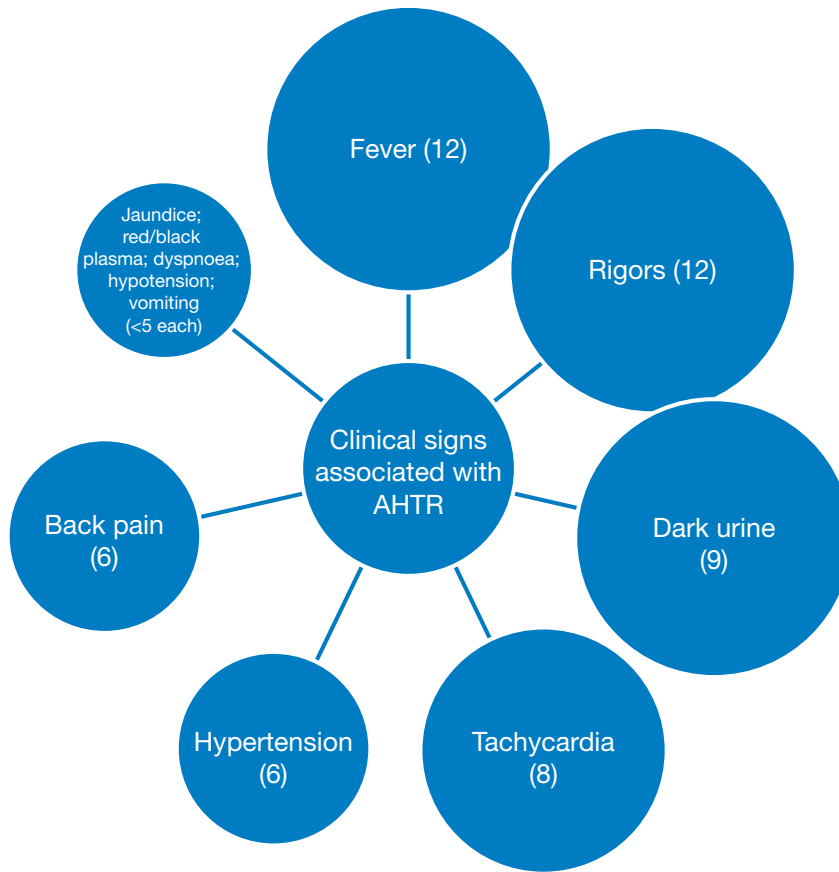


Figure 14.1:
Clinical signs
associated with
AHTR

Delayed haemolytic transfusion reactions n=26 (excluding potential cases of hyperhaemolysis)

Seven patients had jaundice and/or dark urine. In the remaining 19/26 cases (73.1%) there were no obvious clinical symptoms associated with the DHTR, which was diagnosed by laboratory signs of haemolysis. The main indicators are shown in Figure 14.2.

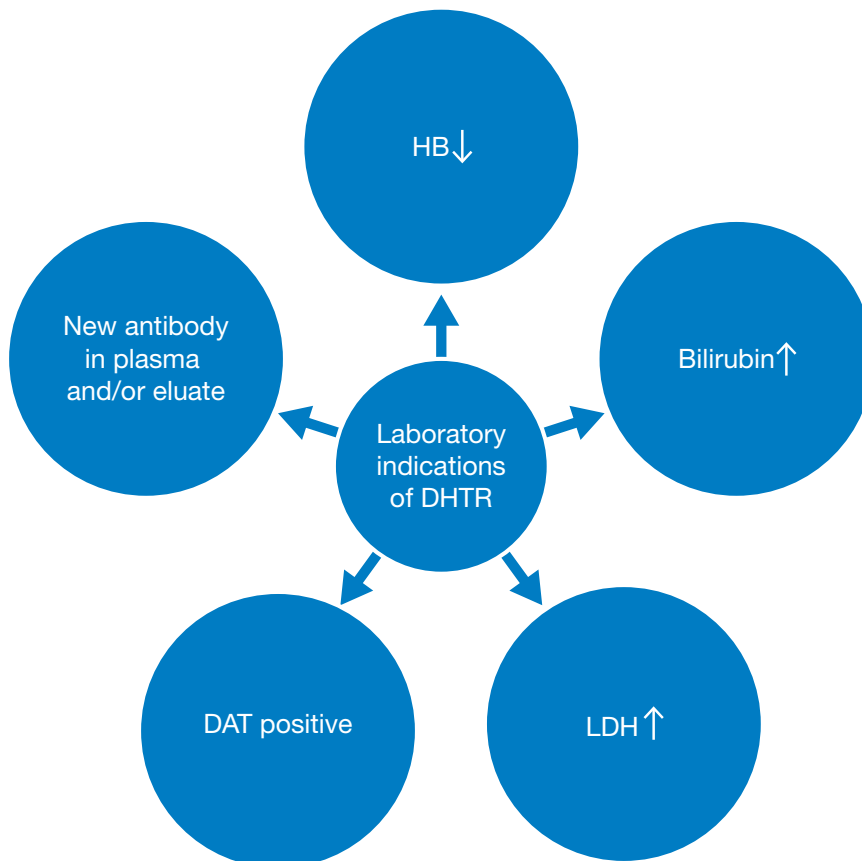


Figure 14.2:
Laboratory
indications of
DHTR

Serological findings

Acute n=24 reactions in 23 patients

Antibodies to low frequency antigens

There were three cases of anti-Wr^a reported in 2015. All were confirmed retrospectively as incompatible with the implicated donation. One patient died as a result of the incompatible transfusion, and this has been described earlier (Case 14.1).

Antibodies known about pre transfusion (1 emergency; 1 error)

Emergency O D-negative red cells were transfused in 1 urgent case where the patient was known to have anti-Fy^a, and the transfused unit was Fy(a+).

Another patient with known anti-K+Fy^a had a rigor and spiked a temperature during the transfusion of one of the selected units, which was noted retrospectively to be unlabelled for K, and was in fact K+. Pre-transfusion testing was undertaken by an experienced biomedical scientist (BMS) in a pressured situation. There were several errors involved, including not noting that the unit was not labelled as K-negative and not investigating or excluding an incompatible crossmatch from transfusion.

Kidd (Jk antigen)/Rh antibodies cause 3 serious haemolytic reactions

Anti-Jk^a was responsible for 2 quite serious haemolytic reactions, in which both patients passed dark urine and became jaundiced. One was a newly developing antibody following a transfusion 2 days earlier, and was detectable in a new sample tested just after a Jk(a+) unit had been transfused. The other was probably identifiable in the pre-transfusion sample, but a doubtful reaction brought forward for review was repeated and found to be negative by the analyser the second time round. Retrospective review showed weak positive reactions by eye.

A third case involved Rh and Kidd antibodies in a patient with sickle cell disease and is described in the section on sickle cell patients.

Passive ABO antibodies causing acute and delayed reactions

Unusually, one group AB adult patient suffered rigors and passed dark urine during the transfusion of a group A apheresis platelet unit (not labelled as high-titre negative), which was retrospectively found to have high-titre anti-B (>512). The patient had a positive DAT post transfusion (C3d coating), but no eluate was undertaken, as there was no in-house method set up for this test.

A second patient (group AB) had a delayed haemolytic reaction following the last of 5 daily injections of high dose intravenous immunoglobulin (IVIg). Five days after the last dose, the patient was admitted with breathing difficulties and his Hb had dropped from 152 to 96g/L, and he reported having passed pink urine. He died suddenly at home 11 days later, but at this point the Hb was 120g/L with a negative DAT and his death was considered unrelated to the HTR.

A third patient was a neonate with ABO haemolytic disease of the newborn, who suffered what appeared to be a severe intravascular haemolytic episode, collapse and DIC following exchange transfusion with 320mL of group O SAGM red cells (this was an error in ordering and has been reported in the IBCT-WCT category), which was retrospectively shown to have a high-titre of IgM anti-A (1 in 512 by saline test). This complex case is described in detail in Chapter 16, Paediatric Summary.

Antibodies not usually associated with haemolytic transfusion reactions

There were 5 cases (related to 4 patients) where anti-Lu^a, -Bg^a and -Sd^a were implicated, although 3 were of low imputability. More information can be found in the supplementary information on the SHOT website www.shotuk.org.

Reactions probably not associated with red cell alloantibodies

One patient suffered a severe intravascular haemolytic episode (black plasma) with fever, chest pain, hypertension and peripheral shutdown. The reference laboratory identified antibodies to flucloxacillin in the plasma and eluate, and an enzyme-only anti-e in the plasma.

Another suffered a severe haemolytic episode, also involving what appeared to be intravascular haemolysis, and required dialysis and ITU admission. No red cell antibodies were detected and it is possible that this was an *Escherichia coli* infection with haemolysis exacerbated by transfusion.

There were 3 cases that were likely to have been exacerbation of autoimmune haemolysis, and another 5 where no cause was found. One of the latter cases did have a positive DAT with anti-Jk^a in the plasma and eluate, which could have been autoantibody, or alloantibody from a possible previous transfusion in another country.

A second case with cause unknown was a patient with complex historical antibodies (not currently detectable) and a positive DAT who required ITU admission following fever, rigors, tachycardia, back pain and a seizure during a (fully phenotyped) red cell transfusion. Although the antibody screen was still negative post transfusion, samples were not referred for more sensitive testing nor was an eluate tested.

Learning points

- Exacerbation of autohaemolysis is a recognised effect of transfusion, and should be taken into account when transfusing patients with autoantibodies. New autoantibodies can also be stimulated by transfusion (Young et al. 2004, Petz and Garratty 2004)
- It is advisable to use more sensitive techniques (and test an eluate if the direct antiglobulin test (DAT) is positive) where no antibodies are detected in the antibody screen following a haemolytic transfusion reaction

Delayed (excluding potential hyperhaemolysis) n=26

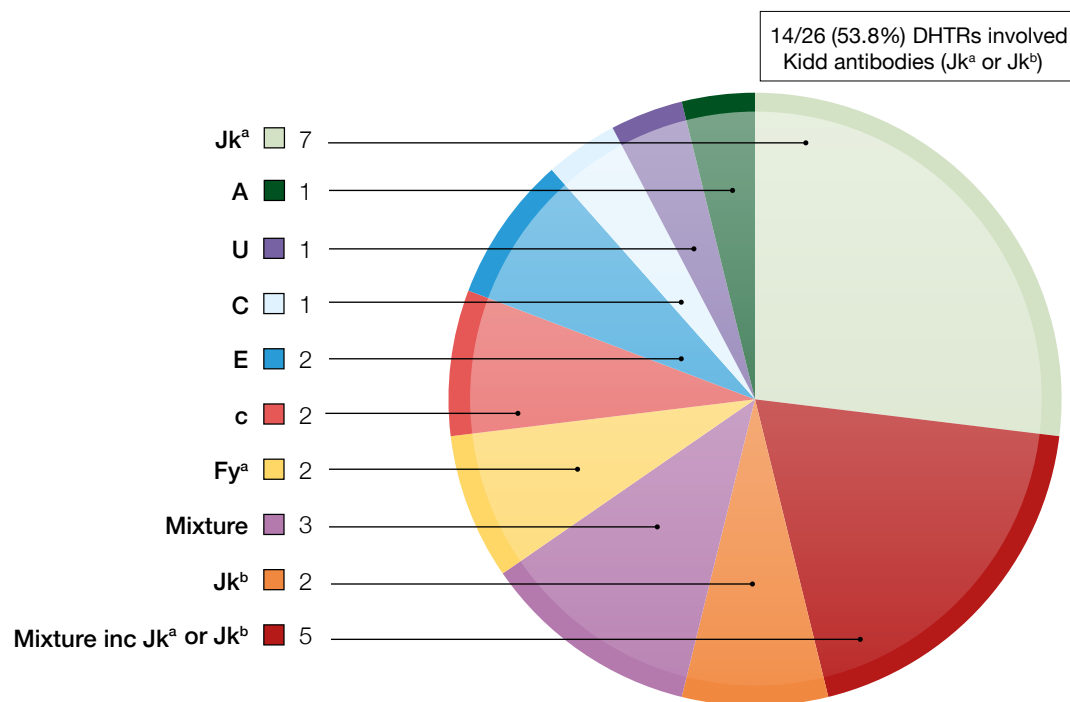


Figure 14.3: Specificities involved in the DHTRs

Haemolytic reactions in patients with sickle cell disease

HTR were reported in 11 patients with sickle cell disease, 9 delayed (all potential cases of hyperhaemolysis) and 2 acute reactions. This is the same number of cases as reported last year.

Acute

One pregnant patient, with known anti-E+Fy^a, had a serious acute haemolytic episode during a red cell transfusion at delivery, resulting in ITU admission. She was found to have developed a new anti-Jk^b, an Rh CcEe-related antibody (compatible with -D-/-D- cells), anti-Le(a+b), and an auto panreactive antibody. It is not clear which of these antibodies was responsible for this serious reaction.

The second patient had known anti-Fy^a and a panreactive autoantibody. The patient had fever and rigors during a transfusion and was found to have anti-Lu^a post transfusion, but there was no evidence of haemolysis provided and it is not clear whether the implicated unit was Lu(a+).

Potential hyperhaemolysis

Some of these cases were reported as minor morbidity and others as major morbidity. However, the reported reductions in Hb were very similar in all cases. SHOT considers that all reported cases of probable hyperhaemolysis where there is a significant fall in Hb should be considered as major morbidity.

The review panel confirmed two cases with the clinicians using the 'post-transfusion hyperhaemolysis referral and follow-up form', before these were reported to SHOT. In addition, there were 5 probable and 2 possible cases.

In 5 cases there were no new alloantibodies, and post-transfusion Hb levels fell to between 36 and 45g/L, with one patient requiring ITU support. Four haemolytic episodes occurred between 4 and 7 days, which is classic timing for cases where no alloantibodies are implicated, and these have been referred to as 'acute' (Win et al. 2008) The 5th case was atypical in that the Hb fell from 63 to 39g/L within 24 hours of admission, 18 days post transfusion.

The other 4 patients developed new red cell antibodies, but in all cases the post-transfusion Hb was lower than the pre-transfusion Hb suggesting destruction of the patient's own cells in addition to any antibody-coated transfused cells. These reactions occurred 7-10 days post transfusion, fitting the classic definition of 'delayed' hyperhaemolysis (Win et al. 2008). One of these patients already had anti-C+S+Kp^a, plus a pan-reactive autoantibody, and developed anti-Fy^a, -Fy³ and -Jk^b post transfusion. The patient's Hb fell to 41g/L which was below the pre-transfusion level, but did not show any other signs of haemolysis, and it is possible that this could have been a more classic DHTR and/or exacerbation of AIHA.

Timing of reactions

Acute

The majority (13/24) of reactions occurred during the transfusion, which was discontinued in all but one case. 4 occurred within 2 hours of the transfusion and the remaining 7 within 24 hours.

Delayed

The delayed reactions were detected between 2 and 18 days post transfusion with a median of 8 days. In some cases, the exact time period was unclear as the patients had received several transfusions over a number of days.

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New or Unclassifiable Complications of Transfusion (UCT) n=14

15

Author: Paula Bolton-Maggs

Definition:

Occurrence of an adverse effect or reaction temporally related to transfusion, which cannot be classified according to an already defined transfusion event and with no risk factor other than the transfusion, and no other explanation.

Serious reactions in this category are reportable to the European Union (EU) as 'uncategorised unintended responses'.

Deaths n=3

In total 5 deaths were reported, including 3 cases of necrotising enterocolitis (NEC) where the transfusion was contributory (imputability 1) and 2 other cases where transfusion did not play a role.

Major morbidity n=3

Three cases resulting in major morbidity are described below, Cases 15.3, 15.6 and 15.7.

Transfusion-associated necrotising enterocolitis

Six infants with NEC were reported in 2015, 4 died and in 3 the transfusion was considered contributory.

Case 15.1: NEC resulting in death, transfusion contributory

A male 24 day old twin born at 27 weeks weighing 1090g developed NEC within 24 hours of top-up transfusion for symptomatic anaemia of prematurity. The baby had no symptoms prior to transfusion. The baby died within 48 hours and the transfusion was considered contributory.

Case 15.2: NEC resulting in death, transfusion not contributory

A 1 month old baby (28.4 days preterm) had additional risk factors for NEC (surfactant lung disease and growth retardation). The baby developed NEC after transfusion, but had signs prior to transfusion and had received paedipacks from the same donation prior to this. The baby died but transfusion was not thought to contribute.

Case 15.3: NEC and intraventricular haemorrhage (IVH)

A 1 month old baby (26.6 days preterm) with surfactant lung disease and bilateral intraventricular haemorrhage developed NEC within 3 hours of transfusion. The consultant could not assess whether the transfusion had played a role; the baby recovered.

Case 15.4: NEC where transfusion contributed to death

A 1 month old baby (born at 28 weeks, 830g) developed an episode of suspected NEC on day 4 and recovered with conservative management. On day 37, now established on enteral feeds, she developed confirmed NEC again 2 hours post transfusion. The child died 2 days later and the transfusion was considered to be contributory.

Case 15.5: NEC where transfusion contributed to death

A 1 month old baby (preterm 23 weeks) had a confirmed episode of NEC at about 2 weeks, then while stable and ventilated, developed another episode 3 weeks later on the same day as transfusion and died within 24 hours with fulminant NEC. The transfusion was considered to be contributory.

Case 15.6: NEC post transfusion and recovered

A 1 month old baby (27 week twin) received a transfusion on day 32. The baby had respiratory distress prior to transfusion but deteriorated during transfusion requiring cardiopulmonary resuscitation. Noted to have distended abdomen and was transferred to tertiary care with suspected NEC. The baby survived.

Comment: This association requires further investigation. However, a large Canadian study identified 927 cases of NEC and confirmed that transfusion in the previous 2 days was significantly higher than in controls (15.5% vs 7.7%) and is an independent risk factor (Stritzke et al. 2013). It has been thought to be related to feeding practice. The evidence is reviewed by Keir and Wilkinson (2013) who conclude that there is some support for this association. They suggest that feeding should be withheld during transfusion 'pending further evidence'. A retrospective multicentre audit in the UK using strict criteria for the definition concluded that 15 (22%) of 68 very low birth weight infants with NEC were transfusion-associated (Hamad et al. 2015) and the authors recommend that a large surveillance study be undertaken.

Pain in relation to transfusion

This interesting complication is a recognised association in patients with thalassaemia (Haines et al. 2013, Green et al. 2014), and a severe case was noted in the Annual SHOT Report for events in 2012. Four similar cases were reported in 2015, two with thalassaemia.

Miscellaneous**Case 15.7: Reaction to intravenous immunoglobulin (IVIg)**

A reminder that IVIg can be associated with serious life-threatening events: a 56 year old woman with serious autoimmune disease and multiorgan dysfunction suffered respiratory arrest necessitating admission to the intensive therapy unit.

Case 15.8: Reaction to administration of granulocytes

A 35 year old with relapsed chronic myeloid leukaemia and fungal infection received granulocytes prepared 'in house' which had not been crossmatched, and developed a rigor with a temperature increase from 36.8 to 39.6°C and tachycardia. This was a procedural failure associated with a serious adverse reaction. Granulocytes should undergo the same compatibility testing as red cells, and be ABO-, D- and crossmatch-compatible with any red cell antibodies in the recipient.

Case 15.9: Unexplained death during transfusion

A 6 year old girl with scoliosis and a complex medical history arrested and died during a postoperative transfusion. Although a potassium level done on a point-of-care machine was elevated, the unit of blood was tested for potassium content and was not implicated. The cause of death was not thought to be related to the transfusion.

Case 15.10: A reminder to de-activate access to the blood refrigerator when a member of staff is on sick leave long term

A 57 year old staff member reported to the community psychiatric nurse that she had taken a unit of blood from the laboratory and infused it into herself as part of self-harm. Her swipe card access to the system at midnight during her admission was confirmed and a unit of blood (group A D-positive) was found to be missing. The patient's group is O D-positive. It was not confirmed whether this unit had been self-infused but no reaction was reported. The security policy was reviewed and changed as a result of this incident.

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16 Paediatric Summary

Authors: Helen New and Paula Bolton-Maggs

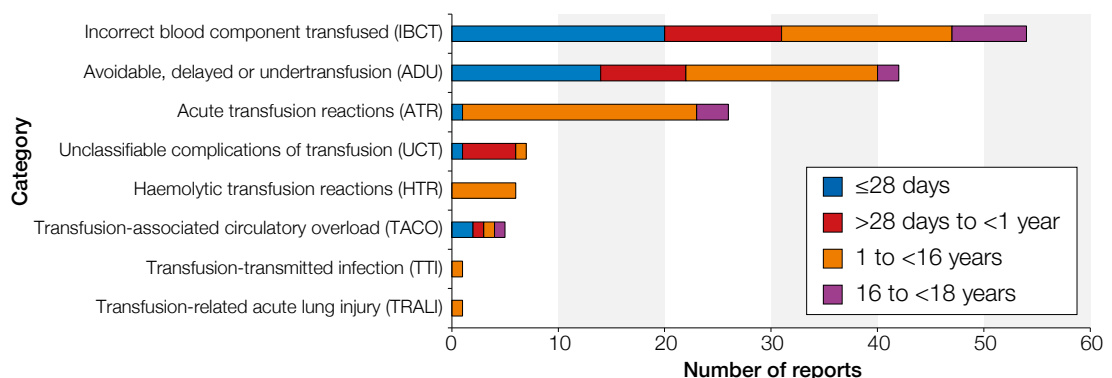
Definition:

Paediatric cases comprise all reports for patients under 18 years of age, including all paediatric cases from the other chapters in this report. Paediatric reports have been subdivided by recipient age group: neonates ≤ 28 days; infants >28 days and <1 year old; children ≥ 1 year to <16 years and young people aged 16 to <18 years.

Key SHOT messages

- There were several cases of adult emergency O D-negative red cell units having been used for neonatal resuscitation despite availability of neonatal emergency packs. Local measures should be in place to help guide staff to select the correct component in emergency situations
- A total of 5 reports related to babies undergoing neonatal exchange transfusion; one died and another had severe clinical deterioration. Exchanges are invasive procedures now performed rarely. They require special components with a short shelf-life with which staff may be unfamiliar. Babies undergoing exchanges are by definition vulnerable
- Laboratory errors result from inadequate neonatal pre-transfusion testing or failure to provide phenotyped blood, which in the context of other laboratory errors reported to SHOT suggest the need for increased support and training for laboratory staff
- The increased reporting of transfusion-associated necrotising enterocolitis (NEC) cases is encouraged in order to improve understanding of this condition in the United Kingdom (UK)

Figure 16.1:
Summary of
paediatric cases
2015 by most
frequent category
and age



Introduction and overall trends

Paediatric reports have increased from 221 in 2014 to 274 in 2015. These contributed 162/1858 (8.7%) of incident reports in 2015, and the total of 274/3288 (8.3%) when near miss (NM) and right blood right patient errors (RBRP) are included.

Six cases of transfusion-associated necrotising enterocolitis (NEC) were reported (discussed in Chapter 15, New or Unclassifiable Complications of Transfusion (UCT)).

Deaths where the transfusion contributed n=6

In total there were 18 deaths (12 unrelated to transfusion) in the paediatric age group, of which 14 were neonates or young infants consistent with the vulnerability of this young population.

Of the 6 deaths that were assessed as being related to transfusion, there were 2 cases of transfusion-associated circulatory overload (TACO) possibly related, 3 cases of necrotising enterocolitis (NEC) possibly related, and 1 Anti-D immunoglobulin (Ig) failure which was probably related (Case 1 in Error Reports: Human Factors section).

Major morbidity n=22

(ATR n=11, HTR n=3, IBCT WCT laboratory n=3, UCT n=2, transfusion-associated circulatory overload (TACO) n=1, transfusion-related acute lung injury* (TRALI) n=1, TTI n=1)

*this case was thought to be unlikely TRALI

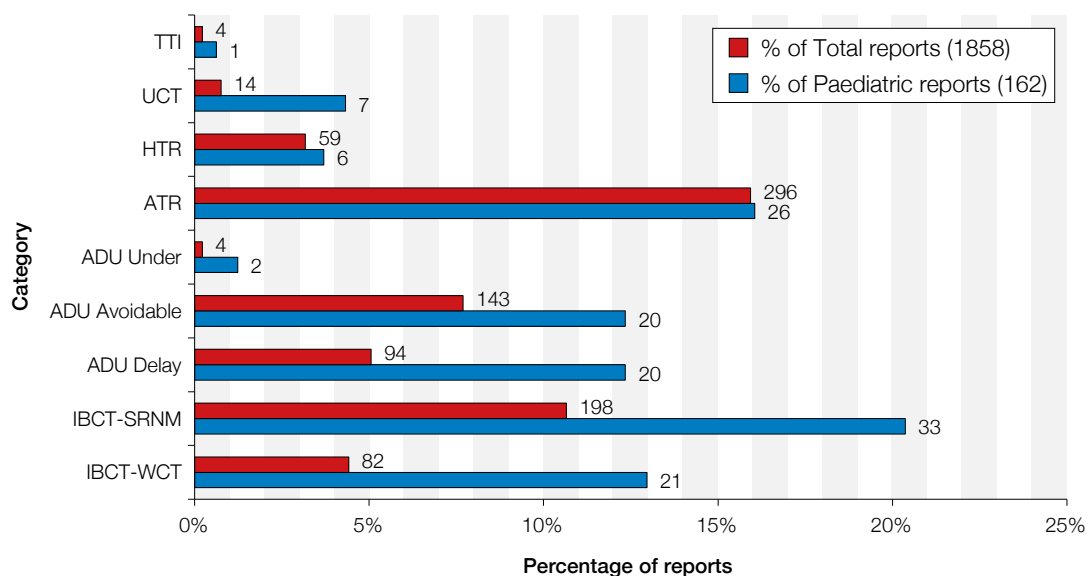


Figure 16.2: Percentages and numbers of paediatric and total reports in key categories

TTI: transfusion-transmitted infection; HTR: haemolytic transfusion reaction; ATR: acute transfusion reaction, IBCT: incorrect blood component transfused; SRNM: specific requirements not met; WCT: wrong component transfused

Error-related reports n=112

(IBCT, handling and storage errors (HSE), ADU and anti-D)

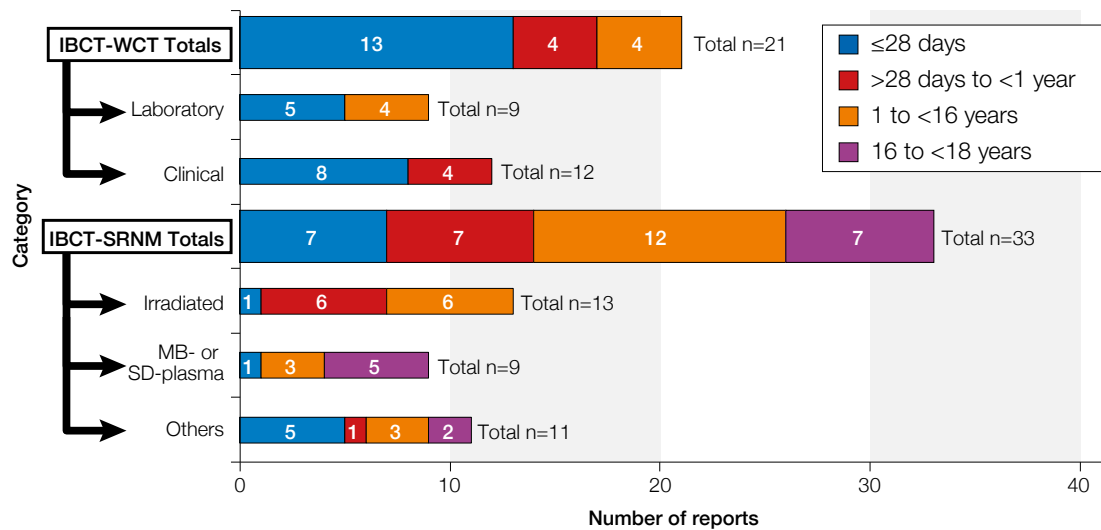
These were 112/162 (69.1%), compared to 71/122 (58.2%) in 2014. There was an increase in paediatric cases (42/162) in the ADU category (Figure 16.2). Almost half (20/42, 47.6%) were reports of delays to transfusion.

A total of 45/112 (40.2%) errors originated primarily in the laboratory (9 wrong components transfused (WCT), 20 specific requirements not met (SRNM), 6 HSE, 8 ADU, 2 anti-D Ig).

Charts showing trends in paediatric reports over time can be found in the supplementary information on the SHOT website www.shotuk.org.

Incorrect blood component transfused (IBCT) n=54

Figure 16.3:
Reports of an
incorrect blood
component
transfusion: type
and age group



IBCT: wrong component transfused (WCT) n=21

Clinical errors n=12

There were 12 clinical errors where adult O D-negative emergency red cell units were collected and transfused instead of emergency units suitable for neonatal use. Most were transfused to neonates within the first few days of life. Four were young infants, all related to the same incident, where adult units were taken from the remote issue refrigerator for the infant transfusions.

Laboratory errors n=9

- Non-neonatal red cells given for neonatal exchange
- See supplementary information on the website for the other 8 cases

Case 16.1: Severe clinical deterioration following neonatal exchange with adult red cells

A neonate, blood group A, with severe ABO haemolytic disease of the newborn underwent a double-volume exchange transfusion, following continuing rise in bilirubin levels despite phototherapy and intravenous immunoglobulin (IVIg). There were no clinical problems noted with carrying out the exchange procedure according to protocol but immediately following exchange, the baby deteriorated and developed multiorgan failure with disseminated intravascular coagulation and evidence of ongoing haemolysis. The baby required resuscitation and multiple blood component transfusions over several days and was also given further IVIg as well as steroids and ongoing antibiotics. The haematology team liaised closely and gave advice on management but unfortunately did not instigate formal investigations for a transfusion reaction. The baby was discharged home well several days later.

Subsequently it was realised that the unit ordered and used for the exchange procedure was an irradiated group O adult unit of red cells suspended in saline adenine glucose mannitol (SAGM), that was not high-titre (HT) negative, containing high-titre anti-A (IgM 1:512). The unit had been requested in the early hours of a Sunday morning by a biomedical scientist (BMS) without previous experience of ordering blood for neonatal exchange transfusion and who had last been rotated into the blood transfusion laboratory 3 months previously. The standard operating procedure (SOP) did not include specific instructions about the correct component to order. The product name for neonatal exchange units on the Blood Service electronic ordering system drop-down menu is 'Exchange Red Cells Irradiated', without specifying 'neonatal'. The BMS was confused by this and selected 'Red Cells Irradiated' instead, ticking several additional optional requirements and adding a line note that the blood was required for neonatal exchange transfusion, HT-negative. The Blood Service staff did

not take account of all the line notes as these did not align with the system-controlled component requested by the BMS.

Comment: The cause of the sudden clinical deterioration is not certain in this complex case. It could not be explained by electrolyte disturbances. Bacterial sepsis was considered by the clinical team but felt to be unlikely as the baby did not behave clinically as expected for sepsis and the C-reactive protein (CRP) was not significantly raised. However, the baby did not have a blood culture sent after deterioration and the blood bag was not cultured so sepsis was not formally excluded.

After careful review it was felt that the least unlikely cause of the clinical deterioration after exchange transfusion was the HT anti-A antibodies in the transfused red cell unit causing an acute haemolytic transfusion reaction (with possible additional bystander haemolysis causing destruction of transfused red cells). However, as only a small volume of plasma was infused in the SAGM unit (approximately 15mL), such a reaction would be very unusual and it was not established that the donor IgM anti-A was lytic in vitro (so low imputability). Moreover, there was already maternal IgG anti-A present (IgG titre of 1 in 8000 in the maternal plasma). The bilirubin was already high due to this, but did not rise much further after exchange transfusion. The neonatal plasma was not inspected for increased haemolysis post exchange. Both IgG and IgM ABO antibodies bind complement and both can cause intravascular haemolysis. IgM binds complement more easily, but neonatal complement levels are usually low. Alternatively, IgM anti-A can cause in vitro agglutination in the absence of complement, and these can become trapped in the sinusoidal circulation but it is not clear which processes were active in this instance.

Red cells other than of neonatal/infant specification are not labelled as negative for high-titre anti-A/B as it is not considered that the small volume of plasma in SAGM red cells constitutes a significant risk (BCSH Milkins et al.).

Learning points

- *Biomedical scientist (BMS) training*

Neonatal exchange transfusions are relatively rarely performed now, and BMS staff may lack knowledge and experience of the specific component required. Staff rotate between laboratories and may only have basic training in blood transfusion. Even where there are specific standard operating procedures (SOP) available giving guidance, BMS staff may not know where to find them. Once a specialised component has been ordered from the Blood Service, hospital laboratory staff should not assume that it has been provided correctly and still need to specifically check the provided product on arrival

- *Computer ordering systems*

When ordering components from the Blood Service, product names are not always consistent between all documents, software and labels (see also Case 6.7 in Chapter 6, Incorrect Blood Component Transfused (IBCT)). When using computer system-controlled drop-down menus, the role of additional explanatory 'line notes' is not always clear as they are not information technology (IT)-controlled in the same way

- *Investigation of suspected transfusion reactions*

Where there has been a significant clinical deterioration during or following a transfusion, local standard procedures and British Committee for Standards in Haematology (BCSH) guidelines (BCSH Tinegate et al. 2012) should be followed for investigation of a transfusion reaction in order not to miss possible transfusion-related events and to ensure adequate investigation e.g. for bacterial contamination, unit incompatibility, and whether an appropriate component was transfused

- *Neonatal exchange transfusion components and procedure*

Neonates undergoing exchange transfusion are vulnerable. There is a need to ensure that the correct component is used for the exchange transfusion and there needs to be meticulous monitoring during and following the procedure, including fluid balance and Hb levels

- *Role of high-titre (HT) antibodies in causing the haemolytic transfusion reaction*

For non-neonatal/infant red cell units, information on HT screening is not considered clinically necessary given the low risk related to the low volume of plasma in standard *saline adenine glucose mannitol* (SAGM) units. However HT-negative is recommended for neonatal/infant specification blood, and is particularly important for neonatal exchange units which contain a higher volume of plasma

Neonatal exchange transfusion has been the subject of a British Paediatric Surveillance Unit (BPSU) survey between October 2014 and October 2015 (BPSU 2015, Gottstein et al. 2016). Little is known about indications and complications of this procedure. Details of the protocol are available at www.rcpch.ac.uk/bpsu/ebt. The results are not yet fully available but data published in abstract reports complete data collection for 93 babies who had 1 to 5 exchanges (total 115), the majority (86%) for hyperbilirubinaemia (secondary to haemolysis). Time to obtain suitable red cells varied from 22 minutes to 17 hours (median 4 hours 35 minutes). Four babies died, one from splenic rupture related to the procedure and 3 from their underlying disease. The outcome will be to develop appropriate guidance.

IBCT: specific requirements not met (SRNM) n=33

Additional details can be found in the supplementary information on the SHOT website www.shotuk.org.

- Clinical cases where requirements were not communicated properly to laboratory: n=13
- Primary error in the laboratory: n=20

Avoidable, delayed or undertransfusion (ADU) n=42

- Delays to transfusion: 20 (various reasons – included three neonatal exchange transfusions due to problems associated with the exchange component: age, shelf-life, irradiation)

Additional details can be found in the supplementary information on the SHOT website www.shotuk.org.

Handling and storage errors (HSE) n=14

- Technical administration error: 4 (pump setting error: 1 transfusion given too quickly; no/incorrect giving set in 3)

Case 16.2: Inappropriate method of administration in an emergency

A 1 year old boy was transferred to the emergency department (ED) from a private clinic with major haemorrhage following circumcision. He was managed by a paediatric trauma team who activated the major haemorrhage protocol resulting in 2 emergency O D-negative adult units being brought to the ED. No paediatric giving sets could be found in the ED so the anaesthetist punctured the blood bag several times with needles and syringes and gave blood directly by peripheral venous access with no blood giving set which would normally incorporate a mesh filter. The punctured bag was found leaking in the sink in the ED. The child recovered fully.

Review of this case identified the need for training of paediatric, anaesthetic and ED staff in safe transfusion procedures. Porters needed training to recognise both types of emergency O D-negative units, paediatric and adult. The ED nursing staff were empowered to challenge inappropriate practice by other professionals.

Anti-D Ig n=2

There were no cases related to pregnancy. The two cases were:

- A 3 year old girl who was B D-negative was given B D-positive platelets without receiving prophylaxis with anti-D immunoglobulin. It was a laboratory error which should have been detected by the ward
- A neonate with high bilirubin and probable haemolytic disease of the newborn was born to a mother who had developed immune anti-D (Chapter 9, Anti-D Immunoglobulin (Ig) Errors). The baby died of clinical complications during the exchange transfusion (Case 1 in the Error Reports: Human Factors section)

Transfusion reactions n=50

Acute transfusion reactions (ATR) n=26

This year paediatric ATR made up 26/296 total ATR reports (8.8%). Severe paediatric reactions were reported in 11/26 (42.3%) but there were no deaths. There was only one ATR reported in a neonate (to SD-FFP, see below), and none in infants.

The percentages of ATR shows that the majority were to platelets: red cells 19%, platelets 69%, plasma 8%, granulocytes 4%.

Further details can be found in the supplementary information on the SHOT website www.shotuk.org.

Haemolytic transfusion reactions (HTR) n=6

See Chapter 14, Haemolytic Transfusion Reactions for details; two episodes were reported in the same patient.

Note also neonatal exchange case with possible haemolysis related to HT donor antibodies.

Transfusion-associated circulatory overload (TACO) n=5

There were two cases in neonates. One was severe TACO after a double exchange transfusion, Case 16.3 below. The second was a 25 weeks gestation, 21 day old baby with chronic lung disease who developed increasing respiratory symptoms following a 15mL/kg top-up transfusion.

Case 16.3: TACO following exchange transfusion for hyperbilirubinaemia

A preterm baby aged 6 days was admitted unwell with severe hyperbilirubinaemia and acidosis, requiring ventilation. During the exchange transfusion, the respiratory function deteriorated with decreased oxygen saturations and increased respiratory rate. The Hb increased from 132g/L to 218g/L following the exchange, and the fluid balance was 105mL positive (45mL/kg). The baby developed worsening renal failure, coagulopathy and poor perfusion, had cardiac arrests and died the following day. It was felt that the exchange transfusion was contributory to the deterioration.

The case illustrates the vulnerability of neonates undergoing exchange transfusion and the need for meticulous monitoring of the procedure including fluid balance and Hb levels.

Case 16.4: TACO following a top-up transfusion

A 13kg one year old showed evidence of TACO following transfusion of an apheresis unit of platelets (approximately 20mL/kg) followed by 150mL red cells (approximately 400mL in total).

Unclassifiable complications of transfusion (UCT) n=7

There were 6 babies aged about 1 month with necrotising enterocolitis (NEC) following packed red cell transfusions, of which 4 died. (For further details and the additional case, see Chapter 15, New or unclassifiable complications of transfusion (UCT)).

Transfusion-transmitted infection (TTI) n=1

A 13 year old liver transplant recipient was diagnosed with hepatitis E virus (HEV) infection following a platelet transfusion. This case was identified in the investigation following a confirmed HEV transmission in another adult recipient.

Near miss (NM) n=97 and right blood right patient (RBRP) n=15

Recommendations

- Adult O D-negative units are unsuitable for neonatal emergency use. Dedicated neonatal O D-negative units should be available for emergency use in neonates. Local measures should be in place to help guide staff to select the correct red cell component for neonatal resuscitation in emergency situations
- Particular attention should be provided for laboratory staff training regarding the specification and ordering of neonatal exchange components in hospitals with neonatal intensive care units

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Anti-D immunisation in pregnancy: cases reported in 2015

17

Author: Jane Keidan

Key SHOT messages

- All pregnant women who have produced immune anti-D detected for the first time in the current (index) pregnancy should be reported to SHOT. This includes cases where the woman subsequently produces immune anti-D in pregnancy as a result of an error of anti-D immunoglobulin (Ig) administration
- Accumulation of sufficient cases is needed to clarify the optimal prophylactic anti-D Ig regimen in pregnancy. There is no other way we can obtain this information. These data also serve as a reminder to laboratory and clinical staff of the significance to current and future pregnancies of correct management of potentially sensitising events
- All reporters should ensure they obtain as full a dataset as possible. Since immune anti-D may be detected at the start of pregnancy, the SHOT office will send reporters a reminder to complete the full questionnaire shortly after the expected date of delivery
- SHOT is exploring a potential collaboration with NHSBT Alloimmune Resource (AIR) study - a research project funded by NHSBT to determine genetic influences that predispose women to developing red cell alloantibodies during pregnancy. The findings may influence future management of women in pregnancy to prevent sensitisation to the D antigen

Synopsis of data collected in 2015

Women who have not had a previous pregnancy (NPP):

17 new cases reported in 2015 and cumulative to date 33 cases.

- The majority of women reported in 2015 (11/17) were found to be immunised at delivery. Five of these women received apparently 'ideal' care with timely routine antenatal anti-D Ig prophylaxis (RAADP) and no identifiable sensitising episodes. They were not overweight and the pregnancies did not go beyond term. Only one of the remaining 6 women had had a sensitising event (for which she did not receive appropriate prophylaxis), 3 women did not receive RAADP, 2 women who did receive RAADP had booking weights >80kg, and 2 who received single dose RAADP at 28 weeks delivered beyond term (one of whom also weighed >80kg).

Cumulatively since data collection began in 2012, 10 of 33 NPP cases (30%) who became immunised received apparently 'ideal' care

- 3 cases were immunised at booking despite no previous pregnancies or transfusion, although one was a known intravenous drug user

Women who have had one or more previous pregnancies (PP):

34 new cases reported in 2015 and cumulative to date 84 cases

- In 15 cases, sensitisation was most likely to have occurred during the previous pregnancy as anti-D was detected at booking in the index pregnancy. Five of these 15 cases (33%) received apparently 'ideal' care in the previous pregnancy, although in 2 cases the previous pregnancy had continued beyond term

- In 19 cases sensitisation occurred later in pregnancy so that the relative contribution of previous pregnancies is less clear

Cumulatively since data collection began in 2012, 13 out of 41 PP cases (32%) found to be immunised at booking received apparently 'ideal care' in preceding pregnancy.

COMMENTARY

While errors/omissions in care continue to result in anti-D immunisation in pregnancy we again see a small number of cases where apparently 'ideal' care is given, no other risk factors are identified and yet sensitisation occurs, leading to the production of immune anti-D in current or subsequent pregnancies.

The cause of sensitisation in these cases is unknown and it will be very interesting to see whether genetic studies will identify women at particular risk of alloimmunisation to explain these findings, and whether such women once identified require a different approach to prophylaxis.

Full details are available in the 2015 Annual SHOT Report: Web Edition.

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Medicines and Healthcare Products Regulatory Agency (MHRA) Report on Blood Safety and Quality Regulation in 2015

Author: Chris Robbie

Introduction

The United Kingdom (UK) Blood Safety and Quality Regulations 2005 (as amended) (BSQR) require that serious adverse events (SAE) and serious adverse reactions (SAR) related to blood and blood components are reported by Blood Establishments and hospital blood banks to the MHRA, the UK Competent Authority (CA) for blood safety. This requirement is enabled by the Serious Adverse Blood Reactions and Events (SABRE) reporting system. All data within this report are correct as of 16/02/16.

Key messages

- The MHRA has continued to subcategorise incidents that fall into the 'other' and 'storage' event categories and the 'human error' specification category to provide greater detail and depth of analysis to SAE reports
- Human error accounts for 96.7% of all SAE
- Reporters are encouraged to investigate all possible causes, especially if at first it would seem the root cause is a slip or lapse by an individual. Further investigation may identify improvements to the overall quality system that could have long lasting preventive outcomes
- Changes to the way the MHRA and SHOT receive reports via SABRE have increased the total number of reports received and assessed by the MHRA, however, this has not resulted in a significant increase in the numbers of SAEs and reduction in the number of SARs where a confirmation report was submitted
- Reporters are encouraged always to report SAEs and SARs, not only to meet their regulatory requirements, but also to provide as much data as possible to the MHRA and SHOT haemovigilance schemes
- It has not been possible to obtain inspection data at this time. It is hoped to publish this online in due course

Summary

2015 SABRE data have been analysed by the MHRA haemovigilance team in order to identify common errors and to make recommendations for improvements to corrective and preventive action (CAPA) plans. In reviewing the data and analysis it is important to remember that even with approximately 2.7 million components issued in the UK last year, only 765 SAE confirmation reports were submitted to Europe or 283 SAEs per million components issued or 0.03%. In 2015 60/765 SAE reports were made from Blood Establishments. This is a very low error rate that likely reflects the high standards of blood transfusion procedures and techniques in place throughout the UK. The UK remains one of the safest countries in the world to receive a blood transfusion, but further efforts can be made to continue to improve the quality and safety of blood and blood components.

Human error accounts for 96.7% (740/765) of SAE reports received. SABRE confirmation reports mostly record that individuals are aware of their local standard operating procedures (SOPs) and that

those SOPs are complete and up to date. Human factors play an important part in any total quality system and as such it is key that the appropriate root cause is identified so the appropriate CAPA can be implemented. For example, where a biomedical scientist (BMS) issued the incorrect components because they were distracted, although the distraction is relevant it is not the root cause. It is important to identify what caused the distraction and the CAPA should reflect that. The failure to address the appropriate root cause is a recurring problem in some SABRE confirmation reports.

Please be aware if comparing SABRE and SHOT numbers there are significant, recognised differences. These differences include, but are not limited to:

- MHRA data are based on reports made strictly under the BSQR
- A report is only included in the annual figures if it has been completed/confirmed within that reporting year. This means that the same report to the MHRA and SHOT may be included in different reporting years depending on when it was completed or confirmed. (For example, confirmed on SABRE in December 2015, but not completed on the SHOT database until January 2016)
- MHRA data do not include errors in clinical practice and administration of blood e.g. wrong blood in tube (WBIT), inappropriate transfusions and errors in anti-D immunoglobulin (Ig) issue and administration
- SHOT does not include error cases where the component does not leave the laboratory e.g. expired components left in the refrigerator
- MHRA data do not include the issue of or reactions to blood products which are classified as medicines rather than blood components such as Octaplas® (solvent-detergent fresh frozen plasma (SD-FFP)) and immunoglobulins (both anti-D immunoglobulin and intravenous immunoglobulin)

If you require further guidance on this issue please contact the SABRE helpdesk on 020 3080 7336.

SABRE report data

Table 18.1 below displays the total number of SABRE confirmation reports that were submitted and satisfy the European Union reporting criteria for SARs and SAEs since 2006.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
SAE	507	655	790	968	889	810	931	705	764	765
SAR	237	264	436	500	549	444	343	345	346	262
Total	744	919	1226	1468	1438	1254	1274	1050	1110	1027

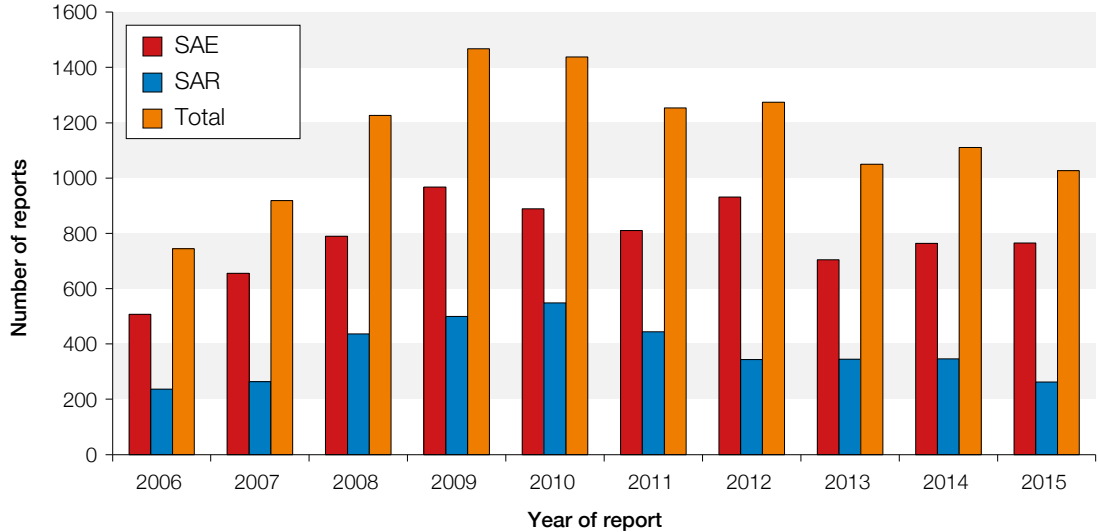
Table 18.1:
Submitted SABRE
confirmation
reports 2006–2015

Despite changes to the way the MHRA and SHOT receive data on SABRE, the number of SAE reports confirmed in 2015 has only increased by 1 report. Since October, reporters have had the opportunity to report all events they consider to be serious and all SHOT reportable clinical errors and near misses. Since the MHRA would then have full sight of all haemovigilance events, and could select SAEs that met the BSQR reporting requirements, it was expected that the number of SAE reports would increase significantly. It would be unwise to make any specific comparisons to numbers of SAEs reported this year to last but the lack of the expected rise in numbers of reports raises a number of questions.

- Have reporters have made genuine improvements to the quality management system (QMS) which resulted in fewer serious errors that meet the SAE definition in the BSQR?
- Are continuing reductions in the numbers of components produced and used resulting in fewer opportunities to make errors?
- Are laboratories suffering from reduced staffing and increased workloads, resulting in reporters not being able to make reports in a timely manner?
- Have the changes to the way reports are made on SABRE resulted in reporters feeling less confident sharing information with the MHRA/SHOT?

There is a reduction in the number of SAR reports confirmed from 346 in 2014 to 262 (24.3%). However, that is most likely down to the new process whereby SHOT update confirmation reports on behalf of reporters. These reports are updated up to a month or so in arrears, and so this year's data is effectively only accounting for 11 months. This offset is expected to balance out in the coming years.

Figure 18.1:
SABRE reports
2006–2015

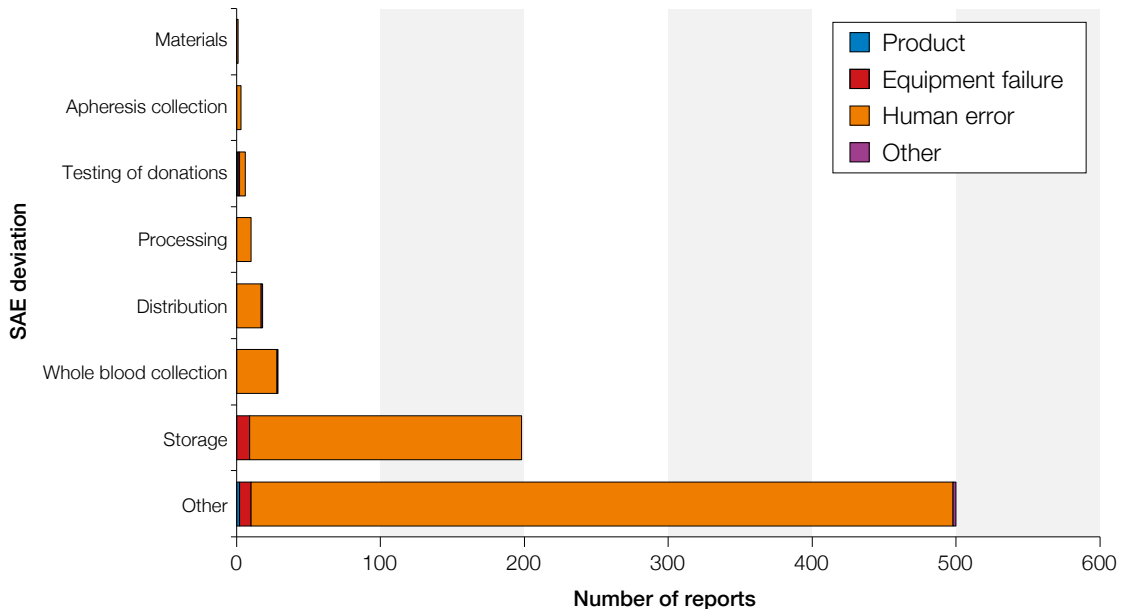


Serious adverse events (SAE)

Definition:

Any untoward occurrence associated with the collection, testing, processing, storage and distribution, of blood or blood components that might lead to death or life-threatening, disabling or incapacitating conditions for patients or which results in, or prolongs, hospitalisation or morbidity.

Figure 18.2:
2015 SAE
confirmation reports
by deviation (what
part of the process)
and specification
(type of report)



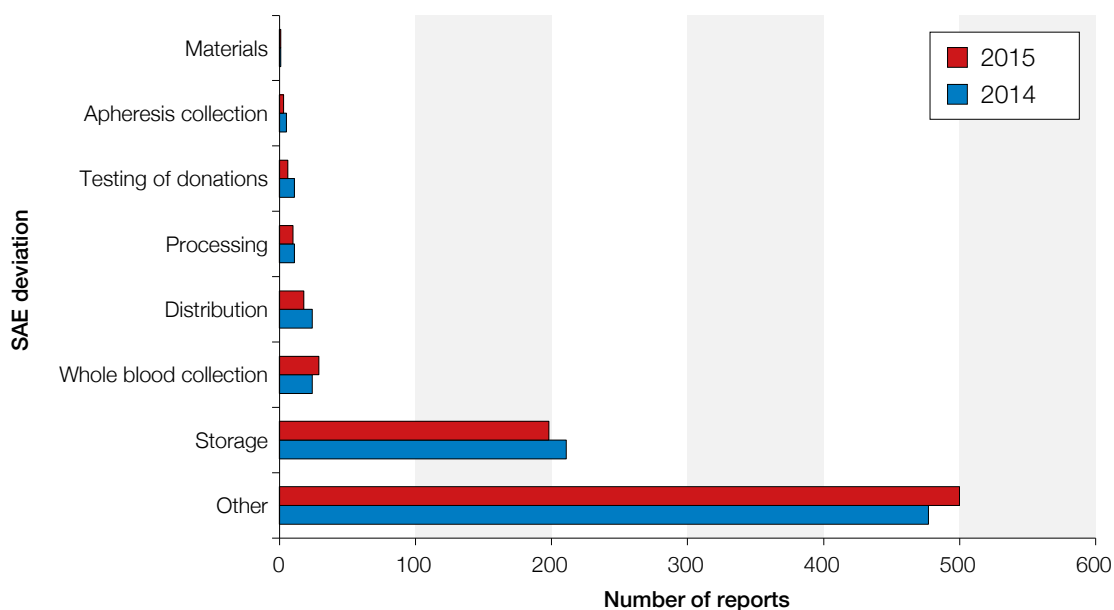


Figure 18.3: SAE confirmation reports by deviation and specification 2014–2015

Although the numbers in most categories of report are broadly similar to the 2014 data there is a noticeable increase (+23 or 4.8%) in the number of SAEs that fall into the ‘other’ category and also a noticeable decrease in the number of ‘storage’ SAEs (-13 or 6.2%).

Storage data n=198

Storage remains the second largest individual error category. The MHRA has broken this category down further to try and identify specific storage error subtypes, Table 18.2.

Storage subclassification	2013	2014	2015	Change
30 minute rule	9	13	9	-4
Component expiry	56	77	58	-19
Failure to action alarm	18	14	21	+7
Incorrect storage of component	73	42	45	+3
Miscellaneous	0	4	3	-1
Return to stock error	13	15	17	+2
Sample expiry	18	18	19	+1
Security	7	7	13	+6
Storage temperature deviation	17	21	13	-8
Total	211	211	198	-13

Table 18.2: SAE storage error subclassifications 2013–2015

The most obvious change in 2015 compared to 2014 is a reduction of **component expiry** SAEs from 77 to 58. In these incidents expired components are found in a storage location after they should have been identified and removed by the de-reservation/re-stocking process. This had been highlighted as a notable increase in reports from the previous year but analysis of individual reports in 2015 has shown laboratories making great efforts to improve the processes involved.

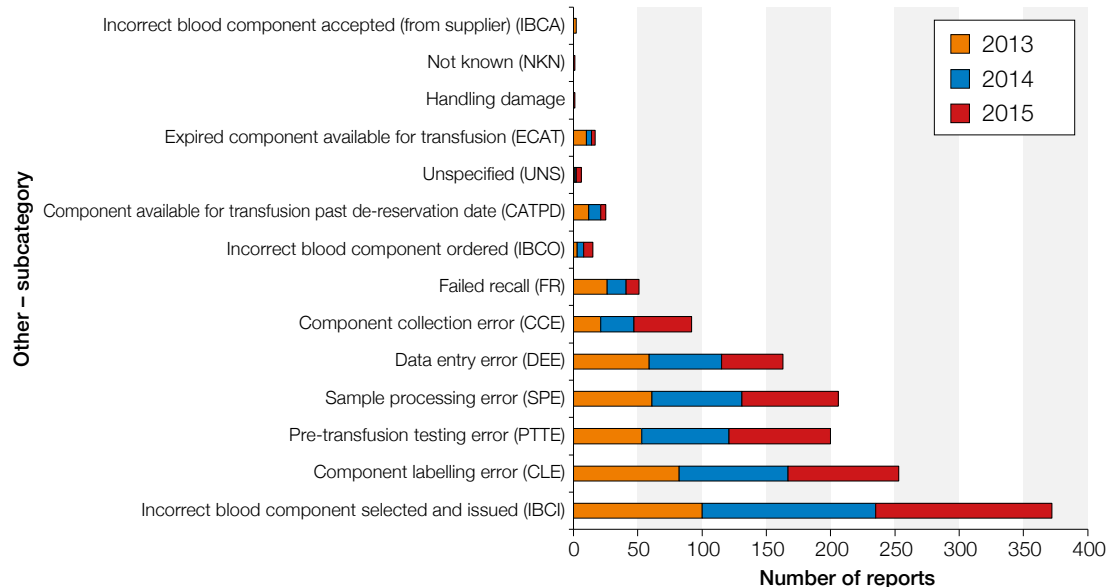
The next most significant change is a reduction in **storage temperature deviation** SAEs from 21 to 13. Events in this category are where the correct storage temperature deviates above or below the required specification. Typically the alarm system also fails and the laboratory is not notified in adequate time to maintain the correct storage temperature of the implicated components. The implication is that laboratories have improved temperature monitoring and storage equipment which either works better than before, or alerts the laboratory to a problem with storage equipment that can be dealt with. However, an increase of 7 SAEs related to **failure to action alarm** generally refers to inadequate procedures for dealing with alarms or in some cases situations where staff were not able to effectively deal with an alarm as well as carrying out their normal laboratory duties.

Although it is encouraging to see a reduction overall related to storage of about 5%, laboratories are encouraged to continue to improve storage and monitoring equipment. However, laboratories should also ensure that processes and procedures related to storage equipment, temperature monitoring and removing unsuitable units from storage locations are robust and clear and that staff are trained in them and able to activate those procedures effectively, even when lone working or during emergency situations.

Other n=500

As 'other' is the largest category of SAE reports, the MHRA haemovigilance team has created subcategories to further analyse this type of error, Figure 18.4.

Figure 18.4:
SABRE reports,
subcategory
'other', 2013–2015



Incorrect blood component issued (IBCI) errors remain the largest group and these are mainly laboratory errors where specific requirements are not met. Although SABRE does not have the facility for reporters to enter the exact time that the error occurred, in reviewing a selection of IBCI reports the narratives suggest a common theme appears to be that these errors occur when the BMS has been busy during a lone working period. This hypothesis is based on comments in the report narrative such as 'BMS A was working on their own, either over a break time, late shift and/or out-of-hours.' Furthermore, it is apparent that many of these reports have occurred following haemopoietic stem cell transplant (HSCT) or solid organ transplant where the appropriate ABO and D group for transfusion has changed from the patient's original group.

The number of **component collection errors (CCE)** reported has increased from 26 to 45. These reports arise when any member of staff (medical staff included) collect the wrong component from storage, either the wrong type of component for the right patient, or more worryingly, a component for a different patient. These errors should be detected at the bedside, but some may have been transfused fortunately without harm to a patient. Three key reasons are demonstrated for CCEs occurring:

- The correct selection and checking procedures are not performed
- Staffing or workload issues had resulted in the checks being rushed and performed incorrectly
- Although trained, the member of staff had forgotten the correct procedure

All staff must complete all steps in a procedure and perform these at a pace that minimises risk of error. If staff have a workload that is not suitable for their ability, they are more likely to make mistakes. It is important that re-training is delivered at an appropriate frequency. Staff who perform a task less often may require more frequent training than someone that performs the same task regularly. These issues and discussion about **component labelling errors (CLE), pre-transfusion testing errors (PTTE) and sample processing errors (SPE)** are expanded below.

Human error category

In order to understand human error the SABRE team has developed subcategories which can be applied to the report narratives to help understand the human factors involved. The categories are:

- Procedural steps not performed correctly – failure to carry out a step(s) correctly
- Procedural steps omitted – missing a key step or not following the procedure
- Inadequate process – inadequate design of a process or fundamental QMS failure
- Incorrect procedure – process not properly described in the SOP
- Ineffective training – training not understood by operator
- Inadequate training – training process not fit for purpose
- Lapsed or no training – carrying out a procedure without any formal training

The following table shows the breakdown of reports received and categorised into the human error subcategories.

Human error subcategory	Total
Inadequate process	263
Procedural steps not performed correctly	159
Procedural steps omitted/wrong procedure performed	141
Ineffective training	75
Inadequate training	43
Incorrect procedure	39
Lapsed/no training	20
Total	740

Table 18.3:
SABRE reports,
human error
subcategory 2015

NOTE: These figures should be used as guidance only. The quality of this data is limited by a number of factors:

- The root causes of incidents are usually the result of many contributory factors. The subcategory chosen reflects the most likely reason for the main SAE category
- The subcategory chosen is based on the information in the report. A limited investigation or a report which does not provide the MHRA with enough information may not be subcategorised correctly

The largest subcategory and reason for SAEs occurring is '**inadequate process**'. This category covers poorly designed tasks which have not been properly planned and allow errors and mistakes to go unnoticed. It also includes those SAEs where there is a fundamental flaw in the overall QMS such as a high workload and inappropriate levels of staffing at the time of the error. For this reason, the MHRA will add further subcategories in 2016 to differentiate process and QMS errors such as staffing and workload.

These errors are best addressed by:

- Reviewing and redesigning processes, focusing on the human factors involved, such as the causes of distractions
- Assessing laboratory ergonomics to ensure lean processes and effective laboratory lay-outs
- Completing or reviewing capacity plans which can be used as evidence for addressing long-term staffing issues
- Addressing workload and workflow issues to avoid peaks and troughs in activity
- Addressing short-term staffing levels with policies for annual leave, appropriate break times and cover for acute staffing shortages

By reporting and investigating incidents thoroughly, it is hoped then that over time reporters will be able to gain enough evidence where necessary to help ensure they have sufficient resources to address long term problems with appropriate preventive action.

Procedural steps:

Procedural steps not performed correctly reflects those incidents likely to result from slips and lapses by individual members of staff. The individual has carried out the correct procedure, but they have made a mistake in calculation, interpretation or accuracy. These errors may be rare or infrequent for the individual, but are unlikely to be related to a poorly designed process, competency, training and education. They may be a result of being busy, multi-tasking, being distracted or interrupted during the task. A common error that falls into this category is **component labelling error (CLE)**, where compatibility labels are transposed.

Procedural steps omitted/wrong procedure performed errors are characterised by omission of a vital step in a procedure, or the wrong procedure carried out. These errors often occur as a result of multi-tasking, being distracted or being interrupted rather than being related to training or flaws in the QMS. Common errors include **incorrect blood component issued (IBCI)**, where a patient's transfusion history is not checked.

It is important **always** to follow the correct procedure – never cut corners or take short cuts.
If you cannot follow the procedure as written, then review it, improve it and re-write it.

Figure 18.5:
Don't improvise,
follow the
procedure



These errors can often be addressed by simply reminding the member of staff of the correct procedure, and situational awareness training to cope with high workloads and distractions. Staff should be made aware that they should work at a pace that is suitable for them to reduce errors of inaccuracy and omission, and should ask for help for periods of acute and short-term low staffing and heavy workloads.

One-off or infrequent procedural errors can be dealt with as above. However, should there be a trend that develops indicating these same errors affect multiple members of staff, or at the same time of day, or day of the week, a more thorough investigation may be required to uncover CAPA that can address flaws or weaknesses in the overall QMS.

Top five SAEs

SAE deviation subcategory	Specification subcategory
Incorrect blood component selected and issued (IBCI)	Inadequate process
Component labelling error (CLE)	Procedure performed incorrectly
Pre-transfusion testing error (PTTE)	Inadequate process
Sample processing error (SPE)	Procedure performed incorrectly
Storage (component expiry)	Inadequate process

Table 18.4:
Top five SAEs
with human error
subcategory

Table 18.4 shows the top five SAE deviation subcategories and the subcategory of human error. The following real examples are shown to illustrate what might be considered as CAPA to address the root causes. They are not meant to represent actual investigation processes and CAPA for all similarly categorised incidents, but are representative of many of the reports received, and are clearly designed to focus on improvements to systems, practice and transfusion laboratories. The examples show the categorisation for the MHRA SAEs and the SHOT equivalent is in brackets.

1. IBCI (incorrect blood component transfused IBCT): Inadequate process

Neonatal FFP was ordered, but neonatal cryoprecipitate was selected, issued and transfused.

- Two similar looking components were stored on the same shelf
- The BMS should have taken time to properly read the labels and select the correct component
- Laboratory staff also need to address additional knowledge and training and understanding about the blood components and be able to differentiate between them

A simple change to the process addressed the human factors involved. The root cause was addressed by separating the two types of component, placing them on different shelves and labelling the shelves with the expected contents.

2. CLE (right blood right patient RBRP): Procedure performed incorrectly

Two red cell components were being issued and both had similar donation numbers.

- The labels were transposed
- The porter collecting the units did not spot the error, but it was discovered during the bedside check
- The BMS admitted to being fatigued
- The BMS was undertaking the activity in the designated 'quiet zone', and was listening to the conversation of two other members of staff
- This distraction led to them not properly checking that the donation numbers on the label and the bag matched before attaching them
- The porter collecting the units did not carry out the proper checks before taking them to the clinical area

This example demonstrates how a relatively simple process can be affected by a number of contributory factors and it also demonstrates the 'swiss cheese' effect when a number of barriers within the process

fail. Distractions, such as conversation, in a busy laboratory are not always avoidable. This is why it is important that staff must concentrate adequately on the task at hand, following the procedures they have been trained in to the letter. Although it is typical to see 'second checks' or scanners used to detect labelling errors, these do not address the human factors which have already led to the error being made.

3. PTTE (IBCT): Inadequate process

Incorrect electronic issue of blood

- A sample result showed a dual population when the cells were tested with anti-B on the analyser. This was due to recent transfusion of emergency group O blood
- One unit was requested urgently by the ward and issued by electronic issue (EI) but the sample was not suitable for EI because the blood group had to be interpreted manually
- The BMS did not notice the dual population result when checking during the process where the laboratory information management system (LIMS) asks if the results are automated and to confirm that it has not been amended. The wrong entry was selected
- The error occurred at the weekend when the BMS was working alone. Due the high volume of work, the BMS had not had any kind of break for over 5 hours

A long-term solution to the problem was stated as a new LIMS system which does not ask the BMS to enter whether the sample is automated or manual. This is an improvement to the way the process itself runs, but does not address the actual root cause of this incident.

Human factors such as workload, staffing, break times and urgency of the task can affect the behaviour of the member of staff in terms of their concentration, accuracy, judgement and the pace at which they work. Laboratory management should not expect staff to work in environments that do not allow staff to work safely.

4. SPE (IBCT or RBRP): Procedure performed incorrectly

Minor discrepancy in patient demographic

- A sample was received into the laboratory and booked in
- Two units of red cells were issued and one unit had already been transfused before it was noticed that there was a slight discrepancy in the spelling of the patient's name
- The sample was checked and it was discovered that the name on the sample was incorrect by a single letter. Note that in another similar instance with a single wrong letter, a patient died as a result of delayed transfusion (Case 7.1 in Chapter 7, Avoidable, Delayed or Undertransfusion (ADU))

The SHOT category depends on whether the sample with the incorrect spelling of the patient name went to the patient it was intended for (RBRP) or to another patient (IBCT).

This case study demonstrates how very small errors or discrepancies are extremely hard to spot in the laboratory. CAPA in this case may simply be to make the member of staff aware of the error and remind them of the procedure. However, when management are designing processes and workflow, they should pay attention to the human factors related to tasks that involve a high level of concentration and may be repetitive and monotonous.

5. Component expiry (not SHOT-reportable): Inadequate process

Expired red cells in blood refrigerator

- Seven units of blood expired at midnight of Friday 4th. They were discovered, still in the stock refrigerator on Monday 7th

If the expired component had been transfused then it would become SHOT-reportable as a handling and storage error (HSE).

The reporter identified a number of factors which had failed or were not robust which shows an overall weakness in the QMS:

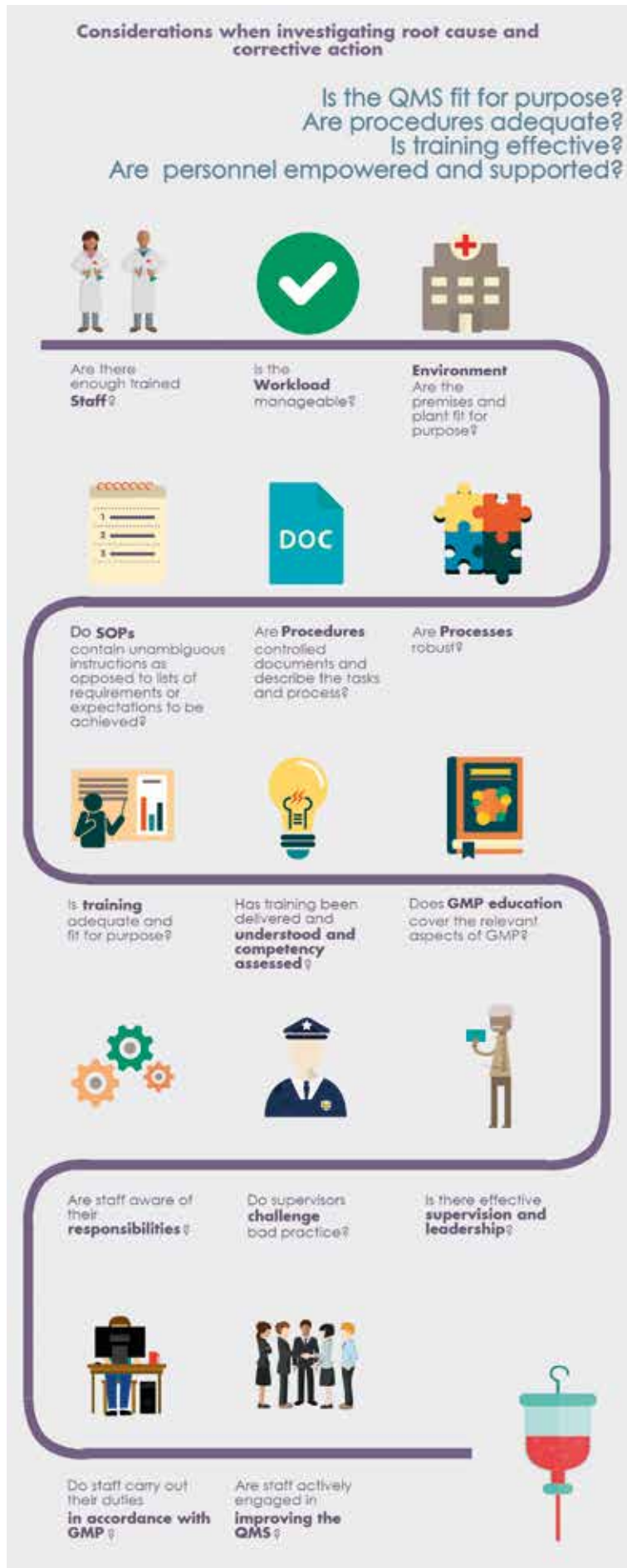
- There was a procedure to clear the refrigerators at midnight, but it can only work if people know about it. The BMS was not aware of the procedure which indicates problems with training and communication
- The training processes need to be reviewed to ensure that changes to procedures are communicated and adequately trained in a timely fashion. A daily task sheet is not fit for purpose if it does not include all the key tasks that are expected to be completed

Effective CAPA

From these top five categories of SAEs, it can be demonstrated how a number of different approaches and actions can be applied when identifying suitable, targeted CAPA. Effective CAPA that addresses weaknesses and flaws in the QMS can prevent errors occurring in other areas of the laboratory, and not just with the actual task that failed. The focus should not necessarily be on re-training, re-competency-assessment or adding extra steps in a process, unless it is absolutely necessary. There are certain key principles to consider when improving your QMS and when investigating incidents. This list is not exhaustive and is meant for guidance only.

- QMS
 - Is staffing appropriate?
 - Is workload manageable?
 - Is the environment (premises and plant) fit for purpose?
 - Are tasks and processes designed to be robust?
- Procedures
 - Are there SOPs to describe the tasks and processes?
 - Are they document-controlled?
 - Do they contain unambiguous instructions as opposed to a set of requirements or expectations that need to be achieved?
- Training
 - Is there a training plan?
 - Is the training material adequate and fit for purpose?
 - Has training been delivered?
 - Has training been understood and understanding assessed?
 - Does good manufacturing practice (GMP) education cover the relevant aspects of GMP?
- Personnel
 - Is there effective supervision and leadership?
 - Do supervisors watch out for and challenge bad practice?
 - Are staff aware of their responsibilities?
 - Do staff carry out their duties in accordance to GMP?
 - Are staff actively engaged in improving the QMS?

Figure 18.6:
What to consider
when investigating
an event



Training

Although not the most commonly reported factor related to the root causes of SAEs, training, and frequency of training is a common discussion point between reporters and the SABRE team. Without adequate and effective training, any member of staff is more likely to make mistakes. Quite simply, unless a member of staff is adequately trained they should not be performing a task. This also applies to any locum or bank staff. Simply because a member of staff has the required level of education and experience on paper, it cannot be assumed that they are familiar with local processes and procedures. Many SAE reports received relate to locum staff and often it is because they are somehow expected to know what to do in a laboratory that is unfamiliar. While they are being trained, a member of staff should be adequately supervised with their work thoroughly checked for errors.

Frequency of training is also a factor when errors are made when members of staff appear to forget what the correct procedure is. Although the National Blood Transfusion Committee recommendation for training is 3 yearly, the BSQR does not stipulate any time-frames for training. The MHRA recommendation for activity within the BSQR is at least yearly. If a risk-based approach is taken to training, then that period can be extended to 2 yearly training. What this means is that senior laboratory management need to assess the effectiveness of training over a period of time. A member of staff that performs a task, for example re-stocking a satellite refrigerator, on a daily basis may have their training period extended to 2 yearly if they continue to perform the task accurately. A member of staff who only performs the same task once or twice a week will require training more frequently to ensure they perform the task correctly.

Assessing competency of staff following training for each stage/element of the transfusion process will provide assurance that an individual can demonstrate the correct procedure to be followed.

Serious adverse reactions (SAR)

Definition:

An unintended response in a donor or in a patient that is associated with the collection, or transfusion of blood or blood components that is fatal, life-threatening, disabling or incapacitating, or which results in or prolongs hospitalisation or morbidity...Blood Establishments and the person responsible for the management of a hospital blood bank shall notify the Secretary of State (Competent Authority) of any serious adverse reactions observed during or after transfusion which may be attributable to the quality or safety of blood or blood components:

- (i) Collected, tested, processed, stored or distributed by the Blood Establishment, or**
- (ii) Issued for transfusion by the hospital blood bank**

This definition (BSQR 2005) is pertinent to both SHOT and SABRE reports, therefore if the SAR conforms to this definition it must be reported to both SHOT and SABRE.

Blood products

Adverse reactions involving blood products which are licensed medicines such as anti-D Ig, Octaplas® (SD-FFP), or coagulation factor concentrates should not be reported to the MHRA via SABRE although some are reportable to SHOT. Complications from these medicines are reportable to the MHRA through the Yellow Card scheme (<http://yellowcard.mhra.gov.uk>).

Summary of SAR report data

Changes to the way SARs are reported in SABRE have been in effect since October 2015. As well as being the first step towards a single, integrated reporting process, reducing duplication of effort for a reporter, these changes were also implemented to address a perception that some reporters were not meeting their regulatory requirements in reporting all SARs to the MHRA, but were reporting some reactions as 'SHOT only' incidents. This change in process has also allowed SHOT experts to assess reaction reports to ensure that SARs are categorised consistently with SHOT data. SHOT will then upload the confirmation report on behalf of the original reporter.

It is too early to tell how this change will affect the collection of SAR reports in SABRE. Analysis of this year's data has shown a significant reduction in the number of SAR reports included in the annual summary. Data received on SABRE up to the date of the change was equivalent to previous years' reporting patterns. Since the change, the MHRA has not received as many confirmation reports as previously. However, this is explained by the extra time it takes for the reports to be received at SHOT, and then analysed by the experts and fed back to SABRE.

The regulatory requirement is that the CA must be informed by a notification report 'as soon as known' and this still occurs. There is no requirement for confirmation reports to be received by any deadline, so there is no failure or flaw in the new system. The expectation is that the difference in numbers of SAR reports received will find a new equilibrium for next year's SHOT report.

To avoid any confusion the MHRA will only supply, in this Annual SHOT Report, total SAR figures reported to Europe.

Table 18.5: SAR reports, by imputability, reported to SABRE only in 2015 n=262

	Imputability score				
	NA	0	1	2	3
SAR reports by imputability score	1	28	98	105	30

In previous years SAR data between the two organisations have differed and caused confusion for reporters, the EU and at parliamentary level. It is hoped that the new SAR reporting arrangements will avoid this confusion and produce more accurate SAR data for the UK and Europe. For SAR type please see the relevant clinical reactions chapters in this report for more detail.

References

BSQR (2005) **Blood Safety and Quality Regulations**. (SI 2005/50, as amended)
<http://www.legislation.gov.uk/ukxi/2005/50/contents/made> [accessed 30 April 2016]

Council of Europe (2013) **Good Practice Guidelines for elements of the Quality System**.
https://www.edqm.eu/medias/fichiers/good_practice_guidelines_dec_2013.pdf [accessed 30 April 2016]

HSE. Human Factors and Ergonomics. HSE website <http://www.hse.gov.uk/humanfactors/> [accessed 30 April 2016]

Right Blood Right Patient (RBRP) n=187

19

Author: Diane Sydney and Joanne Bark

Definition:

Incidents where a patient was transfused correctly despite one or more serious errors that in other circumstances might have led to an incorrect blood component (IBCT) being transfused.

Key SHOT message

- Hospitals using electronic storage solutions or bedside checking systems should ensure that staff are trained and assessed as competent in their use in accordance with British Committee for Standards in Haematology (BCSH) guideline (BCSH Jones et al. 2014)

This category continues to be linked with patient identification (ID) and labelling errors, for example:

- Administration with erroneous or partial/omitted patient details on the label
- Labels being transposed between multiple units that are intended for the same patient
- Not using a patient ID wristband
- Administering transfusions for the intended patient that have not been authorised/prescribed

Reporters are encouraged to submit incidents where the right patient was transfused with the right blood, despite the observation that many of the errors could have led to rejection of the unit or limited evidence of documentation being available for the transfusion episode. Although these errors do not fit the IBCT definition as the intended patient received the blood component that was planned for them, they have been included to inform practice. There were 187 cases analysed in 2015, a slight increase from 169 cases in 2014.

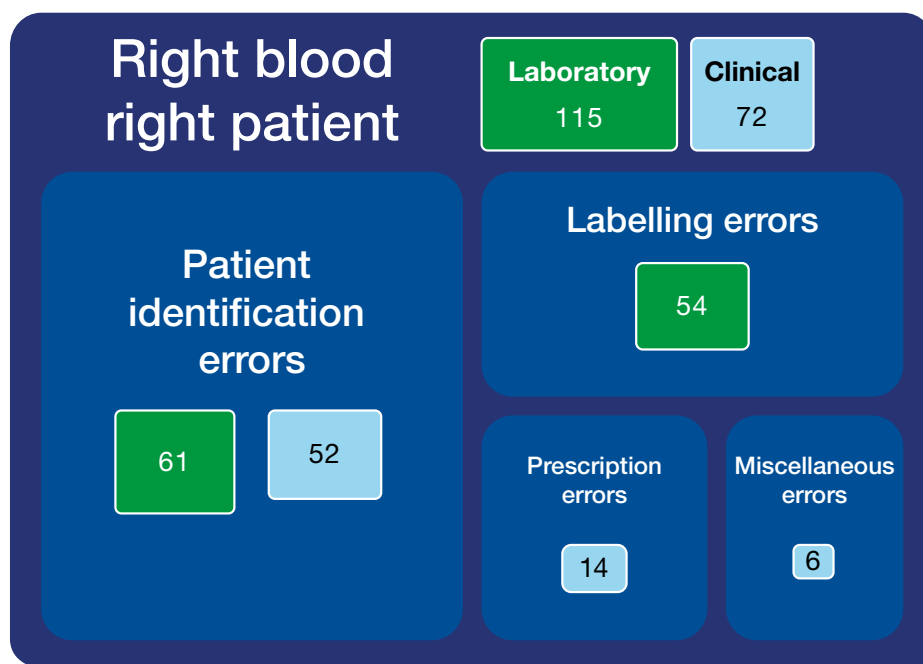


Figure 19.1: Overview and primary source of error

Table 19.1:
Classification of
errors

Type of error	2013	2014	2015
Patient identification errors	118	116	113
Name alone or with other elements	51	45	51
Date of birth (DOB) alone or with other elements	28	32	26
Wristband* missing/wrong wristband in place at final bedside checking procedure	14	11	7
Hospital or National Health Service (NHS) number or with other element	21	27	24
Address alone or with other elements	3	1	5
Patient ID details missing on sample tube/request form	1	0	0
Labelling errors	52	34	54
Transposed labels	38	24	26
Other labelling errors	14	10	28
Prescription error	9	14	14
Miscellaneous errors	5	5	6
No final patient ID check undertaken prior to administration of component	1	2**	1**
Other errors	4	3	5
Total	184	169	187

*'Wristband' refers to identification wristband (or risk-assessed equivalent) as defined in the BCSH Guideline on the Administration of Blood Components (2009)

**BloodTrack electronic bedside checking and tracking used inappropriately resulting in RBRP checks not performed. This occurred with 164 units issued from a BloodTrack refrigerator with no final bedside check undertaken (same error as in 2014, 273 components). Users used the system designed to issue O D-negative blood in an emergency when removing components from the refrigerator

Case 19.1: Patient identification error

Using the BloodTrack electronic system a nurse checked the patient's ID band against the compatibility tag on the unit of red cells. The system alerted the nurse to a wristband compatibility mismatch. There was a difference in spelling of the surname. This was the right blood for the right patient and the nurse proceeded with the transfusion ignoring the alert. The transfusion was stopped because the blood transfusion laboratory staff noticed the alert on BloodTrack and contacted the ward to instruct them not to proceed.

Case 19.2: Labelling error

Two units of red cells were issued to a patient where the blood tags were transposed. The first unit was collected and transfused. It was not noted that the bag and the label details did not fully match. The error was identified on checking the second unit prior to transfusion, when the staff realised that the blood tag and blood unit did not correspond. The staff notified the transfusion laboratory staff of the incident and the unit was returned, the error was corrected, and the unit was reissued and transfused.

Information technology (IT)-related RBRP error reports n=31

The 2014 Annual SHOT Report noted the need for hospitals and manufacturers to ensure that effective systems were put in place to negate staff bypassing the inbuilt checks when collecting blood. Unfortunately this continues to happen as detailed in the case study below.

Case 19.3: Bedside override of electronic system results in several units not being checked properly at the bedside

These incidents (discussed also in Chapter 10, Information Technology (IT) Incidents) are related to a previous 2014 SHOT report in which the BloodTrack electronic bedside checking and tracking was set up and used inappropriately resulting in RBRP checks not being performed. Despite identification of the problem a further 164 units were transfused in this way over a 13 month period, from November 2014–November 2015.

Remedial actions taken after the first occurrence noted last year have not had the expected impact required. This should be reviewed and resulting action plans implemented and assessed on a regular basis to ensure compliance.

Near miss RBRP cases n=130

Point in the process	Type of error made	Number of cases	Percentage of cases
Sample receipt	Sample labelling error not rejected	23	33.8%
	Wrong identifiers entered in LIMS	21	
Component labelling	Transposition of labels for same patient	52	66.2%
	Incorrect patient information on label	34	
Total		130	100%

Table 19.2:
Near misses that
could have led to
RBRP n=130

*LIMS=laboratory information management system

COMMENTARY

There has been little change in the overall findings. All staff must adhere to correct identification practice in all aspects of transfusion.

References

BCSH Harris AM, Atterbury CL, et al. (2009) **Guidelines on the administration of blood components.**

http://www.bcsghguidelines.com/documents/Admin_blood_components_bcsgh_05012010.pdf

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BCSH Jones J, P Ashford, et al. (2014) **Guidelines for the specification, implementation and management of information technology (IT) systems in hospital transfusion laboratories.**

http://www.bcsghguidelines.com/4_haematology_guidelines.html?dtype=Transfusion&dpage=0&sspage=0&ipage=0#gl

[accessed 20/01/2016]

Bolton-Maggs PHB, Poles D et al. (2014) **The 2014 Annual SHOT Report.** www.shotuk.org

[accessed 20 January 2016]

20 Handling and Storage Errors (HSE) n=254

Author: Diane Sydney and Joanne Bark

Definition:

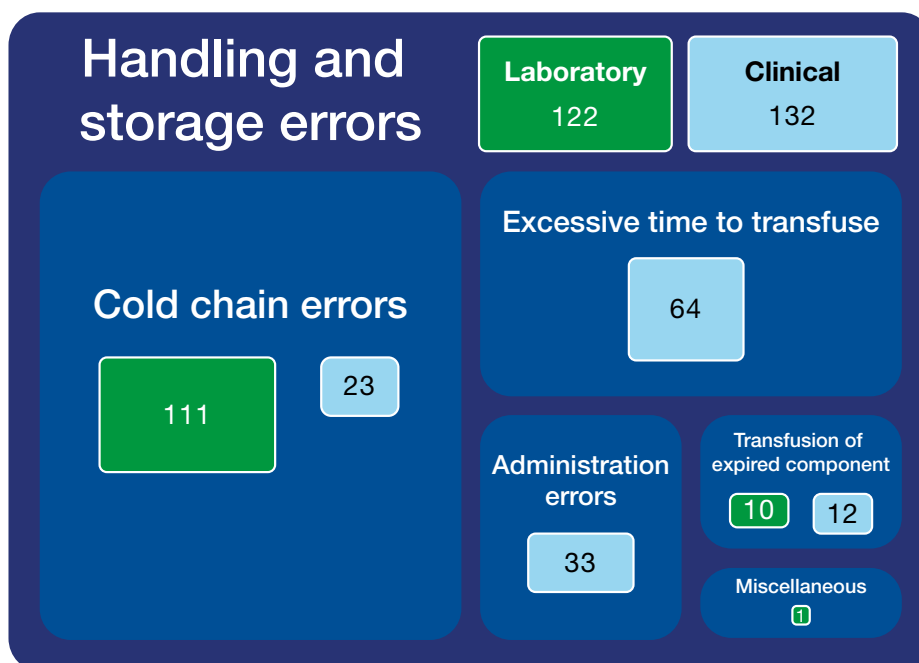
All reported episodes in which a patient was transfused with a blood component or plasma product intended for the patient, but in which, during the transfusion process, the handling and storage may have rendered the component less safe for transfusion.

Key SHOT message

- Clinical staff are reminded to be vigilant and to adhere to the recommended transfusion times for blood components, available in current British Committee for Standards in Haematology (BCSH) guidelines (BCSH Harris et al. 2009)

Clinical errors accounted for 132 (52.0%) with laboratory errors accounting for 122 (48.0%) of overall HSE errors.

Figure 20.1:
HSE type and
origin n=254



HSE trends 2015

The most notable trend for 2015 is the overall increase in reports submitted compared to 2014 (254 compared to 188). This could be due to diligence by reporters rather than an actual increase in the overall incident rate. The main areas are in excessive times to transfuse with an increase from 37 to 64, and cold chain errors with an increase from 79 to 134. This included equipment failures where there was a striking increase (6 to 85) of reports compared to 2014 as a result of 11 cases of refrigerator failure which affected multiple patients. In the technical administration errors category 23 cases were due to the wrong giving sets being used.

Type of error	2013	2014	2015
Technical administration errors	20	42	33
Transfusion of expired blood components	23	30	22
Excessive time to transfuse	83	37	64
Cold chain errors	67	79	134
Equipment failure (number of patients transfused with red cell units that had been out of temperature control)	11	6	85
Alarm-related (staff failed to carry out correct procedure following alarm being triggered on a refrigerator)	3	6	3
Inappropriate storage			
Laboratory error	24	37	20
Clinical error	22	27	22
Transport/delivery	7	3	2
Transfused beyond sample validity			2
Miscellaneous			1
Total	193	188	254

Table 20.1:
Categories of error

Case 20.1: Units available beyond expiry and excessive time to transfuse

A 69 year old male patient received solvent-detergent fresh frozen plasma beyond its expiry once thawed. Four units were thawed and were to be used by 02:18. The first two were transfused, however the second two were available for collection at 03:30 and 03:45 respectively. They were taken to the ward but not started until 07:00, and transfusion was completed at 10:40. This was 7 hours after removal from cold storage.

Case 20.2: Cold chain error

A unit of blood was released by remote issue for a patient and returned to the refrigerator after 46 minutes. This unit was quarantined by the refrigerator as it was outside the 30 minute rule and should have been wasted. However, when the unit was returned to the laboratory it was returned into general stock. The biomedical scientist (BMS) made an error and returned the unit by overriding a computer rule. It was later issued and transfused to another patient the next day.

Case 20.3: Administration error

While attaching a blood administration set to a bag of platelets, the bag was pierced. The doctor then drew up the platelets into 4x50ml syringes and injected the contents into a bag of saline before infusing into the patient using a blood administration set.

There were no reports of any adverse effects for the transfused patients in the case studies. This is consistent with previous years and the data for extended transfusion times is summarised in a recent publication (Foley et al. 2016).

Near Miss HSE cases n=97

Table 20.2:
Near misses that
could have led to
HSE n=97

Point in the process	Type of error made	Number of cases	Percentage of cases
Component selection	Expired unit	15	15.5%
Collection	Time-expired component available	12	12.4%
Administration	Incorrect transport/packing of units	6	51.5%
	Inappropriate storage in clinical area	26	
	>30 mins out of temperature control in clinical area	11	
	Unit expired on ward	7	
Other	Outside sample suitability	6	20.6%
	Incorrect storage in the laboratory	12	
	Part used unit returned to refrigerator	1	
	Thawing temperature led to deposits in SD-FFP	1	
Total		97	100%

*SD-FFP=solvent-detergent fresh frozen plasma

COMMENTARY

Both laboratory and clinical staff have opportunities to ensure that best use is made of blood components by making sure that blood components are stored correctly and distributed appropriately. It is fortunate that no harm came to any of the patients who received a transfusion which had either expired or run over the recommended time limit. Vigilance is also needed when removing or returning stock to the refrigerator and to ensure that the correct giving set is used.

References

Bolton-Maggs PHB, Poles D et al. (2015) **The 2014 Annual SHOT Report**. www.shotuk.org [accessed 20 January 2016]

Foley K, Poles D et al. (2016) **Are the 'rules' for times in set up and duration of red cell transfusion too strict?** *Transfus Med* published online: 25 April 2016; DOI: 10.1111/tme.12308 [accessed 15 May 2016]

Adverse Events Related to Anti-D Immunoglobulin (Ig): Prescription, Administration and Sensitisation

n=350

21

Author: Tony Davies

Definition:

An adverse event related to anti-D Ig is defined as related to the prescription, requesting, administration or omission of anti-D Ig which has the potential to cause harm to the mother or fetus immediately or in the future.

Key SHOT messages

- A total of 350 case reports were reviewed this year, of which 271 (77.4%) related to the omission or late administration of anti-D Ig. This is a continuing worrying situation, putting a significant number of women at risk of potential sensitisation to the D antigen with associated mortality and morbidity in affected neonates
- There was one case where immune anti-D was wrongly assumed to be present due to prophylaxis and so the pregnancy continued unmonitored, resulting in a severe case of haemolytic disease of the fetus and newborn (HDFN) requiring exchange transfusion, during which the baby died
- As in last year's report there were 3 cases where a woman developed an immune anti-D following delay or omission of prophylaxis during the current pregnancy

Common themes in this year's reports include:

- Misunderstanding of national guidance, specifically that anti-D Ig should be offered for sensitising events, regardless of whether the woman has received routine antenatal anti-D prophylaxis (RAADP) (and vice versa), and that diagnosis and delivery of intrauterine deaths (IUD) should be treated as separate sensitising events as they may be some days apart
- There persists a culture of transcribing blood grouping results onto maternity notes and care plans, often incorrectly, resulting in omission or inappropriate administration of anti-D Ig
- Failure to consult computer records before issuing anti-D Ig from the laboratory
- Putting the onus on the woman to return for anti-D Ig when she is variously frightened, traumatised, too ill, or has her hands full with a new baby, instead of issuing it at presentation, and then putting the blame for failure onto the woman for not answering her mobile rather than an inadequate system
- Comments that 'nobody would take responsibility for dealing with this issue'
- Community midwives often do not have access to the electronic patient record, and therefore do not see the most recent or updated reports related to D status or antibody titres, relying instead on what may be outdated versions in the hand-held notes
- Poor (and unsubstantiated) advice that there is no point in administering anti-D Ig once 10 days have passed since a sensitising event

It is disappointing to read a comment from one case, that 'the onus on checking reports from the reference laboratory should be on clinical staff', when the hospital laboratory has such an important role to play in interpreting and conveying often complicated messages to clinical colleagues whose concerns are 'Should I be worried by this?', or 'Do I need to do anything because of this report?'

There is however one excellent example of implementation of good practice following reported errors, and this is to be applauded:

Case 21.1: Laboratory report misinterpreted

Anti-D Ig was issued for routine prophylaxis at 28 weeks from clinical stock, after midwives misinterpreted 'Antibody Screen Negative' as 'D negative'. The laboratory has changed the wording on their grouping reports to; 'No antibodies detected' in an attempt to stop this happening again.

As ever, SHOT's main message about anti-D (use of anti-D Ig and recognition of immune anti-D antibodies) is to encourage consistency of practice within hospitals, with robust policy formulated as a partnership between obstetricians, midwives and the laboratory, regardless of which professional guideline may influence the finer detail.

A total of 414 case reports involving anti-D Ig were submitted via the SHOT online reporting database in 2015. Of these 53 were withdrawn because they did not meet the criteria for anti-D reporting, or were perfectly reasonable decisions made on the information available at the time, and 11 were transferred to anti-D immunisation questionnaires.

350 case reports, each involving 1 individual, were considered in the final analysis.

The reports are divided into the reporting categories shown in Figure 21.1 and Table 21.1.

Adverse events related to the prescription and administration of anti-D Ig are not required for the European Union (EU) and so are reportable as 'SHOT-only' (BSQR 2005). Clinical reactions to anti-D Ig are reportable to the Medicines and Healthcare Products Regulatory Agency (MHRA) 'Yellow Card' system.

Figure 21.1:
Reporting
categories for all
anti-D Ig errors

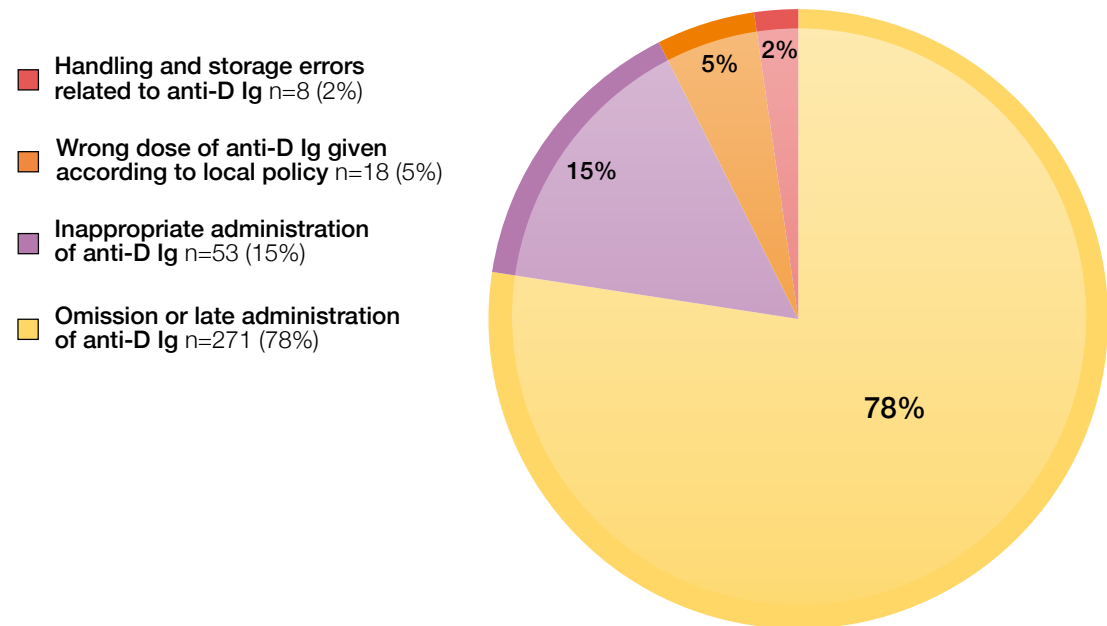


Table 21.1:
Reporting
categories for
inappropriate
administration

Inappropriate administration category	Number of cases
Anti-D Ig given to a D-positive woman	15
Anti-D Ig given to a woman with immune anti-D	22
Anti-D Ig given to a mother of a D-negative infant	7
Anti-D Ig given to the wrong woman	9
Total	53

Deaths n=1

There was one death of a baby reported in a case where unmonitored maternal anti-D antibody led to a severe case of HDFN. The baby developed complications while undergoing exchange transfusion. Although the cause of death has not been unequivocally related to the HDFN it is likely that appropriate diagnosis, monitoring and treatment during pregnancy would have improved the outcome (Case 21.5 below and Case 1 in the Error Reports: Human Factors section in the main 2015 Annual SHOT Report).

Major morbidity n=3

In 3 cases women developed an immune anti-D following delay or omission of prophylaxis during the current pregnancy.

Potential for major morbidity n=268

In a further 268 cases anti-D Ig was administered more than 72 hours following a potentially sensitising event, or omitted altogether, resulting in the potential for sensitisation of the woman to the D antigen. This satisfies the current SHOT definition of potential major morbidity. It is not known whether any of these events resulted in the production of immune anti-D.

Clinical versus laboratory errors

For the reporting year 2015, 350 events related to anti-D Ig administration are summarised in Table 21.2 below, with a breakdown of the proportion of clinical and laboratory errors that were primarily responsible.

Type of event	Cases	Staff primarily involved		
		Nurse/midwife	Laboratory	Doctor
Omission or late administration of anti-D Ig	271	227	20	24
Anti-D Ig given to a D-positive woman	15	13	0	2
Anti-D Ig given to a woman with immune anti-D	22	7	14	1
Anti-D Ig given to a mother of D-negative infant	7	0	7	0
Anti-D Ig given to the wrong woman	9	9	0	0
Wrong dose of anti-D Ig given	18	10	7	1
Anti-D Ig handling and storage errors	8	4	4	0
Totals	350	270	52	28

Table 21.2:
Staff groups primarily involved in anti-D Ig process failures

The proportion of reports related to prescription, requesting and administration of anti-D Ig involving midwives, nurses and doctors is similar to last year, accounting for 298/350 (85.1%) of the total, with laboratory cases accounting for 52/350 (14.9%).

Omission or late administration of anti-D Ig n=271

In 227/271 (83.8%) cases the primary error was made by a nurse or midwife, and in 24/271 (8.8%) cases by a doctor (double that of last year). Twenty of 271 (7.4%) cases resulted from failures in the hospital laboratory.

The location was in the community for 59 cases, and in a hospital setting for 212:

- There is a persistent theme of failure to collect anti-D Ig that has been issued by the laboratory, or where it has been collected but is not administered and is found days or weeks later in maternity refrigerators. This was reported in 65/271 (24.0%) cases of delayed or omitted anti-D Ig
- In 50 cases it was noted at a later antenatal clinic appointment or at delivery that a woman had not received routine antenatal anti-D Ig prophylaxis (RAADP) and 27 of these cases were in the community

- There were 6 cases where midwifery staff had transcribed maternal or cord blood groups incorrectly into the antenatal notes
- There were 4 cases where the laboratory entered an erroneous grouping result manually to the laboratory information management system (LIMS)
- There were 11 cases where anti-D Ig was not given for sensitising events because the clinical staff erroneously thought that RAADP would be sufficient
- There were 3 cases where the laboratory staff or transfusion practitioner advised that anti-D Ig should not be given as it was more than 10 days after the event, and one case where the laboratory advised anti-D Ig should not be given as it was more than 96 hours after the event. This is poor advice. Although these are the suggested time limits, there is some evidence* that giving anti-D Ig after these limits may offer some protection

*Note: Experimental evidence is quoted (in Klein and Anstee 2005) 'there is evidence that in a proportion of subjects the response to D can be suppressed by giving antibody [anti-D Ig] as late as 2 weeks'. The experimental evidence was from a study by Samson and Mollison following development of anti-D in volunteer male blood donors injected intravenously with 1mL D-positive red cells (Samson and Mollison 1975).

Case 21.2: Poor advice from the laboratory

A woman did not receive anti-D Ig for a sensitising event after the laboratory advised that free anti-D was detectable following RAADP and no further anti-D Ig was indicated. This is contrary to national guidance that states further anti-D Ig should be given regardless of detectable (prophylactic) anti-D in a woman's sample.

Case 21.3: System failure

It was noted when a woman was admitted for delivery with spontaneous rupture of membranes that she had received no appointments with her midwife since her booking blood tests had been taken, and had therefore missed anti-D Ig for RAADP and any sensitising events during her pregnancy.

Case 21.4: Poor decision following intrauterine death

A doctor advised that anti-D Ig was not required following an intrauterine death 'unless the woman is actively bleeding'.

Inappropriate administration of anti-D Ig n=53

This group is further subdivided into four categories.

Anti-D Ig given to D-positive women n=15

All cases involved clinical staff, 13 errors were made by a nurse or midwife, and 2 primary errors were made by doctors.

8/15 (53.3%) cases originated in the hospital setting, with 7 cases in the community.

- There were four cases where a negative antibody screen report was misread as a negative D-type
- There were two cases in the community where the woman stated she was D-negative, and the midwife failed to check the blood group before giving anti-D Ig

Anti-D Ig given to women with immune anti-D n=22

More than a third, 8/22 (36.4%), resulted from clinical errors and 14/24 (63.6%) from laboratory errors.

Nineteen cases occurred in the hospital setting with three in the community.

- Five involved issue of anti-D Ig from stocks held in the clinical area to women known to have immune anti-D
- Nine cases involved issue of anti-D Ig by the laboratory to women who were clearly marked on the laboratory system as having immune anti-D. The anti-D Ig was issued without reference to the LIMS

- In one case the laboratory issued a card to the woman saying she was eligible for anti-D Ig prophylaxis, even though she was known to have immune anti-D
- In one case, a pregnant woman pointed out that she should not receive an anti-D Ig injection as she had confirmed anti-C+D antibodies, but the midwife insisted, telling her it was 'protocol'

Case 21.5: Assumption coupled with poor handover leads to unmonitored pregnancy

(This case is described in detail in the Error Reports: Human Factors section of the main report, Case 1)

A biomedical scientist (BMS) tested a woman's sample and found anti-D to be present. A message was left for the next shift to ask maternity whether anti-D Ig had been administered. The message was misinterpreted as meaning that the detectable anti-D was prophylactic, and the pregnancy continued unmonitored, along with further prophylaxis. The baby was born extremely jaundiced, requiring immediate exchange transfusion, but developed complications leading to death.

Case 21.6: Poor decision by obstetric doctor

Anti-D Ig was requested for a woman confirmed to have immune anti-D. When the BMS challenged the request, the obstetric doctor insisted it was issued and administered.

Anti-D Ig given erroneously to mothers of D-negative infants n=7

All seven of these errors originated in the laboratory, and all occurred in the hospital setting.

- 2/7 cases involved the cord blood group being manually entered (incorrectly) onto the LIMS
- 5/7 cases involved issue of anti-D Ig without reference to LIMS results

Case 21.7: Anti-D Ig issued without reference to grouping results

During the on-call period, the duty BMS issued 1500IU anti-D Ig to the mother of a baby confirmed to be D-negative. The BMS was 'very busy' and did not check the LIMS to confirm blood groups before issuing the anti-D Ig.

Anti-D Ig given to the wrong woman n=9

All cases were clinical errors, involving failure by nurses and midwives to carry out positive patient identification. Eight cases occurred in the hospital setting, and one in the community

Case 21.8: Bedside checking means 'at the bedside'

Anti-D Ig was issued by the laboratory for a post-natal woman. The anti-D Ig was checked by two qualified midwives away from the woman and then taken to the wrong woman for administration.

Wrong dose of anti-D Ig given n=18

Fourteen of these cases occurred in hospital, and 4 in the community setting. Eleven cases involved a primary clinical error, and 7 were errors in the laboratory.

Case 21.9: Confusion over availability and correct dosage of anti-D Ig

Two doses of anti-D Ig were available in the refrigerator at the general practitioner (GP) surgery for the same woman. A 500IU dose had been issued in response to a potentially sensitising event (PSE) some weeks earlier, but never given, the other was a 1500IU dose for RAADP. The midwife administered the 500IU dose at the 30-week RAADP appointment and returned the 1500IU dose to the laboratory unused.

Handling and storage errors related to anti-D Ig n=8

Four of these eight errors occurred in the clinical area and four in the laboratory. Six occurred in the hospital setting and two in the community.

Case 21.10: Lack of stock control at GP surgery

Anti-D Ig was administered by a community midwife from stock held at the GP surgery. On receipt of the traceability record, the laboratory noted that it had expired three months prior to administration.

Case 21.11: Inappropriate use and questionable storage of previously issued anti-D Ig

Anti-D Ig was administered to a woman undergoing a surgical termination of pregnancy. On receipt of the compatibility tag, the laboratory realised that the anti-D Ig had been issued for a completely different woman six months earlier. There was no indication of how the anti-D Ig had been stored in the meantime.

Figure 21.2:
Cumulative data
for anti-D Ig events
2005–2015

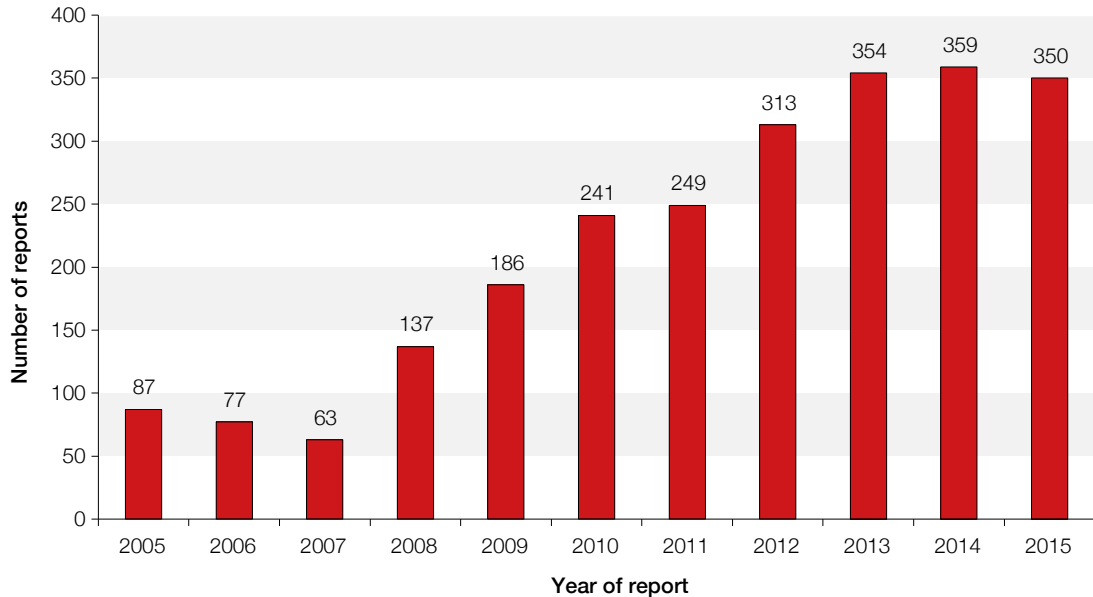
**Near miss Anti-D cases n=23**

Table 21.3:
Near misses that
could have led to
errors related to
Anti-D Ig n=23

Point in the process	Type of error made	Number of cases	Percentage of cases
Sample receipt	Wrong identifiers entered into the LIMS	1	4.3%
Testing	Misinterpretation	1	30.5%
	Incomplete testing prior to issue	6	
Component selection	Wrong volume issued	5	34.8%
	Issued to a woman with immune anti-D	2	
	Issued to the mother of D-negative baby	1	
Component labelling	Anti-D Ig mislabelled	4	26.1%
	Transposition of labels for different patients	2	
Administration	Inappropriate storage in the clinical area	1	4.3%
Total		23	100%

Good practice points from previous years, a suggested standardised anti-D Ig dosing flowchart and examples of system failures are available in the 2014 Annual SHOT Report and on the SHOT website.

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Immunology 28, 349–357

22 Immune Anti-D in Pregnancy: cases reported up to end of 2015

Author: Jane Keidan

Introduction

To improve understanding of the causes of continuing anti-D immunisations, SHOT is conducting a prospective study of women who have produced immune anti-D detected for the first time in the current (index) pregnancy. Such cases should be notified to SHOT via the website so that the reporter can download a questionnaire requesting data on booking weight, management of sensitising events during pregnancy and the administration of routine anti-D immunoglobulin (Ig) prophylaxis, both in the index pregnancy and the pregnancy immediately before the index pregnancy (if applicable).

Going forward, SHOT is exploring a potential collaboration with the NHSBT AIR (alloimmune resource) study: this is a research project to determine genetic influences that predispose women to developing red cell alloantibodies during pregnancy. This will be of particular interest in those cases where apparently 'ideal' care has been delivered.

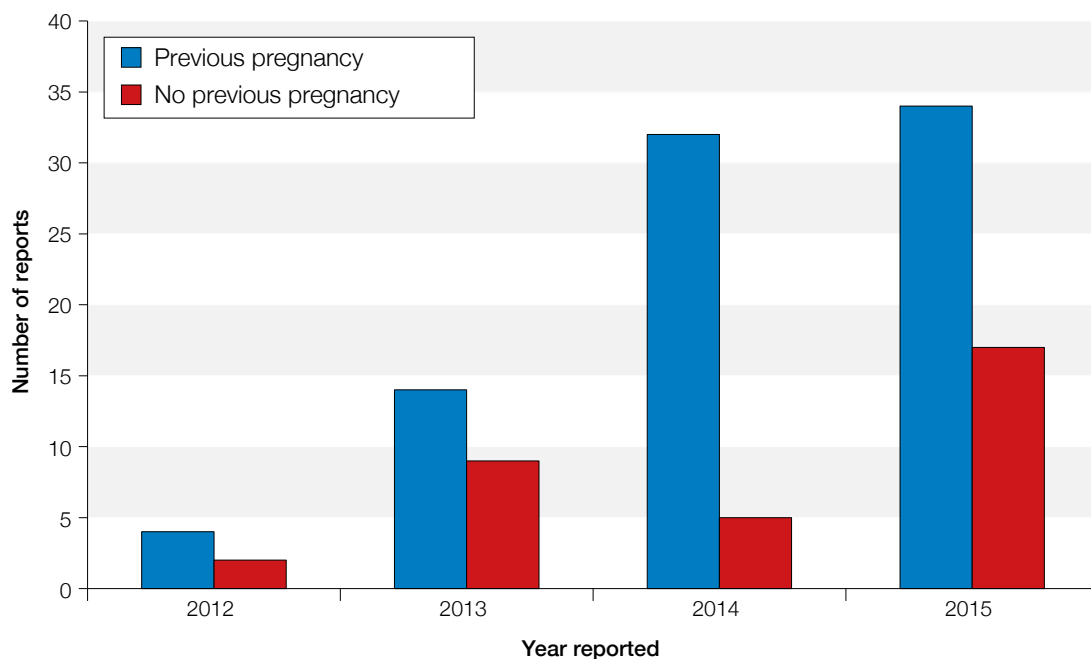
Results

In 2015 a total of 51 cases were reported, although some datasets were incomplete.

- 17 cases occurred in women with no previous pregnancies (NPP)
- 34 in women with previous pregnancies (PP)

SHOT now has a total of 33 NPP cases and 84 PP cases reported 2012–2015.

Figure 22.1:
Number of reports of anti-D immunisation in pregnancy by year, 2012–2015



No previous pregnancy (NPP) n=17 in 2015, cumulative n=33 cases

When was the anti-D detected?

Time of anti-D detection	Number of new cases 2015	Number of cases cumulative
Before 28 weeks	3*	4**
At or after 28 weeks, before delivery	2	7
At delivery	11	21
No information	1	1
Total	17	33

Table 22.1:
When immune anti-D was detected NPP

*One case at 13 weeks in intravenous drug user, 2 cases before 12 weeks with no known cause for immunisation

**All received RAADP before the result showing immune anti-D became available

What was the booking weight?

Weight at booking in kg	Number of new cases 2015	Number of cases cumulative
<68	8	16
68–80	1	4
>80 (obese)	2	4
No information	6	9
Total	17	33

Table 22.2:
Booking weight NPP

Did the women receive appropriate RAADP?

New cases reported in 2015: 14/17 women were eligible for RAADP, as 3 were immunised by booking date.

RAADP regimen	Number of new cases 2015	Number of cases cumulative
Single dose 1500IU at 28 weeks	9	24
Single dose 1500IU at 30 weeks	1	
Two dose regimen 500IU	0	1
Not given	4*	5**
Total	14	30

Table 22.3:
RAADP details for eligible cases n=14 (2015) n=30 (cumulative)

*1 error, 3 reason unknown

**1 case delivered at 26 weeks, 1 error, 3 reasons unknown

The route was specified in 6 cases from 2015 as intramuscular into deltoid, the rest were not specified.

Details of potentially sensitising events (PSE)

PSE	Management
None 12	
Antepartum haemorrhage (APH) 2 cases	1. Bleed at 7,11 and 40 weeks No samples taken and no anti-D Ig given except RAADP 2. Bleed at 30 weeks but already immunised (managed at another Trust/Health Board until 28 weeks: no information provided)

Table 22.4:
Details of PSE for 2015: data exclude 3 cases who were sensitised at booking n=14

Table 22.5:
Details for all cases reported since 2012

PSE	Number of cases
None	24
7 antepartum haemorrhage (APH)	6 women had 10 events
2 interventions (chorionic villous sample, amniocentesis)	
1 fall	

Pregnancy outcomes

In 2015: All pregnancies resulted in live births, of which 8 had no complications, 7 babies required phototherapy and 2 cases required intravenous immunoglobulin and exchange transfusion in addition.

Cumulatively, all 33 pregnancies resulted in live births, of which 20 had no complications, 11 babies required phototherapy and 3 cases required exchange transfusion. No details in one case.

Summary of 2015 NPP data

- The majority of women (11/17) were found to be immunised at delivery, of whom 5 women received apparently 'ideal' care with timely RAADP and no identifiable sensitising episodes. They were not overweight and the pregnancies did not go beyond term. Only one of the remaining 6 women had had a sensitising event (for which she did not receive appropriate prophylaxis), 3 women did not receive RAADP, 2 women who did receive RAADP had booking weight >80kg, and 2 who received single dose RAADP at 28 weeks delivered beyond term (one of whom also weighed >80kg)
- 3 cases were immunised at booking despite no previous pregnancies or transfusion, although one case was a known intravenous drug user

Previous pregnancies (PP) n=34 in 2015, cumulative n=84 cases

When was the anti-D detected?

Table 22.6:
Time of anti-D detection for PP cases

Time of anti-D detection	Number of new cases 2015	Number of cases cumulative
At booking	15 (44%)	41 (49%)
Booking to 28 weeks	2	2
At or after 28 weeks	12	29 (35%)
At delivery	3	7 (8%)
Other	2*	5**
Total	34	84

*1 at planned follow up of large fetomaternal haemorrhage at delivery where correct dose of anti-D Ig had been given, 1 unknown in ectopic pregnancy

** 1 preoperative assessment following pregnancy, 2 at planned follow up of large fetomaternal haemorrhage at delivery where correct dose of anti-D Ig had been given, 2 unknown

Where anti-D was detected at booking in the index pregnancy, only the events in the preceding pregnancy are relevant to the sensitisation. Where anti-D is detected later in the index pregnancy, the relative contribution of events in the previous and index pregnancy is less certain.

Information about the pregnancy immediately preceding index pregnancy:

In 2015, the previous pregnancy ended in miscarriage in 2 cases, and one case underwent a termination at 6 weeks, leaving 31 previous pregnancies that went to term.

What was the booking weight?

Weight at booking in kg	Number of new cases 2015	Number of cases cumulative
<68	10	28
68–80	4	9
>80 (obese)	3	9
No information	14	28
Total	31	74*

*10 cases did not go to term

Table 22.7:
Booking weight for
PP cases

Did the women receive appropriate anti-D Ig prophylaxis for pregnancy loss?

Three cases were reported in 2015: a spontaneous miscarriage at 11 weeks (anti-D Ig is not indicated), a miscarriage at 10 weeks (no further details) who received 250IU anti-D Ig and a therapeutic termination at 6 weeks where information on whether anti-D Ig was given was not available.

Did the women who carried to term receive RAADP?

RAADP	Number of new cases 2015	Number of cases cumulative
Single dose	15	43
Two doses	4	7
Not given	4*	15**
No information	8	9
Total	31	74

*Declined (2), no reason (1), before practice adopted (1)

**Learning difficulties, concealed pregnancy, needle phobic, prior to RAADP introduction (2), delivered abroad (3), no reason given (5), declined (2)

Table 22.8:
Was RAADP given
at term or not?

15 of 74 (20.3%) cases were documented to have not received RAADP.

Number of PSE	Type of event	Management
7 PSE reported	4 APH	3 less than 20 weeks-all received anti-D Ig 1 at 22 weeks, no Kleihauer or anti-D Ig
	1 spontaneous miscarriage	At 11 weeks, no anti-D Ig indicated
	1 miscarriage (no further details)	At 10 weeks, given 250IU anti-D Ig
	1 termination of pregnancy	At 6 weeks, no anti-D Ig given
16 cases had no PSE reported		
11 cases had no information on PSE		

Table 22.9:
Details of
potentially
sensitising events

Method of delivery

Type	Number of new cases 2015	Number of cases cumulative
No information	9	28
Vaginal	12	28
Instrumental	2	4
Elective caesarean section (CS)	3	5
Emergency CS	5	9
Total	31	74

Table 22.10:
Mode of delivery
for PP cases

Gestation at delivery >40 weeks (data collected from 2015 onwards)

3 out of these 31 cases delivered beyond 40 weeks

Postpartum prophylaxis

Table 22.11:
Details of
postpartum anti-D
Ig prophylaxis

What happened?	Number of new cases 2015	Number of cases cumulative to date
Kleihauer test and appropriate dose of anti-D Ig	19	50*
No prophylaxis	2	5**
Incorrect dose of anti-D Ig	0	2***
No information	10	15
D-negative baby	0	2
Total	31	74

*Includes 4 cases requiring higher doses as a result of Kleihauer test

**2 from overseas, 1 learning difficulties, 1 needle phobic, 1 declined

***One dose 250IU, one dose given late

Anti-D detected at booking of index pregnancy n=15

The details of the preceding pregnancy may provide information on the cause of immunisation in these cases.

Table 22.12:
Details of
management in
previous pregnancy
n=15

Details	Management notes for preceding pregnancy
Ideal care 5 cases	Correct RAADP (single dose 1500IU) and postpartum prophylaxis, not obese and no known PSEs 2 cases delivered beyond 40 weeks (41 and 42 weeks)
No RAADP given/documentated 4 cases	1 declined 1 no reason for omission 2 no information on RAADP
PSEs documented 3 cases, all APH	2 cases (at 15 and 18 weeks) anti-D Ig given, Kleihauer not indicated 1 case at 22 weeks did not have Kleihauer or receive anti-D Ig (Note: An additional case had spontaneous miscarriage at 11 weeks so anti-D Ig not indicated or given)
Delivery method	4 vaginal 0 instrumental 4 CS (1 elective, 3 emergency) 7 not specified
Postpartum anti-D Ig	6 correct dose within 72 hours of delivery, Kleihauer performed 1 correct dose >72 hours after delivery, Kleihauer performed 2 no Kleihauer, no anti-D Ig given 2 not given, spontaneous miscarriage at 11 weeks, D-negative baby 4 no information

In 2015, 5 of 15 cases (33.3%) received apparently 'ideal' care, although in 2 cases pregnancy continued beyond term.

Cumulatively, 13 out of 41 cases (31.7%) found to be immunised at booking received apparently 'ideal care' in the preceding pregnancy.

Anti-D detected later in index pregnancy n=19

Excluded cases: n=3 (1 ectopic, 1 miscarriage at 22 weeks and large fetomaternal haemorrhage (FMH) follow up) leaving 16 informative cases.

There is further information requested on the index pregnancy in these cases, as it may be that the sensitisation occurred in the index pregnancy rather than in the preceding pregnancy.

What was the booking weight?

Weight at booking in kg	Number of new cases 2015	Number of cases cumulative
<68	9	18
68–80	2	8
>80	2	2
No information	3	10
Total	16	38

Table 22.13:
Details of booking weight

RAADP in current pregnancy

RAADP given or not	Number of new cases 2015	Number of cases cumulative
Single dose 1500IU	11	25
Not given	5	13
<i>No reason given</i>		4
<i>Needle phobia</i>		1
<i>Late booker</i>	3	4
<i>On advice of the Blood Service</i>		1
<i>Incorrectly typed as D-positive in past</i>		1
<i>Declined</i>	1	1
<i>Intrauterine death</i>	1	1
Total	16	38

Table 22.14:
RAADP information in current pregnancy

Sensitising events in current pregnancy occurred in 2 women, one who experienced a fall (gestation not reported) but declined anti-D Ig prophylaxis, and one of whom was an intravenous drug user who booked late following abdominal trauma and was found to have immune anti-D.

Outcomes of pregnancies reported in 2015

Outcome	Number of cases
Live births	26
<i>No treatment (1 D-negative baby)</i>	13
<i>Required phototherapy</i>	10
<i>Required phototherapy and intravenous immunoglobulin</i>	2
<i>Required phototherapy and exchange transfusion</i>	1
Miscarriage at 22 weeks	1
Intrauterine death at 14 weeks	1
Ectopic (?gestation)	1
No information	5
Total	34

Table 22.15:
Outcome of pregnancies reported in 2015
n=34

Summary of 2015 PP data

- In 15 cases, sensitisation must have occurred during the previous pregnancy as anti-D was detected at booking in the index pregnancy. Five of these 15 cases (33.3%) received apparently 'ideal' care in the previous pregnancy, although in 2 cases that pregnancy continued beyond term

Cumulatively since data collection began in 2012, 13 out of 41 PP cases (31.7%) found to be immunised at booking received apparently 'ideal' care in preceding pregnancy.

- In 19 cases sensitisation occurred later in pregnancy so that the relative contribution of previous pregnancies is less clear

COMMENTARY

While errors/omissions in care continue to lead to anti-D immunisation in pregnancy, we again see a small number of cases where apparently 'ideal' care is given, no other risk factors are identified and yet sensitisation occurs, leading to the production of immune anti-D in current or future pregnancies. The cause in these cases is unknown; whether genetic studies will identify women at particular risk of alloimmunisation to explain these findings, and whether such women once identified require a different approach to prophylaxis will be of great interest.

Further work

It is only by gathering sufficient data that we will have a chance of answering questions that persist around the ideal way to prevent alloimmunisation to the D antigen during pregnancy. SHOT is exploring a potential collaboration with NHSBT Alloimmune Resource (AIR) Study* with a view to collating the two databases and, where possible using the SHOT questionnaire for more detailed evaluation of women who have produced anti-D and are already entered into the AIR database.

*The AIR Study for pregnant women with red cell antibodies

The AIR Study is a research project funded by NHSBT to determine genetic influences that predispose women to developing red cell alloantibodies during pregnancy. Only a small proportion of women who have the potential to develop red cell antibodies during pregnancy go on to mount a clinically significant antibody response. The AIR study aims to collect 2000 deoxyribonucleic acid (DNA) samples from alloimmunised women to allow a genome-wide screening study to identify genes that may enhance the likelihood of antibody production. This information will help focus therapies and improve screening for high risk cases. Ethical approval has been given to write to women who are identified by NHSBT laboratories as having red cell antibodies and they will be asked if they are willing to:

- Provide a saliva sample to allow extraction of DNA
- Fill in a questionnaire about their transfusion and pregnancy history

Pregnant women, with antibodies, from any hospital where antenatal testing is undertaken by NHSBT may be asked to take part but we hope that this will not lead to any new workload for clinical teams. If you (or your patients) have any questions about the study, would like to help or would like more information please contact: sarah.morley@nhsbt.nhs.uk.

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Summary of Incidents Related to Transplant Cases n=70

23

Authors: Alison Watt and Paula Bolton-Maggs

Transfusion-related problems in transplant cases have been summarised since 2012, noting incidents in both haemopoietic stem cell transplants (HSCT) and solid organ transplants.

Key SHOT messages

- Good communication is vital to prevent transfusion errors in transplant patients
- The recommendations from the Advisory Committee on the Safety of Blood, Tissues and Organs (SaBTO) and the British Society for Bone Marrow Transplantation (BSBMT) for the requirement for HEV-screened components for some transplant patients will require robust policies for management and communication in both the clinical and laboratory areas
- Specific national guidelines are still needed for both transplantation and transfusion professionals that cover the procedures necessary for managing transfusions to transplant patients, especially where ABO/D-mismatched transplants have been given

Transplants that are ABO-incompatible or mismatched for the D antigen require clear protocols for transfusion. Errors are also made related to the specific requirements of transplant patients (e.g. the need for irradiated components). Some unusual errors were made which demonstrate the complexities of transfusing transplant patients (Table 23.2). The number of transplant cases reported increased in 2015 to n=70 (n=46 in 2014)) Figure 23.1.

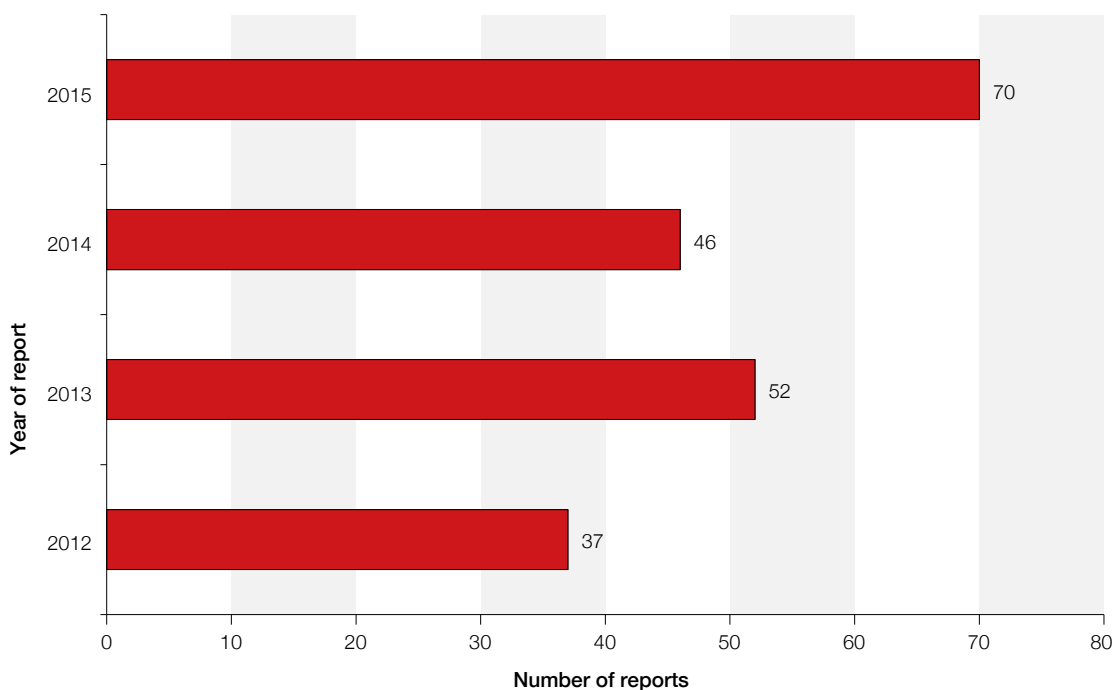


Figure 23.1: Transplant transfusion errors 2012–2015 n=205

Table 23.1:
Summary of errors
made in transplant
cases n=70

Type of transplant	ABO/D errors	SRNM*	Other**	Total
HSCT	34	26	1	61
Solid organ	2	5	2	9
Total	36	31	3	70

*SRNM=specific requirements not met

**Other=summary of 3 cases in Table 23.2

Table 23.2:
Non-ABO/D or
SRNM transplant
errors n=3

SHOT Category*	Description of error	Outcome
ADU (undertransfusion)	Patient with sickle cell disease on hypertransfusion to suppress haemopoiesis pre-transplantation was not transfused despite Hb 112g/L, which dropped to 96g/L two weeks later	No adverse reaction
Anti-D	D-negative female of childbearing potential given D-positive renal transplant. No quantification of D-positive red cells and received 2500IU anti-D at least 5 days after the event	Patient checked six months post transplant; no anti-D detected
HTR	Patient showed symptoms of a haemolytic transfusion reaction (HTR). History indicated patient was suitable for electronic issue (EI), but the HTR investigation revealed a 2+ incompatibility with the first unit given, possibly due to an antibody to a low frequency antigen. Further investigation revealed the patient had a history of previous reactions at another hospital, and had also had a solid organ transplant. Both of these factors would have deemed the patient unsuitable for EI, but were not communicated to the laboratory	Life-threatening acute reaction requiring immediate medical intervention

*ADU=avoidable, delayed or undertransfusion; Anti-D=adverse events related to anti-D immunoglobulin

ABO and D errors n=36

Table 23.3:
ABO and D errors
in transplant cases
n=36

SHOT category	ABO error	D error	Total
Incorrect blood component transfused (IBCT)	16	5	21
Near miss	10	5	15
Total	26	10	36

There were no known adverse outcomes for any patient receiving inappropriate ABO/D components, but the unintentional transfusion of ABO-incompatible blood components is a never event in England (NHS England 2015) and in Scotland these would be 'red incidents' through the Scottish National Blood Transfusion Service clinical governance system and/or those of the Health Board. It is not known whether reporting organisations are reporting these as never events.

Table 23.4:
Details of ABO-
incompatible
transfusions to
allograft HSCT
patients

ABO/D	Component	Gender	Patient group	Donor group	Group transfused	Error
Incorrect blood component transfused (IBCT) as a result of clinical error						
ABO and D	Mixed	Unknown	B D-positive	A D-negative	B pos RBC B neg PLT A pos PLT	ABO-incompatible & D-mismatch
Incorrect blood component transfused (IBCT) as a result of laboratory error						
ABO	RBC	Male	A	B	A	ABO-incompatible
ABO	RBC	Male	A	O	A	ABO-incompatible
ABO	RBC	Female	A	O	A	ABO-incompatible
ABO	RBC	Male	B	A	B	ABO-incompatible
ABO	RBC	Male	A	O	A	ABO-incompatible

RBC=red blood cells; PLT=platelets

ABO and D errors have increased in 2015. Figure 23.2 summarises these cases from 2012 to 2015

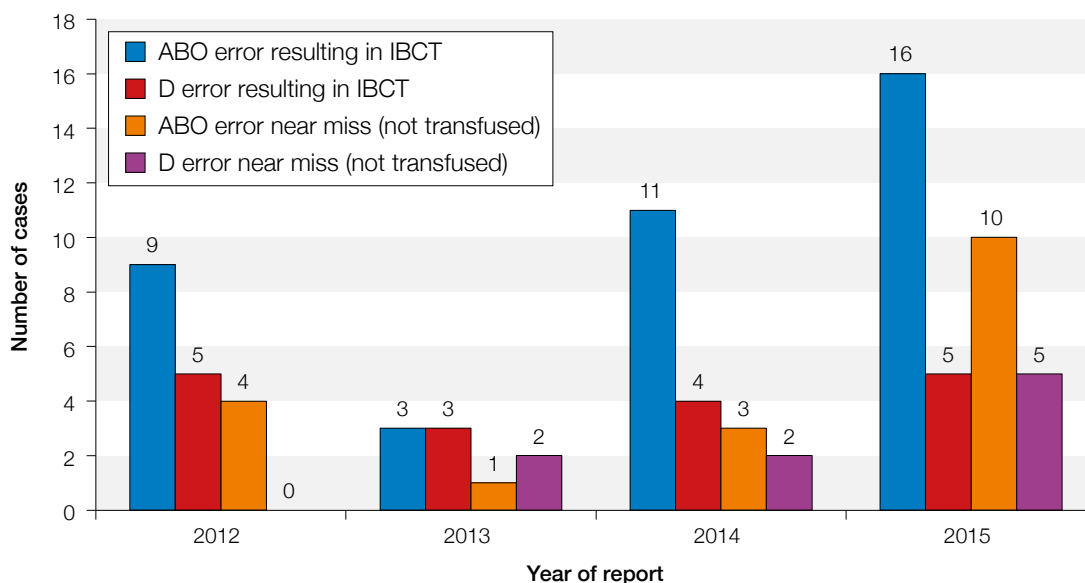


Figure 23.2: Transplant ABO and D errors 2012-2015, n=83

Specific requirements not met n=31

SHOT category	Irradiated	Other*	Total
Errors related to solid organ transplants			
SRNM clinical error	3	0	3
SRNM laboratory error	0	1 Sample validity	1
Near miss clinical error	0	0	0
Near miss laboratory error	1	0	1
Subtotal errors solid organ	4	1	5
Errors related to HSCT			
SRNM clinical error	13	1 HLA	14
SRNM laboratory error	2	2 EI	4
Near miss clinical error	7	0	7
Near miss laboratory error	1	0	1
Subtotal errors HSCT	23	3	26
Total	27	4	31

Table 23.5: Failure to provide components with specific requirements for transplant patients n=31

*EI=electronic issue; HLA=human leucocyte antigen

Specific transfusion requirements for transplant patients can be complicated and now include recommendations for HEV-screened blood components for patients receiving solid organ transplants or allograft HSCT (SaBTO 2016). All errors associated with failure to provide or transfuse HEV-screened components should now be reported to SHOT in the ‘specific requirements not met’ category.

The need for irradiated components for some patients receiving solid organ transplants has been challenged. A recent retrospective single-centre review noted that there were no cases of transfusion-associated graft versus host disease among 647 renal transplants patients who received non-irradiated components in the context of alemtuzumab (Campath, anti-CD52) conditioning therapy (Hui et al. 2016). This centre decided not to follow the 2010 guidelines (BCSH Treleaven et al. 2011, online November 2010), and did not institute irradiated components for these patients in the absence of other indications.

These guidelines are being revised by the Transfusion Task Force of the British Committee for Standards in Haematology (BCSH), but until then the current guidance remains in place (BCSH Treleaven et al. 2011).

Causes of errors

Table 23.6:
Causes of all
transplant errors,
including near
misses n=70

Error made	ABO/D error	SRNM	Other	Total
Errors related to solid organ transplants				
Clinical error – protocol or communication	0	2	1	3
Clinical decision making	1	1	0	2
Laboratory error – LIMS flags not heeded or updated	1	0	0	1
Lack of understanding in laboratory	0	2	1	3
Subtotal errors solid organ	2	5	2	9
Errors related to HSCT				
Clinical error – protocol or communication	11	20	0	31
Clinical decision making	0	1	1	2
Laboratory error – LIMS flags not heeded or updated	16	5	0	21
Laboratory error – communication	3	0	0	3
Lack of understanding in laboratory	4	0	0	4
Subtotal errors HSCT	34	26	1	61
Total	36	31	3	70

LIMS=laboratory information management system

COMMENTARY

Since 2012 SHOT noted that there is little guidance available for transfusion of transplant recipients. The following requirements are either not addressed or are not clear within national transfusion or transplantation guidelines:

- Procedures, particularly communication protocols, necessary for managing transfusion in transplant patients

The European School of Haematology (ESH)/European Group for Blood and Marrow Transplantation (EBMT) handbook (Pawson and Pamphilon 2012) includes the advice 'It is essential to define robust transfusion policies and procedures and these should be regularly audited.' No similar guidance appears to exist for solid organ transplantation.

- Management of female transplant patients who are of childbearing potential, where D-positive transplants have been given to D-negative recipients
- Protocols for the use of plasma-rich components in the immediate post-transplant period following an ABO-incompatible solid organ transplant until the organ is accommodated (Koch et al. 2004)
- Transfusion risks associated with passenger lymphocyte syndrome (PLS)

This is covered within the existing BCSH guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories (BCSH, Milkins et al. 2013), but SHOT has previously suggested this could be supplemented by guidance produced in conjunction with transplantation experts (Bolton-Maggs et al. 2015).

Many healthcare institutions have their own guidelines and protocols, such as those from Newcastle cardiothoracic unit (Aujayeb et al. 2014), but SHOT recognises that the lack of national guidance may be contributing to the confusion that leads to errors such as those described in this chapter.

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24 Transfusion-Related Acute Lung Injury (TRALI) n=10

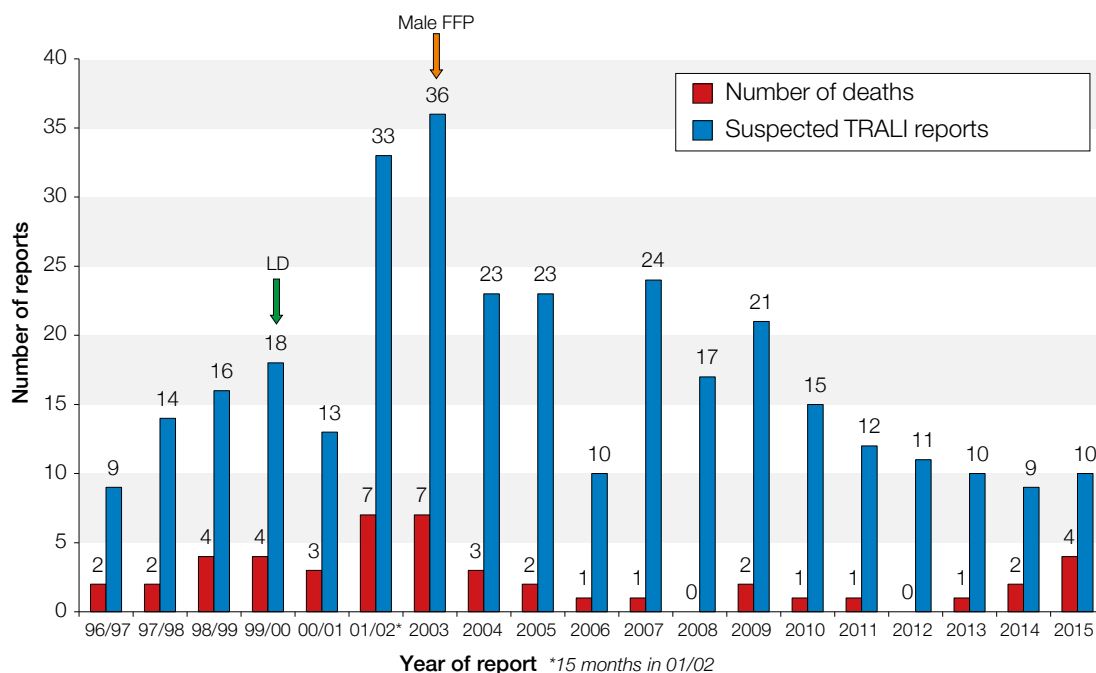
Author: Tom Latham

Definition:

Transfusion-related acute lung injury (TRALI) is defined as acute dyspnoea with hypoxia and bilateral pulmonary infiltrates during or within 6 hours of transfusion, not due to circulatory overload or other likely causes.

Ten cases of suspected TRALI have been included in 2015 (9 in 2014). One other case was transferred to another SHOT category (transfusion-associated circulatory overload (TACO)) and a further 4 were withdrawn because they did not fit TRALI criteria and their respiratory deterioration was attributed to another cause.

Figure 24.1:
Number of suspected TRALI cases and deaths at least possibly related to TRALI by year of report



LD marks the date when universal leucodepletion was introduced (during 1999). Male FFP (fresh frozen plasma) marks the date (from September 2003) when the Blood Services introduced use of male-only donor plasma for FFP and preferential use of male plasma for suspending pooled platelets. Hospital stocks of female FFP were not recalled at that time.

Patient outcomes

Deaths n=4

Five patients died but 1 death was considered to be unrelated to the transfusion.

Case 24.1: A transplant patient with pneumonia

This patient died following 2 units of red blood cells in optimal additive solution (RBCOA). The patient was already on oxygen for pneumonia post autologous haematopoietic stem cell transplant (HSCT) but deteriorated rapidly 20 minutes after transfusion and died of respiratory failure 7 days later. Serology showed human leucocyte antigen (HLA) class 1 antibodies cognate with the recipient. The event was classified as probable TRALI and it was assessed that TRALI had probably contributed to his death (imputability 2).

Case 24.2: Possible TRALI follows transfusion for a variceal bleed

This patient developed breathlessness 40 minutes following 6 units of red cells, 4 units of fresh frozen plasma (FFP) and 1 pool of cryoprecipitate for a variceal bleed. There was pre-existing fluid overload before transfusion and a chest X-ray before transfusion suggested pneumonia. However antibodies cognate with the recipient were present in one red cell unit and two donors to the cryoprecipitate pool. The case has been classified as possible TRALI and the patient's subsequent death was assessed as possibly related to transfusion (imputability 1).

Case 24.3: A sick patient with multiple contributory factors

A patient had alcoholic liver disease with encephalopathy and developed hypoxia 30 minutes after a platelet transfusion, but had pre-existing fluid overload and pulmonary effusions. The cause of death was considered to be hepatorenal syndrome. Serology showed HLA class 1 antibodies cognate with the recipient. This case was classified as possible TRALI and death possibly related to transfusion (imputability 1).

Case 24.4: Deterioration following HSCT

A patient with acute myeloid leukaemia (AML) deteriorated during transfusion of the second of 2 units of red cells. The patient was already receiving inotropic support for neutropenic sepsis following an allograft HSCT for relapsed AML. Serology was negative. The case was assessed as unlikely TRALI and death possibly related to transfusion (imputability 1).

Case 24.5: Breathlessness due to myocardial infarction

A patient became breathless 6 hours after a 3 unit transfusion following admission in a state of collapse with a myocardial infarction. Serology was negative. The case was classified as unlikely TRALI and death unrelated to transfusion (imputability 0).

Major morbidity n=4

All had life threatening acute reactions requiring immediate medical intervention. All 4 patients who suffered major morbidity recovered fully from their respiratory events.

Assessment of TRALI

There is no diagnostic test for TRALI and it is difficult to distinguish from other causes of acute lung injury, circulatory overload or infection. Most reported cases are complex with several possible contributory factors. The probability of TRALI has been assessed in each case using the criteria in Table 24.1. Clinical factors considered in assessments include: timing; radiological features; possibility of infection; other risk factors for acute lung injury or acute respiratory distress syndrome; evidence of circulatory overload and/or impairment of cardiac function; pre-existing cardiac, pulmonary, renal, hepatic or other disease and response to diuretics. Serological results are also considered.

Two intensive care specialists and a transfusion medicine expert (TRALI expert panel) assessed clinical details of all National Health Service Blood and Transplant (NHSBT) cases (7 of 10 cases) before laboratory investigation was initiated. Cases were subsequently categorised to take account of the laboratory results (Table 24.2).

Table 24.1:
SHOT criteria for
assessment of
TRALI cases

Probability	SHOT criteria for assessment of TRALI cases
Highly likely	where there was a convincing clinical picture and positive serology
Probable	where there was either a less convincing history and positive serology or a good history and less convincing or absent serology
Possible	where either the clinical picture or serology was compatible with TRALI, but other causes could not be excluded
Unlikely	where the picture and serology was not supportive of the diagnosis

Table 24.2:
TRALI case
probability (SHOT
criteria)

Probability	Number of cases
Highly likely	0
Probable	1
Possible	3
Unlikely	6

Additional information can be found in the supplementary information on the SHOT website www.shotuk.org.

This includes data extracted from individual TRALI questionnaires and the associated laboratory results.

TRALI Table 1 Patient characteristics and component details

TRALI Table 2 Clinical characteristics and radiological features of cases reported as TRALI

TRALI Table 3 Treatment, outcomes, investigation results and likelihood of case being TRALI

Patient characteristics

Age: Ages ranged from 10 to 73 years.

Clinical speciality: The referring specialities were: haematology 4 cases; gastroenterology, cardiology, endocrinology, internal medicine, oncology and emergency department 1 case each.

Clinical presentation

All patients were hypoxic and had bilateral changes on chest X-ray. Six patients were treated in the intensive therapy unit (ITU). Three of these required full mechanical ventilation; duration of mechanical ventilation for these cases was 2 days, 5 days and was not reported in 1 case. Fever was present in 4/9 and hypotension present in 4/8 patients for whom data was submitted.

Laboratory investigations

Complete results were available for all 10 patients. Concordant donor HLA- or granulocyte-specific antibodies were found in 3 cases, the antibody specificities are tabulated below in Table 24.3. Concordant donor antibodies were excluded in 7 cases.

Donor antibody	Concordant antibody specificities	Component	Other risk factors	Outcome
HLA class I	A2	RBCOA	Pneumonia	Death probably related to transfusion
HLA class I and II and human neutrophil antigen (HNA)	B44, Cw5, DR4, DR53, HNA2	Cryoprecipitate: 2 female donors had concordant antibodies RBCOA: 1 female donor had concordant antibodies	Pneumonia, massive haemorrhage, liver disease, fluid overload	Death possibly related to transfusion
HLA class I	Cw12	RBCOA	Alcoholic liver disease, fluid overload, positive fluid balance	Death possibly related to transfusion

Table 24.3:
Concordant donor antibodies 2015: specificities and implicated components

Patients who have suspected TRALI are no longer tested for leucocyte antibodies unless granulocytes have been transfused. This is because all other United Kingdom (UK) blood components are leucodepleted.

Cumulative serological data

Since 1996 204/324 (63.0%) reported cases have had full laboratory investigation for TRALI. Concordant antibodies were identified in 116/204 (56.9%) of these. The most frequently identified antibody specificities (either alone or in combination with other concordant antibodies) have been HLA-DR4 (22/116 cases, 19.0%), HLA-DR52 (17/116, 14.7%) and HLA-A2 (18/116, 15.5%). All other HLA antibody specificities have been identified in less than 10% of cases. Concordant HNA-specific antibodies, alone or in combination, have been found as follows: HNA-1a (9/116 cases, 7.8%); HNA-2 (2/116, 1.7%); HNA-3a (2/116, 1.7%).

Analysis of reports of 184 complete TRALI investigations between 2001 and 2015 inclusive has shown that the specificities of concordant antibodies were as follows:

Concordant donor antibodies 2001 to 2015 inclusive				
HLA class I alone	HLA class II alone	Both HLA class I and HLA class II	Granulocyte-specific antibody (+/- HLA antibodies)	None identified
20/184 (10.9%)	36/184 (19.5%)	27/184 (14.7%)	18/184 (9.8%)	83/184 (45.1%)

Table 24.4:
Concordant donor antibodies 2001 to 2015 inclusive

Classification of cases according to Canadian consensus criteria

All 10 reports have also been classified using the Canadian consensus criteria to allow international comparison (Goldman et al. 2005; Kleinman et al. 2004). Using these criteria, no cases were classified as TRALI, 5 as possible TRALI and 5 were classified as not being TRALI (including 2 with antibodies) because there was a history of fluid overload.

Case 24.1 above, further details: Probable TRALI

A 60 year old man with multiple myeloma, day 24 post autologous HSCT and with hospital-acquired pneumonia had been stable, maintaining oxygen saturation of 100% on 3L/minute oxygen. Within 20 minutes of commencing a unit of red cells, respiratory rate increased to 30/minute and oxygen saturation dropped to 70%. Blood pressure fell to 85/49 from 103/59mmHg at baseline and heart rate rose to 180 from 100 beats per minute at baseline. Chest X-ray showed bilateral changes in addition to the previously noted lower lobe pneumonia. The patient was clinically volume depleted and was in negative fluid balance over the previous 24 hours. An echocardiogram pre transplant had shown good left ventricular function. Despite ITU admission and ventilation the patient died 7 days post transfusion. Investigation of the female red cell donor showed HLA-A2 antibodies cognate with the recipient.

Likelihood of TRALI: This was classified as probable TRALI according to SHOT criteria because concordant HLA class I antibody was transfused within 6 hours of his respiratory deterioration and the clinical picture was concordant with the TRALI definition but could also be consistent with infection.

COMMENTARY

Five patient deaths were reported. One was assessed as probably due to TRALI, three as possibly related and one as unlikely to have been caused by TRALI. This is the highest number of reported deaths since the introduction of TRALI reduction measures but it is notable that all cases had alternative, and often multiple, reasons for respiratory deterioration which in most cases were more likely than TRALI. Two of the deaths classified as TRALI according to SHOT definitions because of the presence of antibodies would not have been classified as TRALI under the Canadian consensus definition due to the presence of fluid overload.

Three cases this year were found to have received donations from female donors with concordant HLA-specific antibodies. The implicated component/s were pooled cryoprecipitate and RBCOA in one case and RBCOA only in two cases. Multiple female donors contributing to the cryoprecipitate pool were found to have leucocyte antibodies.

The recommendation from last year's SHOT report for all UK Blood Services to avoid the use of female donor plasma for the preparation of cryoprecipitate thus remains active.

No case of TRALI linked with transfusion of female FFP, apheresis platelets or plasma contribution to platelet pool containing concordant HLA- or granulocyte-specific antibody has been reported to SHOT during the last five years.

References

Goldman M, Webert KE, Arnold DM, et al. (2005) **Proceedings of a consensus conference: Towards an understanding of TRALI.** *Transfus Med Rev* 19, 2–31

Kleinman S, Caulfield T, Chan P, et al. (2004) **Towards an understanding of transfusion-related acute lung injury: statement of a consensus panel.** *Transfusion* 44, 1774–1789

Post-Transfusion Purpura (PTP) n=2

25

Author: Tom Latham

Definition:

Post-transfusion purpura is defined as thrombocytopenia arising 5–12 days following transfusion of cellular blood components (red cells or platelets) associated with the presence in the patient of antibodies directed against the HPA (human platelet antigen) systems.

Two cases of confirmed PTP were reported this year. Five cases were initially reported but three were withdrawn because HPA alloantibodies had not been found. This compares with 1 confirmed case last year.

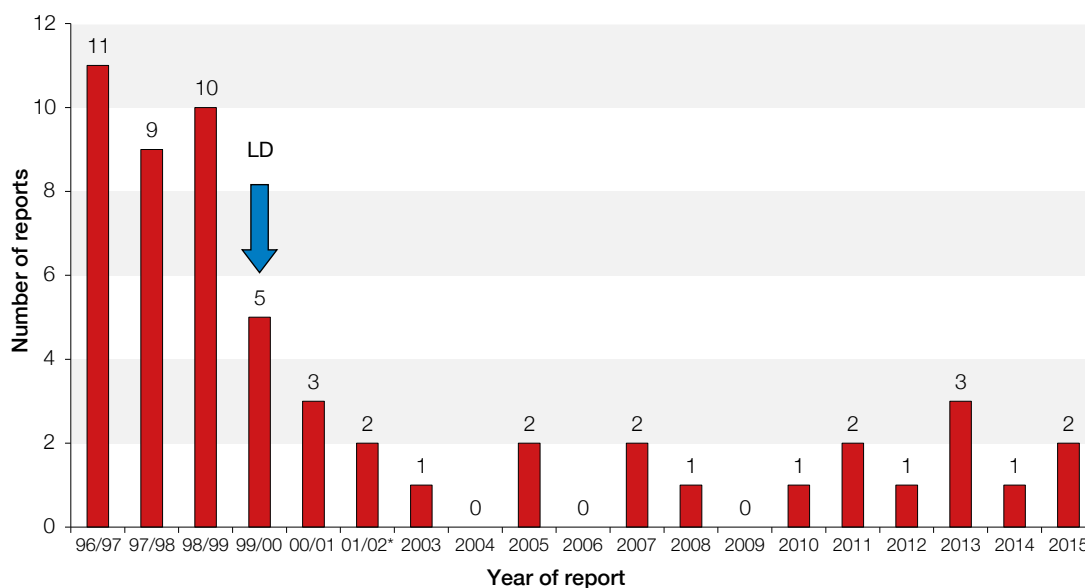


Figure 25.1: The number of cases of PTP with confirmed HPA alloantibodies reported annually to SHOT since 1996, a total of 56 reports. Cumulative data 1996 to 2015

LD indicates the introduction of leucodepletion in 1999

Analysis of cumulative data since 1996 has shown that there have been 56 cases of serologically confirmed PTP. Almost all, 52/56 (92.9%), of these patients have been female. Alloantibodies with specificity for HPA-1a remain the most frequent cause of PTP found either alone or in combination with other antibodies in 75.0% of cases. The annual number of reported cases has decreased since the introduction of universal leucodepletion of cellular components during 1999.

Causative antibody specificity	Number of cases
HPA-1a alone	37
HPA-1a with other HPA antibodies	5
Other HPA antibodies (HPA-1b,-2b, -3a, -3b, -5a, -5b and -15a)	14
Total	56

Table 25.1: Cumulative causative antibody specificity 1996–2015

Case History: PTP followed by immune thrombocytopenia

A 61 year old multiparous female was admitted with multiple injuries following a road traffic accident. She required several surgical interventions and a total of 5 units of red cells. Her platelet count was $195 \times 10^9/L$ on admission, $12 \times 10^9/L$ on day 10 and $5 \times 10^9/L$ on day 15. She had petechiae, bruising, wound oozing and oral blood blisters. Platelet transfusions were given without increment. Serological investigation confirmed the presence of HPA-1a alloantibodies.

She received 2g/kg of intravenous immunoglobulin (IVIg) in divided doses (day 17–21). Her platelet count remained $<10 \times 10^9/L$. Plasma exchange was performed on 4 alternate days (day 32–39) without effect. IVIg 2g/kg in divided doses (day 43–46) was repeated. Three days later her platelet count was $448 \times 10^9/L$ and she was discharged.

One month later she attended a preoperative assessment clinic. Further neurosurgery was required but deferred as her platelet count was $43 \times 10^9/L$. No further blood transfusions had been given. At this point a diagnosis of immune thrombocytopenia (ITP) was made. She commenced prednisolone 60mg/day and her platelet count recovered to $127 \times 10^9/L$ allowing surgery to be performed. HPA-1a-negative red cells were made available but were not required.

COMMENTARY

Two cases were reported this year. The first case was unusual as it was a male patient with anti-HPA-5a. This was in a chronically anaemic patient who developed purpura 6 days after transfusion.

The second case (described above) is interesting on two points (Burney et al. 2016). The majority of cases of PTP respond to IVIg but plasma exchange has been used as a second-line treatment in refractory cases. The subsequent development of steroid-responsive thrombocytopenia suggests autoimmune thrombocytopenia. It has been proposed that an autoimmune mechanism is responsible for bystander destruction of the recipients own HPA-1a-negative platelets, and the history in this case would be consistent with such a mechanism.

Advice on management of PTP is available in Practical Transfusion Medicine (Murphy et al. 2009)

Recommendations from previous years can be found in the supplementary information on the SHOT website www.shotuk.org.

References

- Murphy M. (2009) **Post-transfusion purpura**. In Murphy M, Pamphilon D, editors. Practical Transfusion Medicine. 3rd ed: Wiley-Blackwell 2009:117–21
- Burney C, Wolf J, Lucas G, et al. (2016) **Post transfusion purpura followed by immune thrombocytopenia**. Br J Haematology 173 (Suppl 1), 157

Author Dafydd Thomas

Definition:

Any adverse events or reactions associated with autologous transfusion methods, including intraoperative and postoperative cell salvage (washed or unwashed), acute normovolaemic haemodilution or preoperative autologous donation (PAD).

Twenty cases were reported; on review none were withdrawn, transferred to another section or transferred in from another section. This chapter describes the main findings from 20 completed questionnaires.

There were no reports submitted during this reporting period which related to adverse events whilst undertaking acute normovolaemic haemodilution (ANH) or preoperative autologous donation (PAD).

Cell salvage adverse events

The collection of adverse events related to autotransfusion is now in its 8th year and reports have been entirely related to cell-salvage autotransfusion. A pattern has developed showing events related to vasoactive responses to reinfused blood particularly related to the use of leucocyte depletion filter (LDF). During the 2015 reporting year there were 3 instances of major morbidity reported requiring intensive care admission, 5 minor morbidities and in the remaining 12 cases there were no clinical consequences. All 3 patients requiring intensive care survived.

Specialty

Obstetric operations had the most reported cases with 9 reports related to use of cell salvage in caesarean section and there were 4 cases related to orthopaedic surgery. There were 2 gynaecology and 3 urology reports. Unusually there was one case of cell salvage used during cardiac catheterisation and another during bleeding for an abdominal procedure post splenectomy.

Type of cell salvage

Intraoperative cell salvage (ICS) involved 18 patients and there was only one report related to postoperative cell salvage (PCS) and one case where both ICS and PCS had been used.

Operator error

Five of the reports involved failure to set up the equipment correctly, ignoring sensors and warnings. One operator was suspended as a result of incorrect assembly of equipment and use.

Clinical adverse events

It should come as no surprise that human errors are as likely during collection, preparation and the administration of autologous blood as with allogeneic blood components. This year there were incidents related to wrongly labelled autologous blood and human error or violation of procedure when setting up the disposable components of the cell salvage equipment.

Yet again hypotensive reactions were observed when cell-saved blood is reinfused via a LDF. It was reassuring however that there was no mortality as a result of these events and the immediate clinical responses were appropriate and timely.

When the blood was clinically needed the LDF was removed and the blood transfusion continued. In addition the investigation of the clinically adverse events took into consideration the advice and suggestions included in previous Annual SHOT Reports and one such case is outlined below.

A clinically significant event included the use of a LDF in a patient undergoing radical cystectomy. The initial hypotension was coincident with re-infusion of cell-saved blood, but the patient remained hypotensive after stopping the cell-saved blood. When the situation was assessed in retrospect it was thought that overall blood loss and the fact the patient was routinely receiving an angiotensin-converting-enzyme (ACE) inhibitor had contributed to the longer period of hypotension. He made a complete recovery but required a period of observation postoperatively on intensive care.

Another event resulting in major morbidity and intensive care admission was as a result of cell salvage not being set up early enough during a caesarean section. As a consequence not all salvageable blood was collected and this resulted in a low haemoglobin level in the woman after the surgical intervention and need for close observation. She survived the event.

One adverse report related to the anaesthetist's instruction NOT to use a LDF as the blood reinfused too slowly via such a filter. The collected blood was reinfused without a LDF and there were no clinical problems.

Case 26.1: Cell salvage for an obstetric complication associated with disseminated intravascular coagulation (DIC)

A woman with a low lying placenta and a history of a previous myomectomy was undergoing a lower segment caesarean section. The initial procedure appeared relatively uneventful and the woman's transfusion requirements included a single bag of packed red cells and 770mL of cell-saved blood.

Two hours later the patient developed gum bleeding and experienced a 600mL haematemesis and the laboratory findings revealed an extremely low fibrinogen especially for a woman at term and in addition activated partial thromboplastin time ratio (APTT-R) and international normalised ratio were both elevated at 2.3 and 2.4 respectively. Her platelets had dropped to $96 \times 10^9/L$.

A diagnosis of DIC was made and the woman treated with 4 units of packed red cells, 2 pools of cryoprecipitate, 3 units of fresh frozen plasma and an adult unit of platelets. She underwent hysterectomy for Couvelaire syndrome (haemorrhage that penetrates into the uterine myometrium forcing its way into the peritoneal cavity).

Comment: Previous adverse reactions during the administration of cell-saved blood have mainly involved an immediate hypotension reversed by stopping the infused cell saved red blood cells, clear fluid resuscitation with the use of an intravenous vasoconstrictor. It has been postulated that the presence of free cytokines have led to profound vasodilation, which is treatable and the effect is only transient due to the short half-life of the vasoactive cytokines. In all cases a LDF has been used and where the red cells were urgently needed the LDF was removed and the remaining cell salvaged red cells were infused successfully. No cases of amniotic fluid embolus have been reported.

The case above is unlikely to be directly related to the cell salvage. The time scale of development of bleeding suggests a different aetiology for deranged coagulation and very low fibrinogen. The correction of the low fibrinogen with FFP and cryoprecipitate supports this theory and there are case reports of this obstetric complication associated with hypofibrinogenaemia in the literature (McHenry 1956, Cheng and Lin 2008). The administration of a platelet transfusion was probably not necessary, unless the woman had been taking medication to interfere with platelet activity; a platelet count of $90 \times 10^9/L$ even in the presence of haemorrhage should have been sufficient. This is a rare obstetric complication and hysterectomy is not usually necessary (Rathi et al. 2014).

General comments arising from cell salvage reports

It is reassuring that close observation of cell-salvage autotransfusion via the SHOT reporting system has not identified any mortality related to its use. Furthermore the observation that significant hypotension can occur when LDFs are used has identified serious adverse events and allowed widespread dissemination of knowledge of this problem allowing practitioners to develop and publicise clinical responses that can help treat the adverse event. It needs to be stated that the awareness of this problem amongst obstetric anaesthetists using intraoperative cell salvage gives further reassurance that the possible risk of amniotic fluid embolism amongst this population of pregnant women when receiving reinfused cell-saved blood does not seem to be a problem with no reports received yet attributing the hypotension to this condition. It is worth restating that there have been NO reported deaths as yet associated with the use of cell-salvage autotransfusion.

Recommendations

- All cell salvage operators must undertake initial and regular update training and be assessed as competent (there should be documented evidence of competence in the form of a training record)
- All bags of cell salvage blood must be fully labelled with the patient identification and unique case number
- All hospitals where intraoperative cell salvage (ICS) and postoperative cell salvage (PCS) are undertaken should report adverse events to SHOT
- Monitoring of patients is as important for the reinfusion of red cells collected by ICS or PCS as it is for allogeneic red cells
- Practitioners need to revisit previous Annual SHOT Reports particularly related to autologous transfusion to ensure historic incidents are not repeated

Action: Cell salvage teams

References

Cheng WW, Lin SQ (2008) **Analysis of risk factors for uteroplacental apoplexy complication placental abruption.** *Zhonghua Fu Chan Ke Za Zhi* 43, 593–596

McHenry AG (1956) **Acquired afibrinogenemia with Couvelaire uterus following cortisone therapy and Pitocin induction for an Rh isosensitisation.** *J La State Med Soc* 108, 169–171

Rathi M, Rathi SK et al. (2014) **Couvelaire uterus.** *BMJ Case Rep* doi:10.1136/bcr-2014-204211

27

Alloimmunisation n=236

Author: Clare Milkins

Definition:

Alloimmunisation is defined as demonstration of clinically significant red cell antibodies after transfusion, which were previously absent (as far as is known), when there are no clinical or laboratory signs of haemolysis.

Final report

SHOT has been collecting data on alloimmunisation since 2010, although always in a voluntary reporting category. It was introduced partly because the International Society of Blood Transfusion (ISBT) has a defined category for delayed serological transfusion reaction (synonymous with alloimmunisation), and partly because cases were being reported as haemolytic transfusion reactions (HTR) and having to be withdrawn by SHOT.

Before 2012, a patient with a new antibody and a positive direct antiglobulin test (DAT) post transfusion met the SHOT definition of HTR even where there was no biochemical or clinical evidence of haemolysis. This was changed in 2012 to categorise such cases as alloimmunisation rather than HTR. The number of reports of alloimmunisation has increased each year, and is likely to be the tip of the iceberg, as new cases are only recognised if a new sample happens to be tested at some point post transfusion.

Some interesting data have emerged over the last 5 years, demonstrating a different profile of antibody specificities to those reported in the HTR category. However, this picture is similar each year, and with the exception of new cases of anti-D resulting from deliberate transfusion of D-positive components to D-negative recipients, there have been no useful learning points or recommendations to be made.

Following a review by the Working Expert Group, SHOT has decided to stop collecting reports of alloimmunisation from January 2016. Reporters are requested to report cases of new antibody formation as HTRs, only where there is biochemical or clinical evidence of haemolysis.

SHOT will continue to analyse data from cases where a new anti-D is detected in pregnancy. Such cases should be notified to SHOT via the website so that the reporter can download a questionnaire.

Number of cases

There are 236 cases, including 1 transferred from HTR, and 1 from right blood right patient (RBRP). This is a 55% increase from last year, and probably just represents an increase in reporting awareness.

Age of patients

Patients ranged from 1 to 97 years, with a median of 69 years.

Specificity of new antibodies identified post transfusion

Table 27.1 shows these in order of how commonly they were identified, rather than by blood group system, and the top 4 are the same as last year. It is notable that the profile of the antibodies identified differs from those reported in the delayed haemolytic transfusion reaction (DHTR) category and is similar to last year. The majority of antibodies causing DHTRs were anti-Jk^a, whereas the vast majority in this chapter are anti-E, anti-K and anti-c, reflecting the higher clinical significance of Kidd antibodies in respect to haemolytic transfusion reactions.

The definition states that antibodies should be of clinical significance, and some of those reported have been classed as ‘unlikely to be of clinical significance’ (Milkins et al. 2013), e.g. anti-Le^a and anti-Lu^a. However, as there is no absolute definition of clinical significance they have all been included in this analysis and report.

Specificity	Number of cases
E	68
K	30
Mixture including Rh (includes 2 with anti-D+C)	24
c (+/-E)	22
Fy ^a	18
Jk ^a	16
Lu ^a	13
Jk ^b	9
e (+/-C)	5
C	5
Other mixture	5
Kp ^a	5
M	4
C ^w	3
D	2
Fy ^b	2
S	2
One each of Le ^a , f	1 of each (2 cases)
No specificity given	1
Total	236

Table 27.1:
Specificity of new antibodies

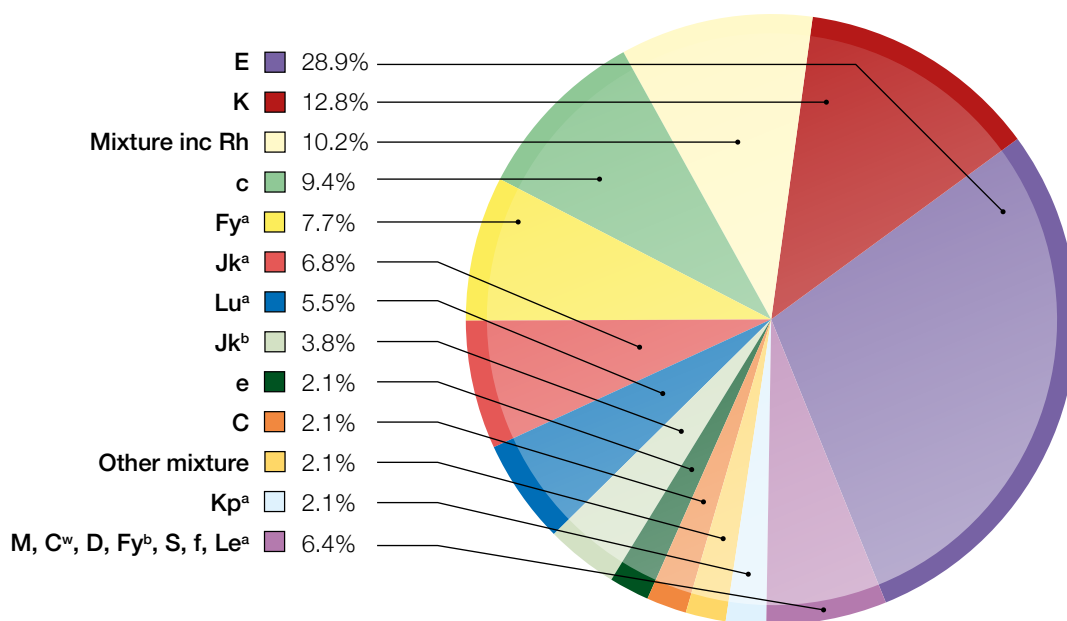


Figure 27.1:
Percentage of new antibodies by type

Development of anti-D n=4

Three elderly female patients and one male patient developed anti-D following deliberate transfusion of D-positive red cells.

Interval between the transfusion and detection of new antibodies

The time intervals reported ranged from 4 days to weeks, months or even years.

Reference

BCSH Milkins C, Berryman J et al. (2013) **Guidelines for pre-transfusion compatibility procedures in blood transfusion laboratories**. *Transfus Med* 23, 3–35

Haemoglobin Disorders: Updated Cumulative Summary of Events

28

Author: Paula Bolton-Maggs

Category	Sickle cell disease (SCD)						Total 6 years	Outcome
	2010	2011	2012	2013	2014	2015		
HTR	4	5	7	16	11	11	54	2 deaths, 24 MM
SRNM	3	6	7	7	6	9	38	1 alloimmunisation
ATR	4	3	2	2	1	4	16	Minor morbidity
NM	2	2	0	1	6	2	13	
ADU	0	1	1	2	0	4	8	2 deaths
TACO	0	1	0	0	1	0	2	1 MM
TAD	0	1	0	0	0	0	1	
TTI	0	0	1	0	0	0	1	Parvovirus
IBCT	0	0	0	0	0	3	3	2 ABO-incompatible 1 D-positive to D-negative female

Table 28.1:
Adverse clinical incidents in haemoglobinopathy patients – cumulative data for 6 years (2010–2015) (Excluding alloimmunisation, handling and storage and right blood right patient errors as there were no clinical adverse outcomes.)

Category	Beta thalassaemia major						Total 6 years	Outcome
	2010	2011	2012	2013	2014	2015		
HTR	0	0	0	0	1	2	3	1 MM
SRNM*	0	2	2	1	1	1	7	
ATR	6	3	3	2	2	2	18	Minor morbidity
NM	0	0	1	0	0	1	2	
ADU	0	0	0	0	1	0	1	
TACO	0	0	0	0	1	0	1	
IBCT	0	0	2	0	1	1	4	3 ABO-incompatible transfusions

(MM=major morbidity; ATR=acute transfusion reactions; HTR=haemolytic transfusion reactions; TACO=transfusion-associated circulatory overload; TAD=transfusion-associated dyspnoea; ADU=avoidable, delayed or under transfusion; SRNM=specific requirements not met; NM=near miss events; IBCT=incorrect blood component transfused; TTI=transfusion-transmitted infection NS=not specified whether the case was sickle cell disease or thalassaemia)

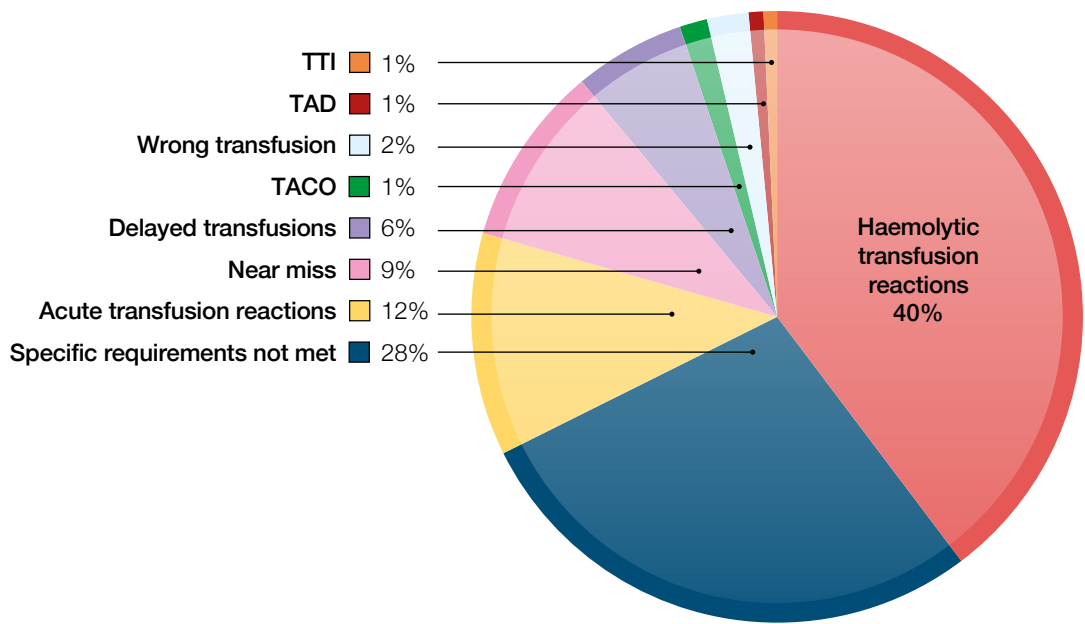
Note: These numbers do not include 2 additional cases of transfusion errors to patients with other haemoglobin disorders: a woman with HbC disease was transfused for menorrhagia in 2014 where the laboratory was not informed about the haemoglobinopathy, and in 2012 another woman with HbH disease did not receive CMV-screened blood because the clinicians did not inform the laboratory that she was pregnant. In 2015 there were two reports of severe pain during transfusion in patients with beta thalassaemia major.

As in previous years, patients with SCD were more likely to have adverse reactions than those with beta thalassaemia. The most serious complications result from haemolytic transfusion reactions. Eleven were reported in SCD in 2015, 2 acute, and 9 delayed, all these with features of hyperhaemolysis. It is worrying that within the total of 7 ABO-incompatible red cell transfusions in 2015, three of them occurred in haemoglobinopathy patients, which is a patient group that should have a well-known transfusion history.

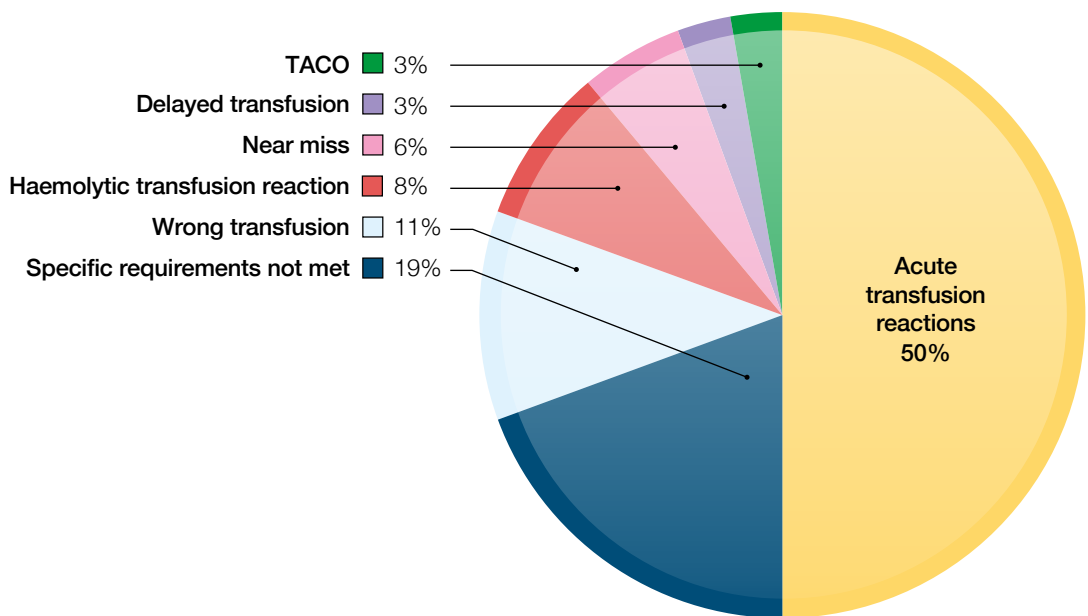
Please continue to report cases of suspected hyperhaemolysis. There is need for further study of this complication. An advisory panel is available through National Health Service Blood and Transplant. Further information is available in the Annual SHOT Report 2014, page 158.

Figure 28.1
Cumulative data
for adverse events
in haemoglobin
disorders 2010 to
2015

Sickle cell disease: n=136



Thalassaemia: n=36



Author: Shruthi Narayan (Consultant Donor Medicine, NHS Blood and Transplant)

On behalf of the SHOT Donor Working Group:

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Stephen Field, Medical Director, Welsh Blood Service

Key SHOT messages

- Blood donation is generally a safe process; however, donor complications sometimes do occur. Donor haemovigilance systems permit monitoring of donor safety, developing mitigating actions and evaluating the success of these interventions designed to further improve donor safety. This also allows international benchmarking of donor adverse events
- Reducing human errors: Human errors contribute to donor adverse events. Blood Services must ensure staff are adequately trained and comply with standard policies and procedures which are essential in promoting donor safety

Introduction

The blood supply depends entirely on the invaluable commitment of volunteers, who ostensibly gain little personal benefit from blood donation but are exposed to the risks of discomfort, complications and injury resulting from the collection procedure.

Donor safety is paramount and is ensured by donor selection guidelines, standard policies and procedures, trained staff and appropriate facilities. National and international standards exist for donor selection, blood collection procedures and quality management. Despite these measures, adverse events will occur in a number of donors either at the time of or shortly after donation. About 2–6% of donors experience an adverse event. Most of these are classified as non-severe and resolve promptly but are still unpleasant for the donor. Serious adverse events occur infrequently. Rarely, these reactions may result in long-term or permanent disability or injury to the donor. These donor adverse events may also lead to cessation of collection and loss of the donation, and decreased likelihood of donor return. Blood Establishments also face reputational risk with legal claims and these adverse events may also negatively impact donor recruitment. Preventing these adverse events must be a priority and when donor complications do occur, they should be managed promptly and appropriately.

Donor haemovigilance systems permit monitoring of donor safety, assessing frequency of risk factors, developing mitigating actions and helps evaluating the success of interventions designed to further improve donor safety. Standardised definitions facilitate international benchmarking of donor adverse events and promote best practice.

Regulation and guidance on donor haemovigilance

The current European Blood Directives, issued and enforced between 2003 and 2005 (2002/98/EC and 2005/61/EC), which describe the basic regulatory requirements and standards of quality and safety for the collection, testing, processing, storage and distribution of human blood and blood components also provide the regulatory bases of haemovigilance requirements for traceability and notification of serious adverse reactions and events (EU Directives).

The EU Directives were transposed into UK law through the Blood Safety and Quality Regulations (BSQR) 2005. The Blood Safety and Quality (amendment) Regulations 2006/2013 further amend the BSQR 2005 (SI 2005/50) ('the principal regulations') to make a number of changes to the provisions governing the operation of Blood Establishments relating specifically to traceability requirements and notification of adverse reactions and events and introduced standards and specifications relating to a quality system for blood establishments (BSQR 2005).

Standard definitions for surveillance of complications related to blood donation

Standard definitions of donor reactions allow each Blood Service to monitor donor adverse events and compare with other organisations to develop and promote best practices. The 2008 International Society of Blood Transfusion (ISBT) standard for surveillance of complications related to blood donation introduced a classification with descriptions of types of complications. Two problems were however identified with these definitions:

- Descriptions were not sufficiently specific to permit standard classification and comparison of different donor surveillance programmes
- Definitions were difficult to apply because they required information not easily obtainable in many countries

The ISBT Haemovigilance Working Party subsequently led a multi-organisational effort to update the 2008 ISBT standard for surveillance of complications related to blood donation and revised definitions have now been developed (Goldman et al. 2016, ISBT 2014).

The goals of this revised classification system were to:

- Provide simple definitions that are easy to apply in a standardised way
- Provide minimal requirements for international comparison that meet the needs of a basic surveillance programme
- Provide additional attributes that may be collected nationally if possible which would be important to make improvements by the blood centre or lead to relevant research in donor reactions
- Align definitions with those used in the American Association of Blood Banks (AABB) Donor Haemovigilance System to permit comparisons

The new classification system provides clear, standard definitions for donor adverse events. The revised classification scheme and abbreviated definitions are shown in Table 29.1. The recommended numerator and denominator parameters and basic information about donor screening and collection practices are shown in Table 29.2. Optional categories are shown in italics. The mechanisms and signs and symptoms of each reaction, as well as a data entry form, are included on the ISBT website (ISBT 2014).

Donor adverse event categories (optional categories in <i>italics</i>)			
A	Local symptoms	A1 Blood outside vessels Haematoma (bruise) Accumulation of blood in tissues Arterial puncture Puncture of brachial artery or brachial artery branch <i>Delayed bleeding</i> Rebleeding after initial bleeding has stopped	
		A2 Arm pain Nerve injury/irritation Injury or irritation of a nerve <i>Duration < or >12 months</i> <i>Other arm pain</i> Pain without characteristics of nerve irritation, large haematoma or other possibly painful complications	
		A3 Localised infection/inflammation of vein or soft tissue Localised infection/inflammation Inflammation along the course of a vein, which may progress to localised infection; there may be clotting Optional split into two categories <i>Thrombophlebitis</i> Redness, swelling, tenderness extend along the vein <i>Cellulitis</i> Redness, swelling, tenderness not localised to the vein	
		A4 Other major blood vessel injury: must be medically diagnosed Deep venous thrombosis Thrombosis of a deep vein in phlebotomy arm Arteriovenous fistula Acquired connection between vein and artery Compartment syndrome Increased compartment pressure leading to necrosis Brachial artery pseudoaneurysm Collection of blood outside an artery contained by adventitia or the surrounding tissues alone	
		B Generalised symptoms-vasovagal reactions: General feeling of discomfort and weakness with anxiety, dizziness, and nausea which may lead to loss of consciousness (faint)	
		Vasovagal reactions	No loss of consciousness The donor does not faint
			Loss of consciousness The donor faints for a period of time
			<i>>60sec, and/or complications</i>
			<i><60sec, without complications</i>
			<i>With or without injury</i> Injury caused by falls/accidents
			<i>On or off collection site</i> Before or after donor has left donation site
		C Related to apheresis	
			Citrate reactions Neuromuscular hyper reactivity related to reduced Ca ²⁺
			Haemolysis Damaged donor red cells, releasing haemoglobin
			Air embolism Air bubble introduced to donor's circulation
	<i>Infiltration</i> ^a Intravenous solute (saline solution) enters tissues		
D Allergic reactions			
	Local Red or irritated skin at venepuncture site		
	Generalised (anaphylactic) Anaphylactic reactions may begin soon after starting the procedure, progress rapidly to cardiac arrest		
E Other serious complications: must be medically diagnosed, imputability assessed ^b			
F Other			
	Major cardiovascular event MI ^c , cardiac arrest, other acute symptoms, TIA ^d , CVA ^e , or death within 24 hours after donation		

Table 29.1:
Definitions of donor complications, optional categories in *italics*

^a When return fluid consisting of red cells in plasma and citrate goes extravascular, report under A1 Haematoma

^b Only cases with definite, probable, or possible imputability included for international reporting

^c MI=myocardial infarction

^d TIA=transient ischaemic attack

^e CVA=cerebrovascular accident

Table 29.2:
Recommended
numerator and
denominator data,
optional data
shown in *italics*

Numerator data about each complication		Denominator data about all donors	
Type of donation		Total donations (proceed to phlebotomy)/year	
a) Whole blood	<i>i. Allogeneic</i> <i>ii. Autologous</i>	a) Whole blood	<i>i. Allogeneic</i> <i>ii. Autologous</i>
a) Apheresis	<i>i. RBC+plasma+platelets</i> <i>ii. Platelets+plasma</i> <i>iii. Plasma only</i>	a) Apheresis	<i>i. RBC+plasma+platelets</i> <i>ii. Platelets+plasma</i> <i>iii. Plasma only</i>
Gender of donor		Gender of donors in each donation category	
First time versus repeat donor		First time versus repeat donors in each category	
<i>Age group (16–18, 19–22, 23–29, 30–69, >70 years)</i>		<i>Age group of donors (16–18, 19–22, 23–29, 30–69, >70 years)</i>	
Type of complication		<i>Total number of donors/year by type of donation, gender, first time versus repeat, age group</i>	

Timeline of the significant milestones in donor adverse event reporting by UK Blood Services to SHOT

Each of the UK Blood Services has their own system for recording and investigating donor adverse events. Serious adverse events of donation (SAEDs) are recorded as quality incidents, investigated in a timely manner, corrective and preventative actions instituted and reported by each Blood Service respectively to the Medicines and Healthcare Products Regulatory Agency (MHRA). All known events relating to whole blood and component donations should be recorded.

Following ISBT definitions of donor adverse events in 2008, at the request of the Joint United Kingdom (UK) Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee (JPAC), Standing Advisory Committees on Care and Selection of Donors (SACCSD), a working group with representatives from each of the UK Blood Services was established to harmonise donor adverse event reporting to SHOT and to allow benchmarking of donor adverse events both internally in the UK and internationally. The four UK Blood Services agreed to the definitions of SAEs in 2010 and have been using these since then. Following the introduction in December 2014 of the new ISBT/IHN/AABB-endorsed classification of donor complications, the working party has been re-established with representatives from all the four UK Blood Services to facilitate the same process. It has been agreed that a collated report of SAEDs from the four UK Blood Services will be reported to SHOT in the first instance and the working party will continue to look at expanding this and streamlining the process in the future. The UK Blood Services are in the process of incorporating these new ISBT definitions into the reporting system.

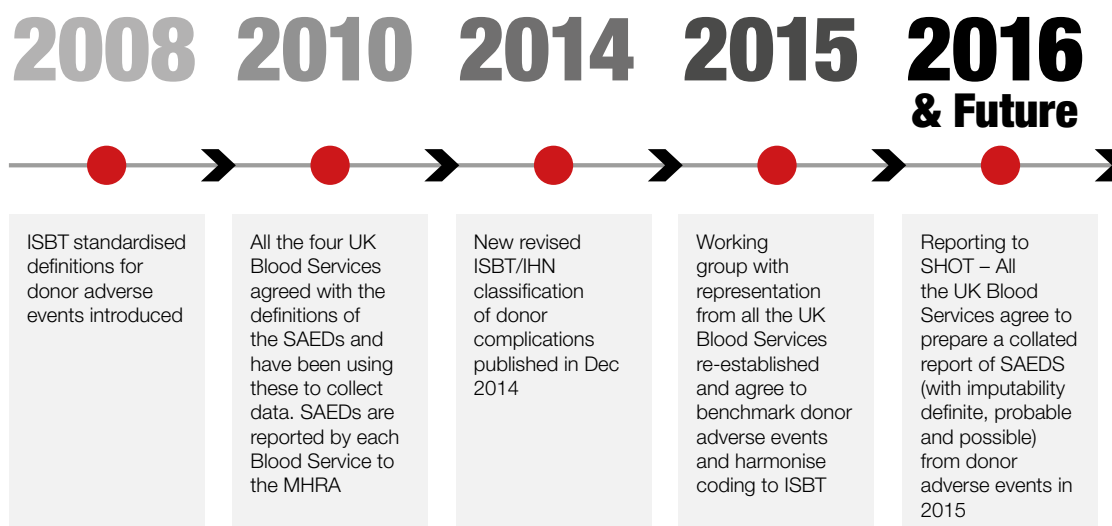


Figure 29.1: Timeline of significant milestones in reporting and benchmarking donor haemovigilance data

Serious adverse events of donation (SAEDs) reporting categories agreed by the UK Blood Services:

The donor SAEDs agreed by the UK Blood Services to be reportable if definitely, probably or possibly linked to donation are shown in Table 29.3.

SAED categories 2016	
1	Death within 7 days of donation
2	Hospital admission within 24 hours of donation
3	Injury resulting in a fracture within 24 hours (including fractured teeth)
4	Road traffic collision (RTC) within 24 hours of donation
5	Acute coronary syndrome (ACS) diagnosed within 24 hours of donation
6	Problems relating to needle insertion persisting for more than a year or requiring hospitalisation/intervention
7	Anaphylaxis (component donation, CD)
8	Haemolysis (CD)
9	Air embolism (CD)
10	Other event linked to donation resulting in hospitalisation, intervention or disability/incapacity for more than a year after donation, not included above

Table 29.3: SAED categories 2016

7, 8 and 9 previously one category and 10 a new category

All SAEDs will be investigated within each Blood Service, and will be notified to the MHRA. Imputability is defined as the strength of the relationship between the donation and the event and is graded as:

- Definite or certain: when there is conclusive evidence beyond reasonable doubt for the relationship
- Probable or likely: when the evidence is clearly in favour of a relationship
- Possible: when the evidence is indeterminate for attributing the complication to the donation or an alternative cause
- Unlikely or doubtful: when the evidence is clearly in favour of attributing the complication to other causes
- Excluded: when there is conclusive evidence beyond reasonable doubt that the complication can be attributed to causes other than the donation

Only cases where the imputability is ‘definite’, ‘probable’ or ‘possible’ are reported to SHOT.

Review of SAEDs reported to the UK Blood Services from January to December 2015

The following are the four National Blood Services/Blood Transfusion Services in the UK:

- NHS Blood and Transplant (NHSBT), a Special Health Authority within the NHS, which provides Blood Services and tissues in England and North Wales, and organs for the whole of the UK. From 1 May 2016 however, North Wales was transferred over to the Welsh Blood Service
- The Scottish National Blood Transfusion Service (SNBTS), which is managed by NHS National Services Scotland
- The Northern Ireland Blood Transfusion Service (NIBTS), which is managed by the Northern Ireland Blood Transfusion Special Agency
- The Welsh Blood Service (WBS), which is provided and managed by Velindre NHS Trust

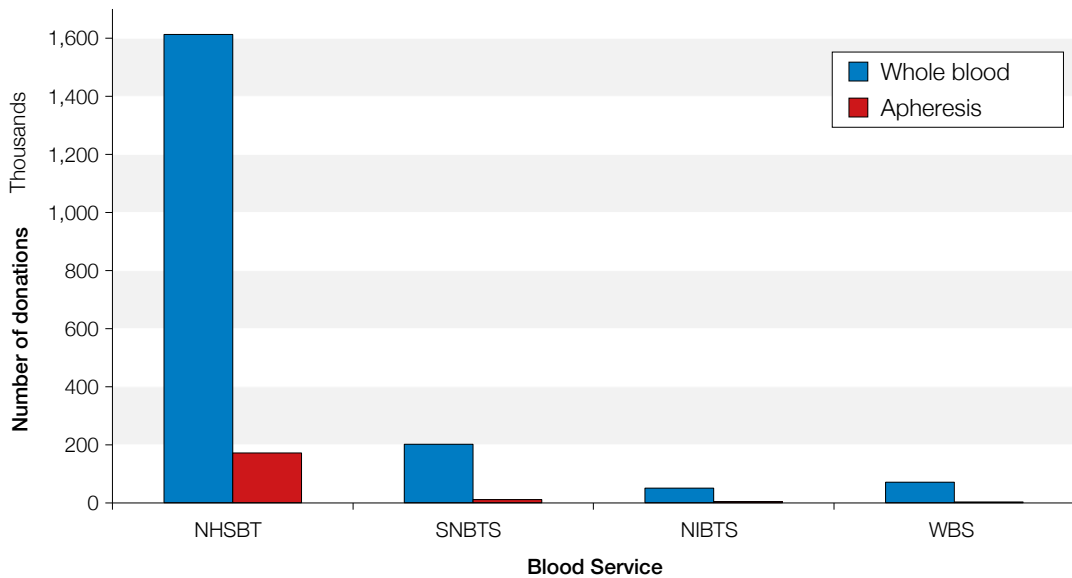
The following table provides information relating to the total number of donations, number of whole blood donations, component donations and total number of SAEDs reported by each of the UK Blood Transfusion Services for the calendar year 2015 (January–December).

Table 29.4:
Summary of SAEDs from the UK Blood Transfusion Services for the calendar year 2015

	NHSBT	SNBTS	NIBTS	WBS
Whole blood donations	1,611,930	201,403	50,791	71,833
Apheresis/Component donations	171,790	11,536	4,497	3,028
Total donations	1,783,720	212,939	55,288	74,861
Total SAEDs	37*	0	0	0

*This equates to a rate of 0.2 SAEDs per 10,000 donations

Figure 29.2:
Donations collected by the UK Blood Services in 2015



The SAEDs reported from NHS Blood and Transplant are shown in Figure 29.3. None were reported from the other Blood Services.

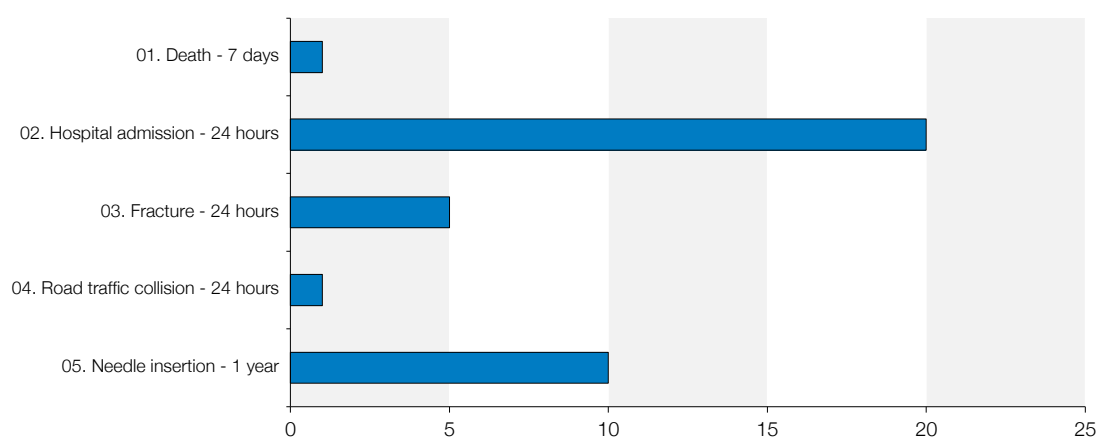


Figure 29.3:
SAEDs reported
from NHSBT in
2015*

*There were no reported cases of other events including acute coronary syndrome, anaphylaxis, haemolysis or air embolism

Further details on donor demographics

The following table provides further details regarding donor demographics for the donations from 2015 from the four UK Blood Services:

Donations in 2015		NHSBT	SNBTS	NIBTS	WBS
Whole blood	Donations from male donors	762,099	93,043	28,259	37,502
	Donations from female donors	849,831	108,360	22,532	34,331
	Donations from new donors	194,496	22,359	5,858	5,775
	Donations from repeat donors	1,417,434	179,044	44,933	66,058
Apheresis	Donations from male donors	133,531	9,881	3,730	2,601
	Donations from female donors	38,259	1,655	767	427
	Donations from new donors	278	0	0	6
	Donations from repeat donors	171,512	11,536	4,497	3,022
Total donations in 2015		1,783,720	212,939	55,288	74,861

Table 29.5:
Data from the UK
Blood Services
2015

Some examples of donor serious adverse events

Case 29.1: Donor death within seven days post donation but not directly linked to donation

The donor death reported last year was a 65 year old regular whole blood donor who died suddenly five days after donation. The donor had not reported any diagnoses of iron deficiency, had no visit to the doctor for heart problems, attendance at hospital for any new illnesses and did not report symptoms associated with iron deficiency. This donor's general practitioner has confirmed that his death was a sudden and unexpected event in a 65 year old man with moderately well controlled hypertension and no other known significant medical problems. The cause of death was a large myocardial infarction. Root cause analysis was undertaken. It was concluded that it was unlikely that giving a donation of blood was a contributory factor in this man's death.

Case 29.2: Delayed vasovagal reaction in a regular blood donor resulting in injury/fracture within 24 hours post donation

This was a 55 year old female donor who had given 45 previous uneventful whole blood donations. The donor was in good health and reported no active problems. The donation was uneventful. The donor had received her post-donation drink and had been informed of the applied muscle tension (AMT) exercises. No bruise was recorded and the donor felt well before leaving the session. The donor woke up the morning after donation, fainted in the bathroom and fractured her fibula. She was taken to hospital, reviewed by the orthopaedic team and had her leg put in plaster. The injury in this case was secondary to the delayed faint which is an unpredictable complication of donation. The donor reported that she did not take much fluid after donation, possibly contributing to this. A root cause analysis confirmed that there was nothing further that could have been done by session staff on the day to prevent this SAED from occurring. All standard NHSBT procedures were followed.

Delayed vasovagal reactions are a well-recognised but poorly understood complication of blood donation. It is thought that they occur as a result of failure of the donor's normal compensatory reflexes to respond to the volume loss associated with donation. Inadequate fluid intake post donation, prolonged standing, high environmental temperature, and alcohol ingestion all increase the risk of a delayed vasovagal reaction. Delayed reactions occur more frequently in female than in male donors. Unlike immediate vasovagal reactions, the risk of a delayed reaction is not significantly higher in first time and inexperienced donors compared to experienced and older donors. It is possible that experienced donors become less attentive about following advice to increase their fluid intake following donation, thereby increasing their risk of a delayed reaction.

Donors should be provided with post-donation information relating to the risk of delayed reactions and advice on prevention, in particular advice on maintaining post-donation fluid intake, and avoidance of known precipitating factors such as overheating, prolonged standing and drinking alcohol.

Case 29.3: Venepuncture-related persistent arm pain more than 1 year post donation

A 56 year old male whole blood donor had donated eight times in the past without event. In this instance, the donor complained of immediate severe pain on needle insertion described as a shooting/stabbing pain radiating down his forearm coupled with an immediate warm and burning sensation around the wrist area of left arm. The donor had reported this to staff at the session but the donation was allowed to complete, contrary to standard procedures. Following donation, he complained of an extremely painful left arm with loss of sensation over the forearm with weakness. He had no local bruising or swelling and no overt problems with perfusion. Although the symptoms have gradually improved, the donor continues to experience occasional shooting pains.

Venepuncture-related arm problems do occur and can have debilitating long term effects due to ongoing pain and restricted function. These could either be arm soreness related to soft tissue injury/injury to a tendon or ligament or secondary to nerve injury. The clinical symptoms usually help differentiate between these. Good phlebotomy technique can minimise the incidence of painful arms. Multiple needle punctures or needle adjustments theoretically increase the risk of nerve injury. Nerve injury is usually immediately apparent with donors reporting a sharp, burning or electrical pain radiating to the lower arm or into the hand/fingers and in some cases also proximally. Donors may also experience paraesthesia. This complication must be recognised by staff who insert needles. When donors report severe pain the needle should be removed immediately. Nerve injuries may not be completely avoidable because the nerve anatomy can be variable and the nerves cannot be palpated. However, venepunctures, when performed correctly, carry a low risk of any type of injury. Staff should demonstrate that they have achieved and maintained competency, and should be conversant with the care of donors at session including prompt recognition of donor adverse events and their management.

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[accessed 29 April 2016] Then click Blood-Legislation and Guidelines to expand list and select each option below:

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